

Fayetteville Area Metropolitan Planning Organization (FAMPO) Regional ITS Strategic Deployment Plan Update



Executive Summary

April 2013

Prepared for:
Fayetteville Area Metropolitan Planning Organization
(FAMPO)

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 CAMBRIDGE
SYSTEMATICS

 FOURSQUARE INTEGRATED
TRANSPORTATION PLANNING

Fayetteville Area Metropolitan Planning Organization (FAMPO) Regional ITS Strategic Deployment Plan Update Executive Summary

Introduction

Over the past two decades, North Carolina has committed substantial resources to the deployment of intelligent transportation systems (ITS) to improve the safety and effectiveness of the state's transportation network, providing increased mobility to all who use it. Advances in technology and operational approaches in ITS have led to great strides in the use of ITS solutions worldwide. Along with these improvements, the United States Department of Transportation (US DOT), through the Federal Transit Administration (FTA) and the Federal Highway Administration (FHWA), has refined and advanced the requirements and guidance surrounding ITS planning and implementation. The original ITS Strategic Deployment Plan (SDP) for the Fayetteville area was developed in 2001. Since that time many ITS projects have been implemented in the region including traffic operations centers for both the City of Fayetteville and NCDOT Region 6. Many ITS devices have been deployed in the region including CCTV and message signs. This effort provides a much needed update to the ITS planning efforts addressing both the changed landscape in terms of ITS deployments and the revised guidance mentioned above.

SDP PURPOSE

This document is a comprehensive update of the existing regional ITS architecture and deployment plan. The plan is guided by the FAMPO region's vision for applying ITS solutions to its growing mobility needs. The SDP update provides users the tools needed to integrate ITS projects into the planning process and to support the implementation of ITS projects. The SDP provides a framework to effectively maintain all components of the plan as the region moves forward.

This ITS Strategic Deployment Plan update, which was led by FAMPO, was developed in close coordination with a wide variety of Fayetteville area stakeholders as described below. The update covers ITS systems within an area that is somewhat larger than the current FAMPO boundary. The Plan covers the planned ITS deployments for the counties of Cumberland, Harnett, Hoke, and portions of Robson. It covers deployments by municipal, county, and statewide stakeholders as well as ITS deployments planned for Fort Bragg.

Along with providing the Fayetteville region with a comprehensive road map for implementing ITS, this updated SDP provides resources and templates that can be used by stakeholders in the region to support both planning for and implementation of ITS projects. The FAMPO Regional ITS SDP Update conforms not only to the latest federal standards, but also acknowledges the needs and requirements of the many regional, state, and federal agencies involved in the planning, implementation, operations,

and maintenance of ITS deployments. This project expands the boundaries of a traditional SDP by providing its users specific processes and tools that have been tailored to augment and complement their current procedures for planning and deploying ITS.

Some of the results and products that were developed for the FAMPO ITS SDP update include:

- Updated snapshot of ITS best practices across the country and internationally;
- Vision, goals, and objectives defined specifically for the FAMPO region;
- Gap assessment describing regional gaps that could be bridged by ITS solutions to address the region's objectives;
- Regional ITS architecture that includes project level architectures specifically for the Fayetteville region and projects planned for the area;
- Multi-modal list of projects for highway and transit for individual jurisdictions as well as regional deployments;
- Evaluation and prioritization of the projects; and
- Guidance for linking and integrating ITS planning with transportation planning.

The complete set of outputs of the FAMPO ITS SDP update effort includes several of the reports, outputs and products that were developed for statewide use under the Triangle ITS Strategic Deployment Plan. Statewide products were developed so that each regional SDP that is updated can be easily incorporated into a future Statewide ITS Plan; the statewide products included in the FAMPO ITS SDP update include:

- Cost Estimate Report
- ITS System Replacement Report
- Systems Engineering Checklist
- SDP Maintenance Plan
- Several appendices to the IDAS manual

FAMPO SDP Stakeholders

The importance of collaboration and coordination between agencies was critical to the development of the Fayetteville SDP update. Long-range planning typically involves groups of stakeholders who often represent different interests or jurisdictions involved in the planning process. The FAMPO Regional ITS SDP was developed through a partnership between multiple agencies, all led by FAMPO, the region's Metropolitan Planning Organization. For the FAMPO region, this effort involved input from a number of agencies at the local, regional, state, and federal levels.

The stakeholders were active participants in all phases of the SDP development. The agencies represented by the stakeholders cover multiple modes and stages of involvement with ITS (planning, design, and operations). Participation with the SDP development varied and included participation in meetings, data collection, input on needs and issues, and the review of key documentation. The following list includes the agencies that participated in the development. An asterisk (*) designates that the stakeholder was a member of the FAMPO ITS SDP Steering Committee.

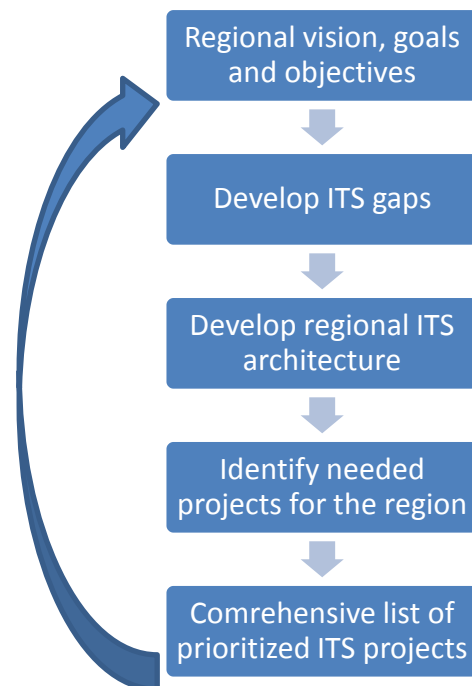
- City of Fayetteville *
- Cumberland County *
- Fayetteville Area Metropolitan Planning Organization (FAMPO) *
- Fort Bragg *
- Federal Highway Administration (FHWA) *
- North Carolina Department of Transportation (NCDOT) *
- Fayetteville Area System Transit (FAST)
- Harnett County
- Hoke County
- North Carolina Division of Emergency Management

The Steering Committee, which is a subset of the stakeholder group, worked closely with FAMPO and NCDOT to monitor and review each output of the effort. Existing practices from each of the participating agencies were integrated into a single regional approach to ITS planning that can be used as a model across the state. The structure of the SDP itself also was developed in a manner that will allow stakeholders to easily maintain the components that are more dynamic, such as the regional ITS architecture and project evaluation matrix.

Development of the FAMPO ITS SDP Update

The FAMPO Regional SDP follows a needs-focused and value-delivered approach to the development of the ITS SDP Update. Stakeholders in the FAMPO area collaborated for the development of the regional vision, goals, and objectives to drive the ITS needs of the region. These objectives were compared against an inventory of existing and planned ITS deployments to derive a summary of gaps that could be addressed by ITS deployments. Using all this information a draft ITS architecture was developed that described the stakeholders, systems, services, and interconnections that exist or are planned for the region. The stakeholders reviewed the details of this draft and provided the inputs needed to finalize the architecture as well as identify a list of ITS projects for the region.

Using the ITS Deployment Analysis System (IDAS) application, along with evaluation measures identified as part of the SDP development project, an evaluation matrix was developed for the stakeholders to use as a tool to compare projects based on specific project evaluation measures. Within each of the categories, the projects were sorted based on their score and rank and assigned a timeframe as defined in the FAMPO Regional ITS Architecture. The result of the process is a comprehensive, prioritized list of projects rooted in the needs and consistent with the vision of the region.



The SDP was developed with the intention of providing the FAMPO stakeholders with the tools to adapt and prioritize projects as funding is available and as needs change. In addition, the FAMPO SDP builds on the Triangle Region SDP to provide other regions in the state with an example for updating their regional

plans. Lastly, the SDP includes guidance for moving forward with incorporating ITS into the region's transportation planning process. As shown in the figure, the results of the SDP update will be the source of future updates as defined in the SDPs maintenance plan.

Best Practices

The Best Practices report component of the FAMPO ITS SDP Update provides an overview of best practices, programs or applications that are the most relevant to ITS deployments in the region. The report was designed to be a reference tool during the development of the SDP Update. The FAMPO ITS SDP Best Practices Report was based on the Best Practices Report developed for the Triangle Region in 2010 and updated according to the specific needs of the FAMPO region and emerging trends in ITS.

The Best Practices Report included the development of application case studies that describe how ITS applications have been implemented in other places for a variety of situations. The eight case studies listed below were selected based on a "wash list" created as part of the Triangle ITS Strategic Deployment Plan Update. Five of the best practices from the Triangle Report were selected as relevant to the FAMPO region. One additional item from the wash list, adaptive traffic signal control, was also selected to best practice information. In response to the needs of the FAMPO Region, two additional case studies were chosen – one focusing on transportation issues associated with military bases, and one covering the use of ITS during evacuations. The eight case studies were:

- Washington State Department of Transportation Gray Notebook and Performance Monitoring Program
- Georgia NaviGator Ramp Metering System
- South Carolina DOT Statewide ITS Maintenance Program
- Florida DOT Statewide and Regional ITS Planning Guidelines
- Albuquerque, New Mexico Regional ITS Architecture
- The Use of ITS During Evacuations
- ACS LITE Adaptive Signal Corridors
- Transportation Issues Around Military Bases

Vision, Goals, and Objectives

As part of the SDP update, the project steering committee engaged in a process to establish a vision, goals, and objectives that would be used to guide the development of the short, medium, and long term components of the SDP. It was important to achieve wide-spread buy-in early on in the planning process, both to ensure that the plan meets the needs of the broad audience but also as a way to explain later down the line why the plan does or does not include particular strategies, by being able illustrate that they are all based on helping the region to achieve the goals and objectives.

The stakeholders first developed a vision statement for transportation in the region that ITS can help support. The vision statement is broad by design, capturing themes that the stakeholders believe are important to the region that can be positively impacted by ITS and the ITS SDP.

Vision

A safe and efficient multi-modal transportation system that uses appropriate technology to provide reliable service in an environmentally sustainable manner, improving the quality of life in the region.

Once the stakeholders had defined the regional ITS vision, a synthesis of existing documentation and stakeholder input resulted in four goals.

Goals

- Advance efficient movement of people and goods, improve reliability of transportation systems, and enhance mobility choices.
- Strengthen coordination and cooperation between municipalities, counties, Fort Bragg, the State, federal government, and public and private stakeholders to ensure effective service delivery in the region.
- Promote, maintain, and improve safety and security on individual facilities and on a system-wide basis
- Provide strong fiscal stewardship that maximizes the cost-efficiency of transportation system investment while protecting the environment.

While the goals are broad statements of what the region hopes to achieve, objectives are specific, achievable, measurable statements of what will be done to achieve goals within a defined time frame. For each objective, one or more performance measures were defined, which can later be used to evaluate how well the objectives are being realized. The vision, goals, objectives and performance measures served as the basis for the development of a Gap Assessment and the definition of the Regional ITS Architecture that addresses the gaps.

Gap Assessment

The first step of the gap assessment task was to inventory the existing ITS network. The project team interviewed stakeholders, reviewed documents detailing existing ITS deployments, such as closed circuit television cameras (CCTV), traffic signals, and dynamic message signs (DMS), and updated the inventory with recent changes to the system. The next step was to identify the service packages that could address each of the 13 objectives that were identified in the Vision, Goals, Objectives and Performance Measures Report. Service packages represent slices of the National ITS Architecture that provide specific ITS services. These service packages drove the development of projects that also align with the regional objectives so the regional ITS deployments remain needs-driven.

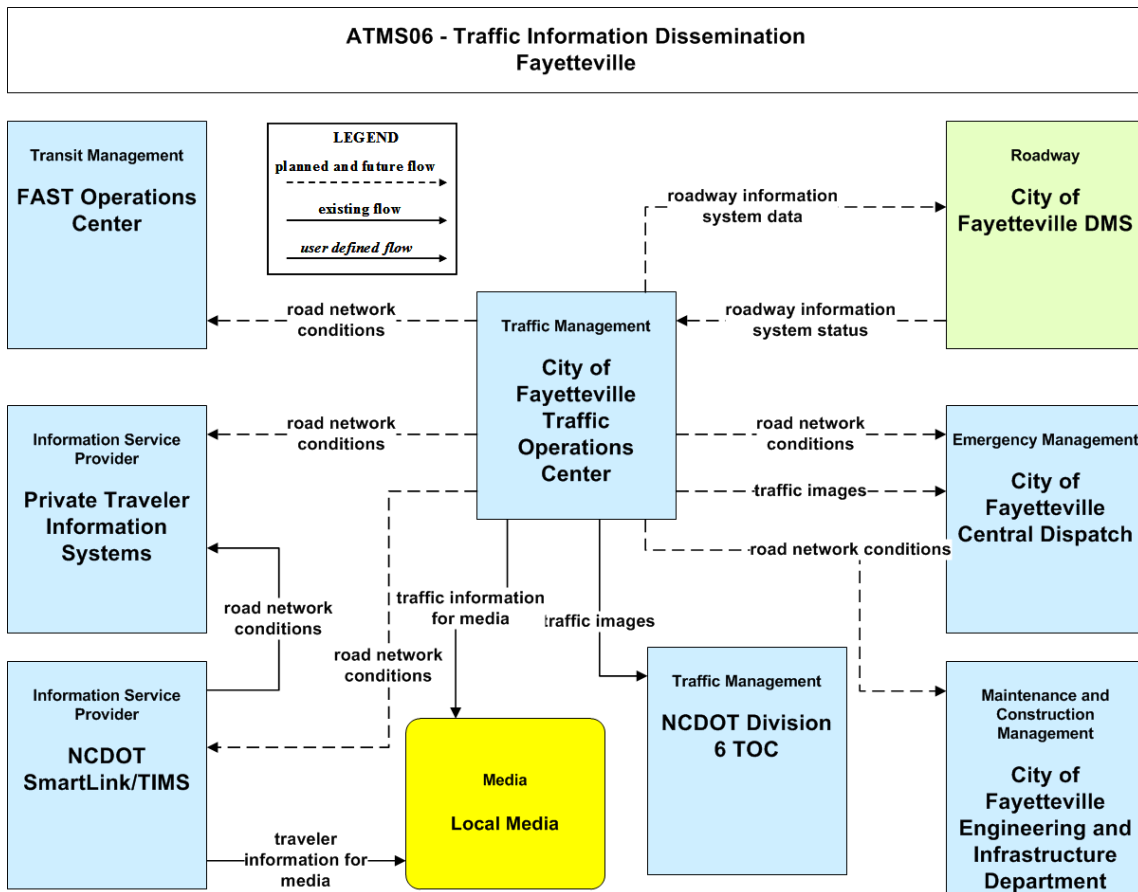
Technological and geographic gaps were identified that need to be bridged to help the region meet its vision, goals and objectives.

Finally, 19 specific gaps were identified by comparing existing and planned ITS deployments to regional goals and objectives. Two types of gaps were considered: technological and geographic. Technological gaps are present when the infrastructure base is lacking or the desired technology is not currently being used in the FAMPO Region. For example, the technological gap of archiving data within the region was identified as a key gap. Geographic gaps are present when the ITS equipment covers less physical area than is shown in the regional target area. For example, network surveillance has a geographic gap due to I-295 having no current deployment of CCTV or traffic sensors as it is under development.

Regional ITS Architecture

The fourth step in the development of the revised SDP was the update of the FAMPO Regional ITS Architecture. The architecture is a roadmap for ITS integration in the region over the next 25 years. The architecture was developed through a cooperative effort by the region's ITS stakeholders, covering all modes and all roads in the region. It represents a shared vision of how each agency's systems will work together in the future, sharing information and resources to provide a safer, more efficient and more effective transportation system for travelers in the region.

The architecture defines a set of 128 elements that include all the ITS systems in the region (e.g., the City of Fayetteville Traffic Operations Center) as well as systems to which communications interfaces could be implemented as part of ITS projects (e.g., Cumberland County Crown Center). A set of 39 different ITS services were selected by the stakeholders to define the current operations or cover future plans. A series of 120 customized ITS service diagrams (such as the one shown below) were created to define the existing and future interconnections between the elements to provide the ITS services.



The architecture is described by a Regional ITS Architecture document, a set of ITS services diagrams and a database holding all the details of the interconnections. In addition an ITS Architecture website, found on the FAMPO website, was created to provide easy working access to the FAMPO Regional ITS Architecture.

This Regional ITS Architecture can be used to efficiently structure implementations of ITS technologies. In addition, the Regional ITS Architecture allows the ITS stakeholders in the region to comply with the FHWA Rule / FTA Policy on Architecture and Standards. The FHWA Final Rule, 23 CFR 940, requires that ITS projects funded through the Highway Trust Fund conform to the United States National ITS Architecture (NITSA) and applicable standards. The Rule/Policy requires that the National ITS Architecture be used to develop a local implementation of the National ITS Architecture, which is referred to as a "Regional ITS Architecture." This Regional ITS Architecture allows identified existing and planned projects in the region to be fully compliant with this Rule/Policy, which will facilitate the approval of federal funds to support ITS projects in the region.

Project Evaluation and Prioritization

Across the state, NCDOT and MPOs are transitioning to the (IDAS) software, which is used to perform the analysis of ITS projects and provide a comparison between the projects. Stakeholders will continue to use IDAS in future years as they revise the list of prioritized projects. All of the previous steps in the SDP development process have been important stepping stones in generating a prioritized project list that can guide the stakeholders in the FAMPO Region. As part of the SDP Update, Project Evaluation Measures (PEM) were clearly defined. PEMs are metrics used to evaluate the merits of a project and help prioritize multiple projects during the development of a deployment plan.

Determination of Projects

Projects for the FAMPO region were based on the region's objectives and needs identified in the gap assessment and input from the regional stakeholders. The projects were segmented into seven distinct categories to align with existing planning and funding structures, including the Metropolitan Transportation Improvement Program (MTIP), operations and maintenance funding, and transit technology funds.

- **System Preservation:** These projects represent the replacement of existing deployments of field devices.
- **Highway Projects:** These projects include freeway and arterial deployments that are typically funded by NCDOT or municipal agencies. The projects also include technologies for controlling traffic flow on freeways and arterials, such as ramp metering and interconnected traffic signals.
- **Transit Projects or Advanced Public Transportation Systems (APTS):** The APTS projects represent all field device deployments and central system improvements related to improving public transportation operations and customer information on transit in the region.
- **Emergency Management (EM) Projects:** The one project defined in this area which could be analyzed was a freeway courtesy patrol expansions for the Incident Management Assistance Patrol (IMAP) program.
- **Regional Non-infrastructure Projects:** This category represents projects that have regional applications and cannot be easily evaluated using the IDAS software. Projects that enhance communications and coordination among agencies fall into this category as well as projects relating to data archiving and development of 511 systems.
- **Statewide Non-infrastructure Projects:** This category represents projects that have statewide applications and cannot be easily evaluated using the IDAS software.
- **Fort Bragg Projects:** This category represents projects that will be deployed in Fort Bragg. These were not analyzed, since they are internal to Fort Bragg, but were included for completeness.

The FAMPO SDP is based on the region's needs and the potential value added of each ITS project. Each project was evaluated based on measures consistent with those used in the Triangle SDP Update, which serves as a model for this and other SDP updates within the state

Project Evaluation Measures

NCDOT, area MPOs, and transit agency partners in the FAMPO region currently consider available funding sources, agency priorities, and level of required investment when determining which projects to implement. NCDOT has developed a new approach to project programming through the Strategic Planning Office of Transportation (SPOT). The project evaluation approach presented in this SDP aligns with the approach used in the SDP efforts performed for the Triangle Region in 2010, which serves as an effective approach for selecting and prioritizing ITS projects. An evaluation matrix was developed for FAMPO to use as a tool to compare ITS projects based on specific project evaluation measures including

IDAS results, the FAMPO Regional Travel Demand Model (TDM), and project specific information. The matrix consists of five criteria used to evaluate each project.

PROJECT EVALUATION MEASURES

Benefit / Cost Ratio: Ratio Taken from IDAS Results

Travel Time Reliability: Dollar Equivalent Taken from IDAS Results

Volume / Capacity (V/C) Ratio: Value Taken from TDM

System Preservation: Value assigned to System Preservation Projects

Emission Reductions: Tonnage Value Taken from IDAS Results

Within each of the categories, the projects are sorted based on their score and rank. The Project Evaluation and Prioritization Report describes the methodology used to calculate the benefits and impacts and ranks each project. The timeframe (short is <5 years, medium 6-10 years and long >10 years) was determined by the stakeholders prior to the analysis and is based on their assessment of when the project is needed and can be realistically implemented. The stakeholders will implement the projects using the projected timeframe along with the ranking as funds become available.

IDAS Methodology

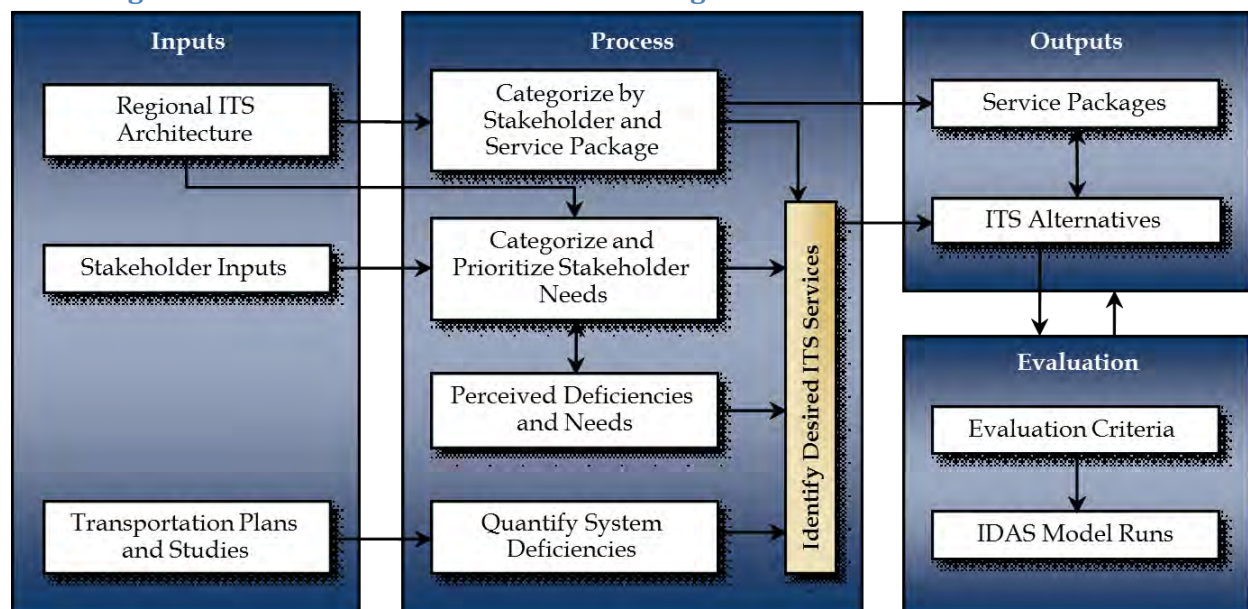
The IDAS results are a key feature of this SDP and provide the quantitative link between the ITS project selection and expected outcomes from those projects with the traditional transportation planning process. It serves to provide a transparent means of comparing ITS and operations projects to capacity expansion projects on several metrics. It is important to recognize that three of the five Project Evaluation Measures are provided by the IDAS analysis. The FAMPO Steering Committee Stakeholders have committed to this approach and the value of using IDAS as an assessment tool for planning ITS projects. Since the IDAS software uses the regional travel demand model, the responsibility of integrating the practice of IDAS analysis lies with the agency representatives that currently maintain those models. The diagram below shows how IDAS fits into the overall ITS architecture and planning process. As shown, the model is used to help evaluate ITS deployments or to evaluate the benefits realized from existing deployments.

Projects in the System Preservation, Highway, Transit and Emergency Management categories were analyzed using IDAS. The system preservation projects are based on the year of implementation and the V/C ratio; and the transit projects do not lend easily to model analysis since they typically are not associated with specific links. Typical applications of IDAS calculate the cost/benefit of deployment types

for a region. For the FAMPO region, each project is analyzed independently to support a prioritization of deployments at the project level. This parallels with the project level application of the Regional ITS Architecture and allows the FAMPO stakeholders to provide a regionally supported list of projects.

The IDAS manual that accompanies the SDP provides guidance on the software procedures used to conduct the cost/benefit analysis for the FAMPO ITS SDP Update. The IDAS manual equips the regional users with the information needed for future ITS deployment analyses. The manual also includes a quick reference guide for more experienced IDAS users or managers of agencies involved in project programming; and technical qualifications for an IDAS analyst to understand the application of IDAS for project analysis. Additionally, the manual includes requirements of a travel demand model in order for it to feed an IDAS analysis. This resource is intended to educate all agencies within the region on the knowledge set and data required to successfully apply IDAS for evaluating ITS deployments.

IDAS Integration with ITS Architecture and Planning Proces

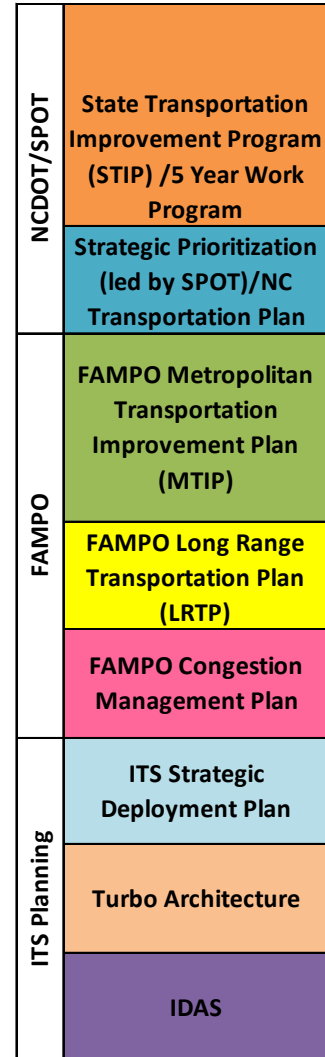


Integration with Planning

FHWA states that “transportation planning processes are required to be organized and directed....” This proposed ITS integration process seeks to establish an organized and directed process that is continuous, comprehensive, and cooperative in nature. The figure to the right shows the key planning elements that were considered as part of the ITS integration process. Integration can be accomplished with a cyclical flow of information from multiple sources used to plan and program projects. The coordination and collaboration of municipal, county, MPO, and NCDOT professionals is vital to the successful planning, development, implementation, operation, and maintenance of ITS projects throughout the state.

The mainstreaming of ITS projects into the transportation planning process has long been a goal of many in the transportation operations and planning community. As part of the FAMPO SDP, an assessment of the MPO’s current transportation planning process was undertaken through review and consultation with the regional planning agencies. Based on these discussions and a review of planning documents, a recommended approach was developed that incorporates the identification and evaluation of ITS projects explicitly in the planning process. The recommended process and methodology provides for a consistent evaluation of ITS approaches and ITS projects alongside the more standard transportation capacity improvement projects.

The improved integration of ITS projects into the transportation planning processes highlights the importance of planning for operations. It is hoped that FAMPO’s current transportation planning process, which focuses on recurring congestion on the network where demand exceeds capacity, will be replaced with a more dynamic consideration of approaches for increasing travel time reliability, reducing exposure to incident based delay, improving access to real time information on the conditions of transportation systems, and improving safety and security within the transportation network. This proposed approach would truly marry the vision, goals, and objectives identified during the Strategic Deployment Plan process with the strategies and tactics identified in the ITS Architecture.

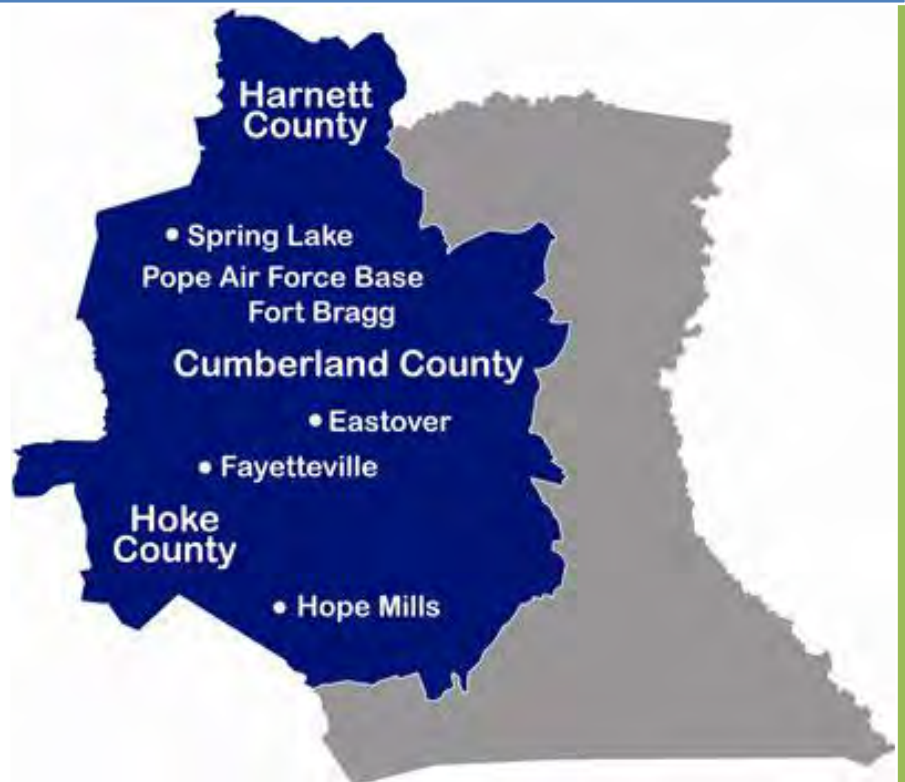


Summary

Consolidating many components, the SDP presents a reorganization of the regional approach to the identification, evaluation, and implementation of ITS projects. It reflects the extensive involvement of the leadership of the FAMPO Steering Committee. The SDP provides a set of outputs and templates that integrate ITS projects into existing transportation planning processes that consolidate data from the regional travel demand model and IDAS software into a consensus based project evaluation approach.

FAMPO Regional ITS Strategic Deployment Plan Update

Best Practices Final Report



Prepared for:
Fayetteville Area Metropolitan Planning Organization
(FAMPO)

Prepared by:
Consensus Systems Technologies

ConSysTec 

In Association with:

May 2013

REVISION HISTORY

Filename	Version	Date	Authors	Comment
FAMPO Best Practices Draft-061812.docx	0.1	6/18/12	B. Eisenhart	Draft Document
FAMPO Best Practices- Final-2012-09-21	1.0	9/21/12	J. Baker, B. Eisenhart	Incorporated Comments
FAMPO Best Practices Final-2013-04-11	1.01	4/11/13	B. Eisenhart	Finalized for Workbook

Note: This document is based on and incorporates relevant sections of the following document developed as part of the Triangle effort: Final Best Practices Report, March 2010.

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1 Introduction

1.1 Background

On January 19, 2012, Consensus Systems Technologies (ConSysTec) was contracted by the County of Cumberland in the State of North Carolina, on behalf of the Fayetteville Area Metropolitan Planning Organization (FAMPO), to provide a Fayetteville (FAMPO) Regional Intelligent Transportation Systems (ITS) Strategic Deployment Plan Update in support of FAMPO's Long Range Transportation Planning process.

Under this agreement, ConSysTec and its subcontractors, Cambridge Systematics, and Foursquare ITP (project team) delivered 8 documents that collectively updates the FAMPO Strategic Deployment Plan. The following summarizes the deliverables for the FAMPO Regional ITS Strategic Deployment Plan Update.

- **Task 1:** A *Best Practices Report* that identifies solutions that may address regional deficiencies
- **Task 2:** A *Vision, Goals, and Objectives Report* that updates the FAMPO ITS Program's vision, goals and objectives
- **Task 3:** This *Gap Assessment Report*, which determines and identifies solutions that address regional goals and objectives and results in service-package based projects that can be reflected in the Regional ITS Architecture
- **Task 4:** The *Regional ITS Architecture*, developed with stakeholder input and including project architectures
- **Task 5:** *Cost Estimates of ITS Projects* delivered as a spreadsheet
- **Task 6:** A *Project Evaluation and Prioritization Report* based on an IDAS model
- **Task 7:** A *Report on Strategies for Integration of ITS into the FAMPO Transportation Planning Process*
- **Task 8:** A *Final Strategic Deployment Plan* that incorporates the previous 7 documents into one comprehensive plan

1.2 Purpose

This document is the Best Practices Report, the output of Task 1. This **Best Practices Report** will provide stakeholders with an overview of best practice programs or applications that may be considered as part of the FAMPO Regional ITS Strategic Deployment Plan Update. It is envisioned that this Best Practices document will become a reference tool throughout the development of the FAMPO Regional ITS Strategic Deployment Plan Update.

1.3 Document Overview

This document is organized into eleven (11) main sections.

- **Section 1: Introduction.** This section provides introductory and background information about this document, its purpose and why it is needed.

- **Section 2: Best Practices Overview.** This section describes the process used to develop the Best Practices Report and how each case study is organized.
- **Section 3: Case Study 1 – Washington State Department of Transportation Gray Notebook and Performance Monitoring Program.** This case study is a discussion on the benefits of a periodical published by Washington State Department of Transportation on the performance information collected by its performance monitoring system.
- **Section 4: Case Study 2 – Georgia NaviGator Ramp Metering System.** This case study is a discussion on the lessons learned from Georgia Department of Transportation's implementation of a ramp metering program.
- **Section 5: Case Study 3 – South Carolina Department of Transportation Statewide ITS Maintenance Program.** This case study is a discussion on the lessons learned from South Carolina's Department of Transportation's development of a statewide ITS maintenance program.
- **Section 6: Case Study 4 – Florida Department of Transportation Statewide and Regional ITS Planning Guidelines.** This case study is a discussion on the lessons learned by Florida Department Of Transportation's development of an ITS Planning Guidelines document, which identified the roles for how MPOs should incorporate ITS into its planning activities, as well as how to evaluate potential ITS technologies.
- **Section 7: Case Study 5 – Albuquerque New Mexico Regional ITS Architecture.** This case study is an examination on how the Albuquerque, New Mexico MPO (MRCOG) tied its regional ITS architecture with its programming process for defining projects in its Transportation Improvement Plan (TIP).
- **Section 8: Case Study 6 – The Use of ITS During Evacuations.** This case study is a review of a research report and a technical memorandum on how transportation, specifically ITS, plays a role in supporting and assisting evacuations.
- **Section 9: Case Study 7 – ACS LITE Adaptive Signal Corridors.** This case study is an examination of the lessons learned from the implementation of adaptive traffic signal control system in Atlanta, Georgia.
- **Section 10: Case Study 8 – Transportation Issues Around Military Bases.** This case study is an examination of the lesson learned from transportation improvements made around several military bases in the United States.
- **Section 11: Summary.** This section is a summary of the lessons learned from the case studies in this Best Practices report.

2 Best Practices Overview

As the FAMPO region looks to the future of the region's transportation system and evaluates priorities that technology and integration may help address, this report will provide stakeholders with an overview of best practice programs or applications that may be considered as part of the FAMPO Regional ITS Strategic Deployment Plan (SDP) Update. It is envisioned that this Best Practices document will become a reference tool throughout the development of the SDP.

This report provides an update of the Best Practices Report developed for the Triangle region in 2010. This update will focus on those best practices that are most relevant to the FAMPO region. As such this report incorporates relevant sections of the earlier Triangle region report.

2.1 Process for Selecting Case Studies

The purpose of this task is to identify innovative approaches and existing examples of ITS applications, projects, programs, policies, and mainstreaming and integrating of ITS into existing business processes. The starting point for this effort was the "wash list" created as part of the Triangle ITS Strategic Deployment Plan Update. This list of the identified best practices was developed as part of the earlier effort to summarize the projects and programs that would be the most suitable for the region in the following categories.

- Existing ITS/Technology/Infrastructure Deployments
- Emerging ITS/Technology/Infrastructure Deployments
- Maintenance Process for SDP Components
- ITS Mainstreaming into the MPO Planning Process and Transit Planning Process

The project team did an initial assessment of this list and, based upon interviews performed with key stakeholders in FAMPO, identified a set of projects most relevant to the stakeholders in the FAMPO region. The complete wash list, along with the recommendations was presented to the Steering Committee for comment. Five of the best practices from the Triangle Report were selected as relevant to the FAMPO region. One additional item from the wash list, adaptive traffic signal control, was also selected to best practice information. Also, as part of that discussion two additional areas beyond those covered by the wash list were identified:

- Use of ITS during Evacuations and
- Transportation Issues associated with Military Bases

The project team has researched these topics as well to present best practices information for use by the region's stakeholders.

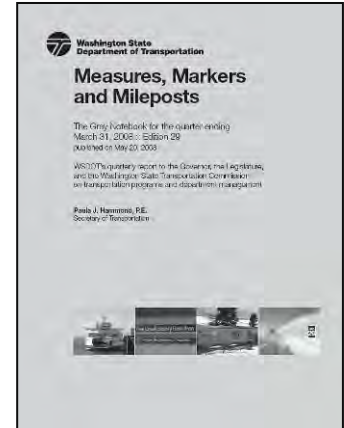
Information obtained from the original Triangle Best Practices Report is provided as originally developed with the following sections.

- **Overview and Background.** This section discusses the history and timeline of the project or program and a general overview of the project partners (lead, partner/support, other external) as well as their roles and responsibilities.
- **Catalyst for the Project or Program.** This section discusses the initial development needs and the role of funding in the development of the project or program (federal funds, regional funds, statewide funds, or earmarks).

- **Development Requirements.** This section discusses what foundation the project or program needed to have in order to be developed, including systems, data, technologies, and partnerships.
- **Outcomes.** This section discusses the benefits, institutional and operational changes, and funding requirements moving forward of the project or program, as well as how it has influenced project programming and development in the region.
- **Lessons Learned.** This section discusses what guidance the region's stakeholders could use in its development of similar projects or programs.

3 Case Study 1 – Washington State Department of Transportation Gray Notebook and Performance Monitoring Program

The Washington State Department of Transportation (WSDOT) has developed one of the most comprehensive performance monitoring programs in the United States. WSDOT details the results quarterly in a document that has garnered the nickname “the Gray Notebook” (GNB) due to the color of the report. Formally titled *Measures, Markers and Mileposts*, the GNB covers system and program performance information related to highway safety, highway maintenance, highway congestion, asset management, construction project progress, worker safety, and Washington State ferries. Measures for each topic are documented in one or more of the quarterly editions each year.



3.1 Overview and Background

The first GNB was developed for the quarter ending March 31, 2001. The report started with existing data, and the first edition was only seven pages long. It focused on work zone-related statistics and project status updates. As the program evolved, data from ITS elements was utilized and now the document is typically more than 100 pages long.

In its current format, the GNB is broken into two sections: the Beige Pages and the White Pages. The Beige Pages include information on the delivery of projects from existing funding and special gas tax increase funding packages from 2003 and 2005. Information presented includes status updates as well as a “watch list” of cost and schedule concerns. As with the entire GNB, the goal is to provide transparency to Department of Transportation (DOT) activities. By openly reporting on projects that are not going well in addition to presenting success stories, the DOT has improved its credibility and public trust of the agency. The White Pages constitute the bulk of the GNB and contain the regularly updated performance measures. Some measures are reported quarterly, while others are presented on a rotational basis so that they are addressed annually.

Each quarterly issue of the GNB is now accompanied by a *GNB Lite*. The *GNB Lite* version contains highlights from the quarter’s GNB in a four-page summary, presented as a two-sided 11”x17” folded handout with a “roll up” of capital project delivery information from the Beige Pages as a one-page insert. In addition to the *GNB Lite*, a Performance Dashboard is developed as part of the quarterly reporting and presents, in a one-page format, the current status of performance measurements and how the measures are trending. Figure 1 provides an example of the dashboard format.

Goal has been met. Performance is trending in a favorable direction. Trend is holding. Performance is trending in a unfavorable direction.						
Policy goal/Performance measure	Previous reporting period	Current reporting period	Goal	Goal met	Progress	Comments
Safety						
Number of traffic fatalities per 100 million vehicle miles traveled (VMT) in Washington State (annual measure, calendar years 2006 & 2007)	1.12	1.0	1.0			Working toward additional reductions through <i>Target Zero</i>
Yearly OSHA-recordable injury and illness rate per 100 WSDOT maintenance & engineering workers (annualized: FY08 Q4, FY09 Q1*)	4.2	4.9	6.0			Continuing to aggressively improve worker safety despite recent rise in annualized OSHA injury and illness rate

Source: Performance Dashboard for the GNB for the quarter ending December 31, 2008

Figure 1. Portion of WSDOT Performance Dashboard

The GNB initially was developed for the state legislature and expanded to address voter concerns after the defeat of a transportation funding package by voters in 2002. The performance monitoring program is DOT-led. Input from the legislature, general public, and other transportation-related groups has shaped the development of the GNB, but the DOT is responsible for its quarterly preparation. Great emphasis has been placed on making the GNB understandable to the general public through a combination of quantitative graphs, tables, and measurements as well as narrative writing. This special form of reporting was developed by WSDOT and is known as “performance journalism.”

The excerpt shown as Figure 2 contains several of the presentation methods used in the performance journalism style. As seen in the excerpt, graphs frequently are interpreted as part of the presentation of numerical data, especially in a case such as the one shown (for incident clearance times), where some of the variance documented can be attributed to a change in data collection procedures. The accompanying narrative clearly explains why average clearance times for the fourth quarter of 2008 were higher than the same period in 2007. In each section, highlights also are given in summary boxes. The combination of these techniques makes the GNB more easily understood by the public and political representatives. The key advantage of performance journalism is that it translates complex performance measure processes and outputs into a format that can be easily reported and communicated to other stakeholders and to the public.

Incident Response Quarterly Update

Statewide Incident Response

The mission of WSDOT's Incident Response (IR) program is to safely and quickly clear traffic incidents on state highways. Quick clearance minimizes congestion and dangerous traffic blockages that can lead to secondary collisions. IR roving units, which operate during peak traffic periods, also offer a variety of free assistance that reduces motorists' exposure to risk, such as providing fuel and jump starts, changing flat tires, and moving blocking vehicles safely off the roadway. IR units are trained and equipped to assist Washington State Patrol (WSP) troopers at collisions and other traffic emergencies. Available for call out 24 hours a day, seven days a week, IR units assist WSP with traffic control, mobile communications, clean-up, and other incident clearance functions as needed during major incidents. More information on the IR program can be found at www.wsdot.wa.gov/Operations/IncidentResponse/.

Average clearance time increases due to winter weather

In Quarter 4, 2008, the average clearance time for all incidents was 15.1 minutes. This is up 19.8% from last quarter's average clearance time of 12.6 minutes, and up 10.2% from the 13.7 minute average clearance time in the same quarter of 2007. The Quarter 4, 2008 clearance time was impacted by unusually high clearance time values in December, when major snowstorms hit Washington. In addition to causing conditions that provide potential for increased incidents, the storms also hindered quick clearance when responders, emergency personnel, and tow trucks were overwhelmed by the number of incidents on the roadways. The resulting congestion affected responders' ability to quickly reach the scene of incidents.

Number of incidents dropped in Quarter 4

The number of incidents WSDOT IR drivers responded to during Quarter 4, 2008 dropped to 10,843 incidents. The past five quarters saw a range of 11,686-13,401 incidents. This quarter's number is 13.6% lower than the average number of incidents a quarter for that five-quarter period. Apples-to-apples comparisons are not available prior to those quarters due to personnel reductions in the Seattle and Tacoma areas (for more on reductions, see March 31, 2008 *Gray Notebook*, p. 76).

This reduction in responses occurred for two primary reasons. First, statewide traffic volumes were down 2% for October and November, resulting in fewer incidents overall. In December, although volumes were down dramatically, the number of traffic incidents responded to was relatively high compared to the prior two months due to severe weather events. The drop in volumes during the quarter most likely contributed to a reduction in collisions on state highways. Preliminary data for Quarter 4, 2008 show 12,459 collisions, down 10.2%-21.1% over Quarter 4 for the previous five years.

Another reason for the decrease in incidents involves staffing and deployment changes in the IR Program. During Quarter 4, 2008, there were two fewer IR drivers on the road (because of the state's hiring freeze and a driver being on medical leave), which reduced WSDOT's capacity to respond to incidents.

IR Performance Highlights:

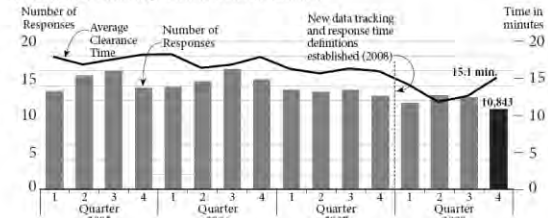
Average clearance time increased by 2.5 minutes to 15.1 minutes due to winter weather.

Annualized average duration of 90+ minute incidents on the nine key congested routes increased by nine minutes to 156 min.

Number of responses and overall average clearance time

July 2005-December 2008

Number in thousands, clearance time in minutes



Data Source: Washington Incident Response Tracking System, WSDOT Traffic Office.

Note: Program-wide data is available since January 2002. Prior to Q3 of 2003, the number of responses by the IR program are shown. From Q3 2003 to Q2 2007, responses by Registered Tow Truck Operators and WSP Cadets have been reported in the total. From Q1 2002 to Q4 2007, Average Clearance Time do not include "Unable-to-Locate" (UTL) responses into calculation. Average number of responses does include UTLs, because this represents work performed on behalf of the Incident Response Program. In Q1 2008, WSDOT's Incident Response Program moved to a new database system and began calculating average clearance time in a different way. This accounts for the apparent decrease in the average clearance time value.

Number of incidents responded to by WSDOT's IR program

Q3 2007 - Q4 2008

Quarter	Number of incidents
Q4 2008	10,843
Q3 2008	12,383
Q2 2008	12,707
Q1 2008	11,686
Q4 2007	12,560
Q3 2007	13,401

Source: WSDOT Traffic Office
Washington Incident Tracking System

Source: GNB Edition 32, for the quarter ending December 31, 2008

Figure 2. WSDOT Performance Journalism Example

3.2 Catalyst

Although a series of legislative mandates for data collection and analysis occurred in the 1990s, State Secretary of Transportation Doug MacDonald taking office in 2001 was the catalyst for the development of the program that is in place today. Secretary MacDonald was hired after the Blue Ribbon Commission on Transportation (tasked by the governor to “analyze state transportation needs and funding issues and propose long-term solutions”) recommended a single point of accountability at the state level, as well as a review of DOT administration practices and staffing levels.

Secretary MacDonald came to WSDOT from the Massachusetts Water Authority and quickly implemented his mantra of “what gets measured, gets managed” — the first GNB was produced just three weeks after his arrival. The goal of the program was to provide a level of transparency to build the DOT’s public and legislative credibility and therefore increase support for transportation in the state of Washington.

All of the data collection and analysis is performed by WSDOT staff. The range of topics covered by the performance monitoring program and quantity of data analyzed have evolved over time and necessitated additional staff resources to manage the program, but no specific funding was set aside to begin the program.

3.3 Development Requirements

The performance monitoring program began with available data and has been expanded from that foundation. No formal guidance was established for the program initially other than the determination of Secretary MacDonald to measure as many aspects of the DOT’s business as possible. The performance journalism presentation style also came from an evolutionary development process.

Based on WSDOT’s experience establishing the program, Daniela Bremmer developed and presented a training class at the Operations Academy for the Center for Advanced Transportation Technology, an affiliate of the University of Maryland, focused on identifying potential data sources for performance measures and developing a performance measure foundation. That presentation was provided by WSDOT as supplemental information following the interview.

3.4 Outcomes

WSDOT has achieved its goal of increasing support for transportation in Washington. Following the 2002 defeat of a transportation funding package, WSDOT expanded the types of information included in the GNB and improved the presentation format. The resulting enhanced credibility and accountability of the agency has led to the following funding successes.

- 2003 State Gas Tax increase of 5 cents per gallon
- 2005 State Gas Tax increase of 9.5 cents per gallon (phased in over 3 years)
- November 2005 public vote defeating an initiative to eliminate the 2005 increase passed by the Washington Legislature (53% voted not to eliminate the increase)
- Polling data changed from 75% of voters saying they did not trust the DOT to spend tax dollars wisely to just 12% (meaning increased voter support)

WSDOT reports on the progress of the individual projects funded using the 2003 and 2005 gas tax increases (as well as projects funded other ways) in the Beige Pages. When presenting data in the annual congestion reporting portion of the GNB, emphasis is placed on congestion-related improvements that are the result of construction projects. Quantifying and drawing attention to these benefits increases support for transportation funding of similar projects. When the public knows how

their tax dollars are being spent and what the results are of that investment, they are more willing to allocate additional funds to transportation. Washington has documented the voting records to substantiate this. For non-construction programs — like the continued operation of a service patrol or implementing additional ITS equipment on an existing system — the performance measures related to incident clearance time reductions and reduced travel times, among others, quantify the benefits of these efforts and provide support for continued funding.

This performance measure publication was developed to increase trust and facilitate the public's understanding of the benefits of the funded programs and projects they approve. WSDOT's annual congestion report draws attention to specific projects when there is a measure with a result that points specifically to a project; otherwise, projects are not individually called out and the report is not used as a planning tool for project selection.

3.5 Lessons Learned

The developers of the WSDOT GNB offer valuable insight into lessons learned during the development of the performance monitoring program in their paper titled Performance Measurement at WSDOT: Overview and Lessons Learned. The following excerpt from that document summarizes what is perhaps the most important piece of advice WSDOT has to offer other agencies in the planning stages of a performance monitoring program:

“Start small but report now — don't delay until you have the perfect data, the right measurement framework or a sophisticated information technology system. WSDOT's 100 page GNB is published every quarter and is not automated. Pick a topic and start now.”

In addition to this encouragement, WSDOT offered the following key lessons learned:

- Measures invariably will change. They are and need to be dynamic to respond to changing political or fiscal environments. Performance measurement is an iterative process. Don't be afraid to try something new.
- Quality control of data and writing needs to become a religion. Apply strict standards of quality control involving all levels of management. Your data and analysis is your credibility.

In the evolution of the performance monitoring program, WSDOT has encountered numerous challenges, including the following:

- The sheer volume of projects and programs to report complicates the process and has led to the rotation of topics each quarter.
- Because the data analysis and reporting are performed manually, the process is time- and resource-intensive, and quality control is difficult. Efforts are underway to address some of the technology issues that are complicating automation efforts, but those improvements are progressing slowly.
- The performance journalism style is only conducive to partial automation.

All of these challenges contribute to a stressful work environment that requires a specialized skill set. As a result, WSDOT has had problems with high turnover. Some of the issues will be improved as technology plays a larger role in the program, but WSDOT is not letting these challenges impede its progress as the agency views them to be just part of the evolutionary process.

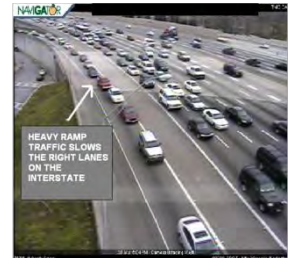
4 Case Study 2 – Georgia NaviGator Ramp Metering System

The Georgia Department of Transportation (GDOT) has been actively expanding its ramp metering program in the Atlanta metro area (grown from five to 165 ramp meters to date). GDOT has been conducting both AM and PM peak studies and early results have shown significant improvements, ranging from 14% to 39% travel time savings, for trip times on key corridor segments as a result of the improved flow. This case study discusses GDOT's ramp metering program, including some of the improvements measured.

4.1 Overview and Background

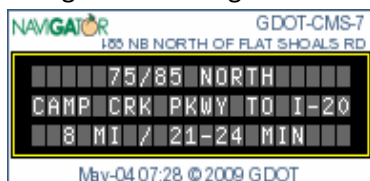
In the early 1990s, Atlanta and the surrounding region were selected as the host for the 1996 Summer Olympic Games. Transportation officials knew they would need to address the growing congestion issues that would be exacerbated by Olympic traffic. The city's record population growth continued and traffic congestion increased substantially.

GDOT had been studying the success of ramp metering implementations in other regions. As a pilot test in 1996 to measure the effectiveness of ramp meters on freeway congestion, GDOT implemented a few ramp meters along the heavily traveled I-75 corridor and along I-75/I-85 through downtown Atlanta. The deployments were a GDOT initiative led by the Office of Traffic Operations, although there was some coordination with local jurisdictions. Additionally, the Offices of Communications and ITS Maintenance were heavily involved (and continue their involvement to date). The results of the initial ramp metering implementation were positive. Over the next few years, additional ramp meters were deployed and the program continued to expand.



4.2 Catalyst

GDOT's 2004 accident data showed approximately 9.5% of Atlanta's traffic accidents on major freeway corridors occurred at entrance ramps. In 2004, the governor introduced his Fast Forward Congestion Relief program specifically aimed at alleviating congestion on the region's interstates. Fast Forward is a comprehensive six-year, \$15.5 billion program to alleviate congestion and encourage economic growth through the acceleration of existing projects. This program provided the



necessary funding to support the growth of the ramp meter program. Initially, the ramp metering program was developed to instrument as many as 138 Atlanta area interstate entrances by mid 2009. Largely because of its early success, the plan has been expanded to include 165 meter locations by mid 2009.



The funding for the ramp metering program included GARVEE (Grant Anticipation Revenue Vehicle) bonds, General Obligation bonds, and Guaranteed Revenue bonds. Federal funds also were made available for the project.

4.3 Development Requirements

In order to develop a sound strategy and design, it was important to GDOT to have access to accurate and reliable data. After the initial test/pilot meters were deployed and GDOT decided to move forward with implementing additional ramp meters, detailed studies were performed to determine additional areas of concern. GDOT used consultants to perform independent evaluations of the area using congestion data from the NaviGator ITS system and then prepare detailed designs for the construction of the ramp meters. Using volume and speed data from the NaviGator video detection system, a



GDOT-retained consultant developed timing plans for each meter.

4.4 Outcomes

GDOT typically measures the operations of its interstate system using several indicators, the most common of which is Travel Time Index or TTI. TTI is the ratio of peak travel time to free flow travel time for a given road segment. For example, if under free flow conditions, it takes 10 minutes to travel from Exit 1 to Exit 10, and on a congested day, it takes 20 minutes to make the same journey, there is a TTI of 2 for that segment on that day and time. GDOT also uses Average Travel Time to assess how well the interstate traffic is flowing.

GDOT has observed reduced congestion levels since the widespread ramp meter deployment. However, because this program is still relatively new, the final measure of results is not formalized. GDOT is planning to undertake and complete a formal study to document results. Early analysis (not formalized) is presented in Table 1 for one of the worst corridors instrumented in the ramp meter program. The early results were obtained using travel time runs to compare before and after times for a specified segment. Results for other corridors show similar improvements to those shown in Table 1.

Table 1. Travel Time Run Results for Sample Corridor

Run	# of Runs	BEFORE (secs)	# of Runs	AFTER (secs)	% Change	Summary	Gauge
Monday Car 1	7	562.3	10	394.7	29.8%		
Monday Car 2	10	480.1	7	325	32.3%		
Monday Average		521.2		359.85	31.0%	31.0%	Better
Tuesday Car 1	11	369.9	9	439.1	-18.7%		
Tuesday Car 2	9	465	8	384.4	17.3%		
Tuesday Average		417.5		411.75	1.4%	1.4%	Better
Wednesday Car 1	4	567	14	328.5	42.1%		
Wednesday Car 2	8	552.4	9	342.9	37.9%		
Wednesday Average		559.7		335.7	40.0%	40.0%	Better
Thurs Car 1	10	487.7	8	418	14.3%		
Thurs Car 2	8	405.9	6	398.2	1.9%		
Thursday Average		446.8		408.1	8.7%	8.7%	Better
Friday Car 1	9	438.1	8	384.3	12.3%		
Friday Car 2	7	413.9	8	264.5	36.1%		
Friday Average		426		324.4	23.8%	23.8%	Better
Weekly Average		474.23 (7.9 min)		367.96 (6.1 min)	22.4%	22.4%	Better

4.5 Lessons Learned

GDOT has provided a summary of its experiences and key findings regarding implementation of the ramp meter program.

- Always begin with the worst corridor. The worse the problem is, the more dramatic the results are, and the easier it is to show the improvements to the motoring public.
- Start with an easy ramp first (one with lots of storage, manageable volume, and that is non-controversial) to minimize potentially negative impacts to public perception of ramp metering if substantial changes are experienced.
- If a ramp has a volume beyond what a meter typically can handle, do not deploy a ramp meter. A ramp meter in these conditions will only exacerbate the problem and is controversial to the public and the media.
- “Spot metering” does not work. It is ineffective to pick and choose ramps to meter. The most effective way to implement ramp metering is to select an entire corridor and then eliminate one or two locations if the volume of the existing conditions on the ramp is too high.
- Public outreach and a detailed communications/public awareness strategy are vital. GDOT’s Office of Traffic Operations engaged the GDOT Office of Communications very early in the process to help with public outreach. Representatives from the two offices met frequently to develop and implement the outreach strategy. GDOT enjoys a very good relationship with local media and has been successful leveraging this relationship. The media helped educate the public prior to activation and was instrumental in publicly celebrating the resulting successes. The outreach campaign consisted of a combination of:
 - Paid media advertising on the radio
 - Ready-made news stories provided to radio, print, and television outlets
 - Speaking engagements at civic organization meetings such as Rotary and Kiwanis Clubs
 - Website updates and alerts
 - Periodic communications (via email and in person) to area businesses to update their employees of upcoming changes
 - “Free” radio and TV advertising through the local “celebrity” traffic reporters
- Caltrans has developed a comprehensive Design Guide for Ramp Meters. It can be accessed at http://www.dot.ca.gov/hq/traffops/systemops/ramp_meter/.

5 Case Study 3 – South Carolina Department of Transportation Statewide ITS Maintenance Program

The South Carolina Department of Transportation (SCDOT) has developed a statewide ITS maintenance program based on a common-sense approach: “make sure the devices you have work.” This case study was developed based on a May 2009 interview with ITS Coordinator Dan Campbell and information provided in a 2007 technical presentation.

5.1 Overview and Background

SCDOT currently has a significant investment in ITS throughout the state. They detect and monitor traffic using 305 closed-circuit television (CCTV) cameras and 310 radar detectors. This information is processed at five transportation management centers (TMC) using 300 miles of fiber optic cable and 16 stand-alone hub consolidation buildings. The information is distributed to the traveling public using 157 dynamic message signs (DMS), of which 64 are permanent installations and 96 are portable, and 36 highway advisory radio (HAR) systems. Figure 3 shows the South Carolina statewide ITS deployments.

The maintenance of this statewide ITS deployment and associated communications is the responsibility of a single group within SCDOT. This group consists of a field services manager and seven field technicians. They receive assistance from nine specialty contractors when needed using on-call contracting mechanisms. This group performs reactionary and preventative maintenance, and also stores documentation. Reactionary maintenance is work to correct equipment malfunctions, structural damage, and communication cable cuts. Preventative maintenance is work to inspect and test equipment, clean cabinets and filters, check electrical grounding conditions, trim trees, and inspect communication cable condition and presence of delineator markers. The documentation maintained by the group includes the geographic location of each device, the allocation of fiber, and construction as-built drawings. The group also will coordinate utility locates. Currently, preventative maintenance is performed quarterly at each ITS device and annually on the entire communications network. Also, a \$1 million inventory of spare parts is centrally maintained and tracked.

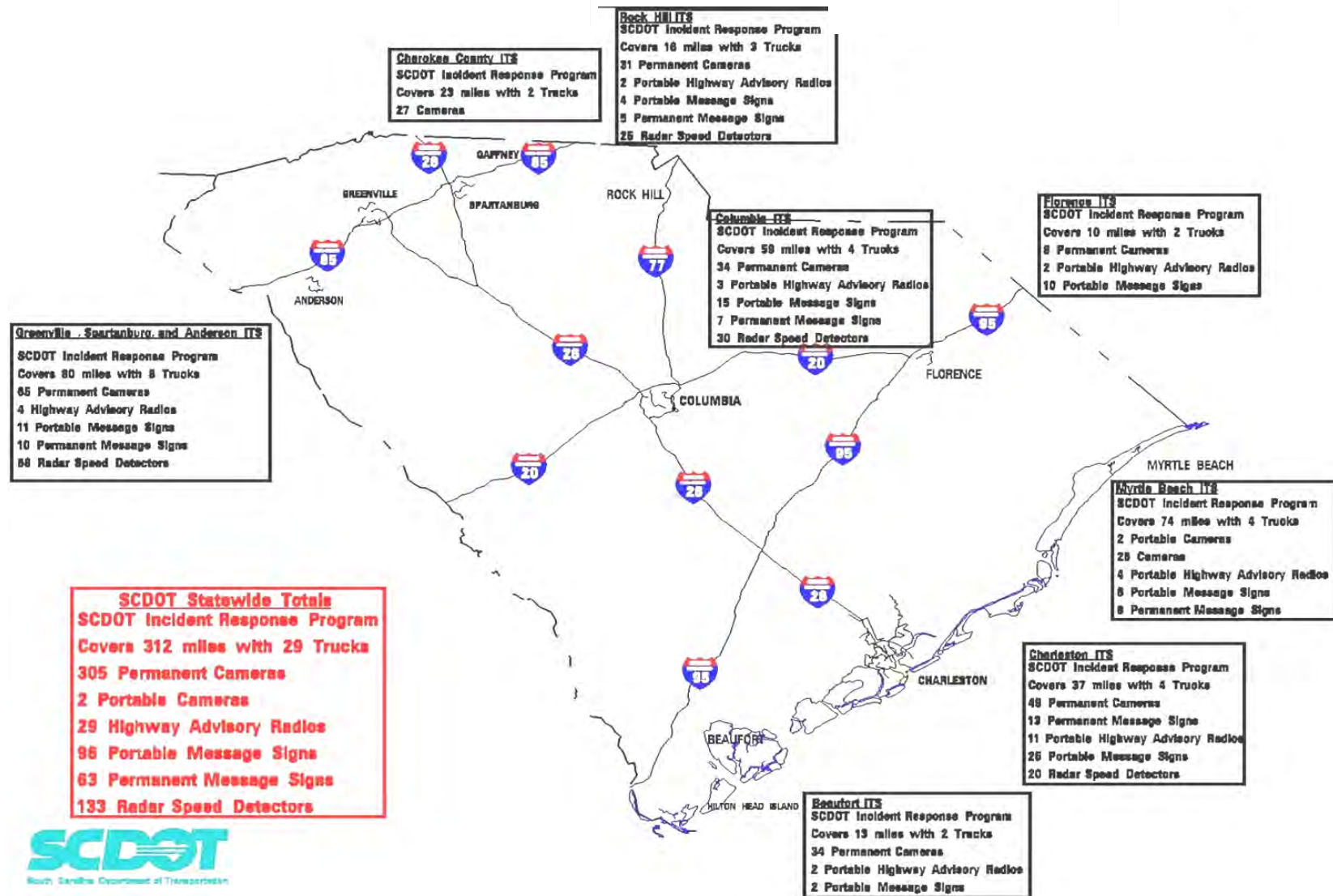


Figure 3. SCDOT Statewide ITS Deployments (as of 2007)

5.2 Catalyst

Originally, the maintenance of ITS devices was part of the statewide traffic signals maintenance program for SCDOT. As the number of devices grew and the equipment and communications became more complex, a separate statewide program for ITS maintenance was developed. It is assumed that all maintenance programs within SCDOT are paid for using annual state funds. The program was spearheaded by Mr. Campbell based on the need and opportunity for organizing the maintenance program. Mr. Campbell's vision for the program and the devotion to growing the program has helped develop the system that exists today.

5.3 Development Requirements

The major points of emphasis in the program are the development of highly trained and skilled technicians, the commitment to preventative maintenance, and regular monitoring of the devices' performance.

Currently, all of the field technicians in the ITS maintenance program have a background in ITS and skill sets specifically developed for the ITS devices in South Carolina. Most of the technicians previously worked for contractors that had installed ITS devices in the state. Two of the technicians also have some construction inspection responsibilities for ITS construction projects. The group has set up a test site along a nearby freeway to experiment with and test new technologies and equipment. Ultimately, it is the field technicians who decide what should be tested and perform the evaluation before deciding if any installations are warranted.

Recognizing that the group occasionally may need additional or specialized help, the group also uses contractors when needed. Currently, the group has six to seven contractors available, each with a different specialty in ITS maintenance. Using technical services contracts, SCDOT pays for technicians at an hourly rate and pays for parts. Using on-call construction contracts, SCDOT has developed specific pay items for services and parts with fixed prices. These pay items cover all ranges and situations of ITS installations and are called for as needed. As part of these contracts, there is no guarantee for work or a minimum dollar amount for the contractors. In addition, the prices for the pay items are evaluated regularly based on input from the contractors.

Finally, the program has developed procedures to monitor the status of ITS devices across the state and can report an "uptime" measure (the measure of the time a device is up and running) at any time. Each morning, a manager in each of the five TMC facilities checks the status of their ITS devices and communications. These reports are then emailed to Mr. Campbell. From these reports, he generates activities for the field technicians or on-call contractors. Also, the reports give a true measure of the percentage of ITS devices on-line at a specified time.

The program uses an integrated software package by Siemens to track all of this information. Currently, the system is being upgraded and eventually will support real-time updates on device status from all of the TMC facilities. The upgrade also will introduce inventory functions.

5.4 Outcomes

The most significant outcome of the ITS maintenance program is being able to measure the status of all devices in the state. SCDOT consistently experiences a 95-98% uptime for all devices at any given time. The goal of the program is a 100% uptime, but considering the large number of devices in the state and their associated lifecycles, there almost always will be a period where some devices are undergoing repairs. This program ensures that the malfunctions are identified early and repaired in a timely manner. Reasonable downtime is therefore defined as between 3-5%.

Another significant outcome is better documentation for budget requests to fund the program. Within the past couple of years, historical data has been gathered to provide detailed budget requests that show actual amounts spent in the previous year and realistic estimates of spending in the coming year. Typically, the program budgets between \$2,000-\$2,500 per device and \$1,000 per mile of fiber optic cable.

Lastly, as the ITS maintenance program grows, SCDOT is experiencing improved quality in the installation of ITS devices. This mostly is due to having maintenance technicians actively involved in construction inspections, pre-deployment testing, and even the design phase of construction projects.

5.5 Lessons Learned

The following are suggestions for any agency that is developing or growing an ITS maintenance program.

- Keep maintenance staff involved in all aspects of an ITS project, including design, installation, and operations. SCDOT has seen this result in increased quality of its statewide ITS deployment. The agency also has been able to perform a majority of systems integration work on construction projects using maintenance personnel.
- Occasional specialized or additional help with the maintenance of ITS may be cost-effective for contractors to satisfy with on-call contracts utilizing hourly rates plus parts.
- Maintenance procedures for ITS devices that do not require lane closures save time and money. SCDOT uses camera lowering devices for CCTV cameras since they only require one technician without a bucket truck to perform the service. Also, the catwalk for overhead DMS structures has been extended to the roadway shoulder for access by a technician using a ladder instead of a bucket truck.
- Regular and frequent preventative maintenance is well worth the investment over the long term. SCDOT also has found that it minimizes downtime when issues do arise.

6 Case Study 4 – Florida Department of Transportation Statewide and Regional ITS Planning Guidelines

In 2000, the Florida Department of Transportation (FDOT) developed a Statewide ITS Strategic Plan as part of the compliance with the FHWA Final Rule. The Strategic Plan encompassed 10 elements, including the need for integration of ITS into the transportation planning process. This integration addressed many issues, including:

- Incorporating ITS user services into transportation plans
- Consistency with the National ITS Architecture
- Role of ITS in congestion management plans (CMP)
- Role of ITS in corridor studies

An FDOT Statewide ITS Architecture was completed in 2004 and documents the ITS program deployment goals for the state. This case study will discuss the development of the ITS Planning Guidelines for FDOT District 1.

The FDOT ITS Planning Guidelines identifies key roles for how MPOs should incorporate ITS into their planning activities, including the CMP (and how ITS can generate the data needed to support the CMP performance monitoring), as well as how to evaluate potential ITS technologies as part of corridor studies. The guidelines also establish a link between ITS and sustainability as well as ITS and air quality monitoring requirements. By providing MPOs with information about how ITS can benefit a wide range of transportation system planning requirements, ITS potentially can be leveraged with other project development efforts.

6.1 Overview and Background

In addition to the FDOT Statewide ITS Architecture, companion District-level ITS Architectures (FDOT has seven geographic Districts) were developed. FDOT realized that implementation of ITS elements had to occur at the local level, so developing guidance for incorporating ITS into local planning processes was a key part of the state's ITS implementation plan.

FDOT District 1 responded to this need by initiating a project to develop guidelines for incorporating ITS into the Transportation Planning Process (TPP) for its five MPOs and one Transportation Planning Organization (TPO). The partners in this project were the FDOT District 1 Office of Traffic Operations, which includes the ITS Division; the District 1 Office of Planning; and the Federal Highway Administration (FHWA). The project was funded through funds allocated for the District ITS program, and the project budget was \$25,000. Staff from the Office of Planning managed the project. The Office of Traffic Operations and FHWA reviewed the draft document. After six months of development, FDOT District 1 completed the *Guidelines for Incorporating ITS into the Transportation Planning Process* in late 2004. These guidelines included:

- Facilitation of MPO ITS Subcommittee
- Development of MPO ITS Goals and Objectives
- Development of an ITS Element of MPO Plans
- Coordination with CMP and Concurrency Analysis

FDOT District 1 is located in southwest Florida (shown in Figure 4). The major cities in the District are Naples in Collier County, Fort Myers in Lee County, Punta Gorda in Charlotte County, Sarasota in Sarasota County, Bradenton in Manatee County, and Lakeland in Polk County. The MPOs in the District are Collier

County MPO, Lee County MPO, Charlotte-Punta Gorda MPO, Sarasota-Manatee MPO, and Polk County TPO. (A TPO in Florida has the same roles and responsibilities as an MPO. There are several regions/counties in Florida that have chosen the name *TPO* because they feel it better describes their responsibilities.)

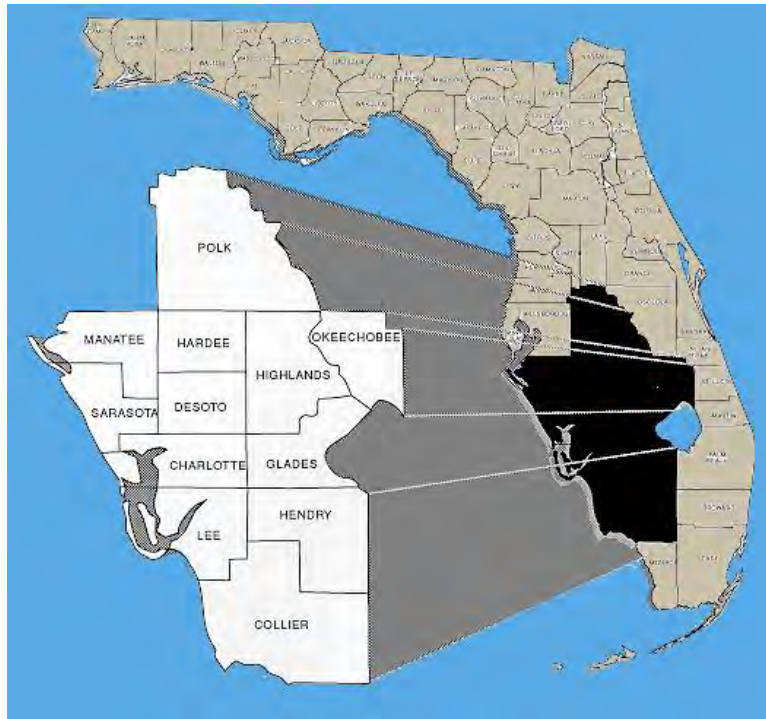


Figure 4. Map of Florida DOT District 1

6.2 Catalyst

The catalyst for the guidelines for District 1 was the development of the Polk TPO's Long Range Transportation Plan (LRTP). In 2004, the Polk TPO was in the process of developing the 2030 LRTP for the County. The TPO determined that ITS would be an important component of the 2030 LRTP. At the same time, FDOT District 1 was receiving requests from other MPOs in the area for information regarding how to include ITS in their plans. FDOT District 1 decided to develop guidance for MPOs for incorporating ITS into the TPP and funded the project through the District 1 ITS program.

6.3 Development Requirements

The development of the guidelines was based on feedback from the District 1 MPOs and TPO through a survey conducted in spring 2004. The survey asked questions about the existing LRTP process, the process for advancing projects to the Transportation Improvements Program (TIP), current practices for incorporating ITS into the planning process, and any data collected or used for measuring performance. The findings of the survey were that the MPOs and TPO all followed federal planning guidelines for the TPP and TIP development. The MPOs and TPO believed that they needed to improve the process for incorporating ITS projects, and since there was little ITS deployment in the District, there was no data collection for measuring performance.

The guidelines called for the MPOs and TPO to create an ITS element of the LRTP and TIP so that those activities would be incorporated automatically into the planning process. Furthermore, the guidelines strongly recommended that an ITS Task Force be set up as a subcommittee under the Technical Advisory Committee (TAC) and that the Task Force meet on a regular basis and provide input to the TAC.

The development of the guidelines was conducted within the existing partnership between the FDOT District 1 Office of Planning and the MPOs and TPO. FHWA also participated as an existing partner in the planning process.

6.4 Outcomes

Section 6.8 of the 2030 Polk LRTP, which incorporated the recommendations of the guidelines, is quoted below:

“The Florida Department of Transportation District One provided technical assistance to identify Intelligent Transportation System (ITS) strategies and projects that are consistent with state and district ITS Architecture and guidelines. The TPO formed an ITS Subcommittee of the Technical Advisory Committee to identify and evaluate ITS needs for Polk County. This subcommittee was comprised of local ITS stakeholders and included public and private sector representatives.”

The ITS Subcommittee identified the following ITS strategies and projects as part of the Polk LRTP.

Incident Management – Freeway/Arterial Integration

- Candidate Project: Regional Incident Management Plan
- Candidate Project: Construct Dynamic Route Guidance Signs

Arterial Traffic Management

- Candidate Project: Polk County Advanced Traffic Management System

Advanced Transit Management

- Candidate Project: Pilot Project for Transit Signal Priority
- Candidate Project: Advanced Transit Management for Countywide Transit Services

There are two measurable benefits of incorporating ITS into the Polk TPO: better coordination with the FDOT District 1 staff, and achieving early results of ITS implementation by having plans in place when money becomes available. Examples of earlier implementation are ITS devices on I-4 in Polk County (which are operated by FDOT District 7 out of the Tampa TMC) and devices planned to be deployed in 2009 on the Polk Parkway around Lakeland.

6.5 Lessons Learned

Having coordinated plans in place helped raise the priority of implementing a regional traffic signal system for Polk County. It also was easier to increase the annual amount set aside for Congestion Management projects from \$2 million to \$4 million. ITS has been identified as one of several eligible deployments for these Congestion Management funds, and an important component of addressing congestion management issues. The Congestion Management funds are a TPO set-aside from the total state and federal funds (mainly for statewide transportation improvements, but other funds are included).

These guidelines were developed for FDOT District 1 and define strategic methods for incorporating ITS into the MPO and TPO processes. These lessons learned certainly can be applied on a statewide basis with more centralized DOT operations, but some concession for the level of detail may need to be made when applying the approach to a “typical” MPO process in North Carolina.

The lessons learned from this case study that can be applied to North Carolina and the Triangle region include:

- Recognize that ITS deployment is important at the local level, just as it is on the statewide level.
- Create a process to incorporate ITS into the existing transportation planning processes (MPO or centralized DOT) that will accelerate project development and funding at the local/regional level while at the same time increasing interest on the statewide level.
- Create ITS Subcommittees at MPOs and facilitate regularly scheduled meetings. In Florida, this approach has been shown to benefit the deployment of ITS, particularly at the local level.
- MPOs should consider developing a local set-aside of federal and state funds for Congestion Management projects. Having available funding for ITS projects coupled with the inclusion of ITS in the transportation planning process almost certainly will increase and accelerate the deployment of ITS projects.

7 Case Study 5 – Albuquerque, New Mexico Regional ITS Architecture

This case study examines the use of a regional ITS Architecture in the planning process. The subject of this case study is the Albuquerque, New Mexico MPO (called MRCOG – Mid-Region Council of Governments). The Albuquerque MPO (AMPA) performs a yearly update of its architecture to bring it into alignment with ITS projects that are put into the TIP. AMPA is a good example of both an MPO that is actively performing periodic architecture updates and an MPO that is providing a more direct connection between the architecture and the programming process (TIP).

7.1 Overview and Background

MRCOG is the lead agency that develops the regional TIP program. MRCOG works along with the other key public transportation agencies in the region to define a set of projects that will be funded for development. They have a two-year cycle for TIP updates. The current version of TIP Policies and Procedures was adopted on October 23, 2008. To support this effort, the MPO has defined a set of TIP policies and procedures that:

“...establishes the process for developing the TIP for the Albuquerque Metropolitan Planning Area (AMPA). It provides an overview of the process and describes how each step of the process will be accomplished. Finally, the procedures that will be followed to revise the TIP after it has been adopted are also established.”

One of the significant updates to the current Policies and Procedures document was the explicit incorporation of ITS and ITS Architecture into the process. The Albuquerque area has a long history of ITS projects (and of ITS Architecture, having been an early developer of a regional ITS Architecture). The previous version of the TIP Policies and Procedures had a simple Yes/No check box in the Project Submittal Form to indicate an ITS project. The key ITS group within the region is called the ITS Committee, which is organized by the MPO and includes representatives from New Mexico DOT (NMDOT) as well as municipal, county, and transit organizations. The committee meets approximately every month and reviews and approves all changes that relate to ITS as part of the revised TIP Policies and Procedures.

7.2 Catalyst

There were several catalysts for changing the programming process to better incorporate ITS and the ITS Architecture. The first was the recognition that very few TIP projects identified themselves as including ITS elements. However, upon examination, many projects not classified as ITS likely were ITS-related such as signal system improvements. Second, the AMPA ITS Architecture was updated in 2007 and, as part of that update, the connection between projects and regional ITS Architecture was made more explicit and much easier for stakeholders to access. Finally, the FHWA Division Office began stricter enforcement of Rule 940, which required an explicit connection between projects and the ITS Architecture. This combination of factors led the MPO to revise its Policies and Procedures to provide a clearer and more explicit inclusion of ITS and ITS Architecture in the TIP process.

7.3 Development Requirements

In coordination with the region's ITS Committee, an expanded section on ITS was added to the most recent update of the TIP Project Form. Shown in Figure 5, a key change to this section was the addition of a list of common ITS project elements. (The full TIP Project Form is contained in Appendix A.) Once this change occurred, a municipal agency submitting a traffic signal improvement project could look at the list and be more likely to correctly identify its project as containing ITS elements.

STEP A.2 – ITS - Will this project include <u>any</u> of the following:			☐ -Yes ☐ -No
<u>This is NOT an inclusive or comprehensive list of ITS Architecture project elements, only common ones</u>			
Traffic monitoring sensors such as in-pavement loops/acoustic sens. RWIS pavement sensors Video imaging and/or CCTV	Remote traffic monitoring Traffic signal installation or coord. Traffic signal pre-emption Traffic signal prioritization	Fiberoptic cable and/or connection ITS integration Message Signs Transit stops/Rail stations/Airport	
If you answered “yes” to this question, the project most likely will need to be included in the Albuquerque Metropolitan Planning Area ITS Architecture and New Mexico Statewide ITS Architecture before any Federal funds can be expended for any ITS component project element. For information, contact Nathan Masek at (505) 724-3620 or Nmasek@nrcog-nm.gov			
If “yes”, after contacting the ITS coordinator, is this project included/being added to the ITS Architecture? ☐ -Yes ☐ -No			
If “yes”, who will be the contact person for data collection? Name: _____ Off. Phone: _____, email: _____			

Figure 5. ITS Section of TIP Project Form

The second change to the form was to identify the need for a connection to the AMPA ITS Architecture or the New Mexico Statewide ITS Architecture, the two relevant architectures for the region. There is a designated contact at the MPO for the AMPA ITS Architecture, and in filling out this part of the form, agencies are more likely to contact that person, as well as provide contact information for the agency staff member responsible for answering the questions about how the project fits into the architecture. This provides the first check point for ITS components within transportation projects. Note that all TIP projects must fill out this step. For projects with no ITS elements, the agency indicates “No” to the first question and goes on.

To assist project managers in answering the question about how their projects fit into the regional ITS Architecture, the MPO created an Architecture Addendum that provided explicit information about how the projects map to the architecture. In the case of the AMPA Architecture, this was simplified by the approach taken to develop the architecture. Although the architecture is captured in a Turbo Architecture database, it also has a complete set of customized, simple market package diagrams that show how a particular agency plans to interconnect elements to provide a specific transportation service (i.e., a specific market package). Figure 6 shows one of the approximately 290 diagrams that define the AMPA Architecture. The complete set of customized market packages exactly matches the Turbo Architecture database to allow either representation to be used to map projects to the architecture.

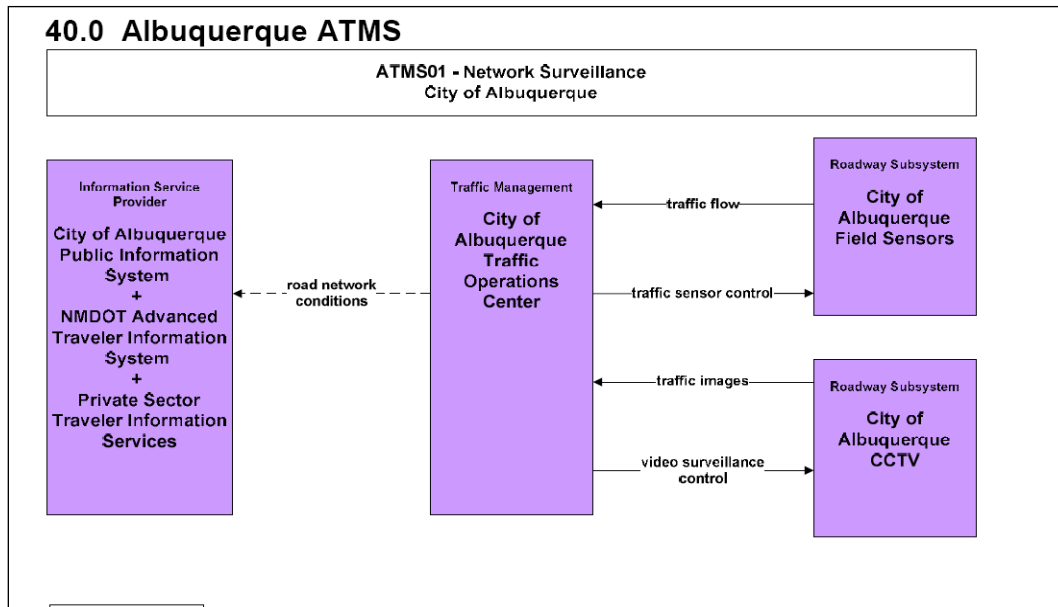


Figure 6. Example of Customized Market Package

As part of the first update to the AMPA Architecture since the 2007 update, the MPO revised the maintenance process and developed a new section titled *Current and 2010-2015 TIP Project Level ITS and Market Package Summary*. The region expects to update the architecture every two years as part of the TIP update cycle. In this section, for each project identified as containing ITS, they created a row in the table shown in Figure 7. If the project had been previously identified in the regional ITS Architecture, they included its mapping to the appropriate market package. However, to make it clear that the scope of the project could evolve beyond that shown in the architecture, they created an additional column that contained the agency-proposed market packages for the project. Note that in the example given, the agency has added a market package (transit signal preemption) in this column. For each project listed, the agency attached the actual market package diagrams.

Figure 7 shows the beginning of the table for Traffic Management, Incident Management, and Maintenance Operations projects. There also was a Category II table for Transit projects and a Category III table for Archive Data and Communications projects. Each of these tables was followed by the specific diagrams mapped to each project.

Category I. Traffic Management, Incident Management, and Maintenance Operations Projects				BLACK text = Projects currently programmed in TIP ('09) BLUE text = Projects programmed in 2010-15 TIP Gray Cells = Projects submitted but unfunded			
MTP/TIP Project Database Information				ITS Regional Architecture Information			2010-15 TIP Project-Level ITS Elements
Seq.	MPO ID	Project Name in TIP	Lead Agency	On ITS Map?	In ITS Arch.?	Recommended MPs in Regional Architecture	Agency-Proposed Project Market Packages (MPs) – Use This Column for Project MPs
1		Isleta Blvd Impr. SIB Repayment	Bern Co	Y	Y	ATMS01, ATMS03	ATMS01, ATMS03
2	40.0*	ITS-Abq ATMS	CoA	Y	Y	ATMS01, ATMS03	ATMS01, ATMS03, APTS09

Figure 7. Example of Market Package Map to Projects

The maintenance plan for the AMPA Architecture identifies the following responsibilities:

- MPO is responsible for identifying changes to the architecture. The MPO uses the ITS Committee as the review mechanism for any changes that come forward during the TIP process (or during project development). This can be accomplished by marking up customized market package diagrams or creating new ones if needed. The updates require a percentage of a full-time staffed person at the MPO.
- NMDOT is responsible for the update of the Turbo Architecture file to correspond to the changes identified.

Regarding NMDOT projects, the MPO has a good working relationship with NMDOT in the AMPA and they are active partners in the development of the TIP. All NMDOT projects in the region are included in the TIP. Also, the project planning/development process in the region is determined by the NMDOT's Location Study Procedures with State and federal oversight. These procedures closely mimic the National Environmental Policy Act (NEPA) process, which in itself is a requirement for federally funded projects. The state procedures also require a comprehensive level of affected stakeholder agency participation.

7.4 Outcomes

One of the primary outcomes of the TIP procedure changes was that projects with ITS elements show up far more often in the TIP. The number of projects identified with ITS jumped from six in the previous TIP revision to 75 in the current revision. In the previous TIP cycles, almost all of the projects identified with ITS elements were projects that were entirely ITS.

Part of the increase in the number of projects with ITS resulted from MPO staff review of each of the project forms and calling the project managers when it was suspected the project had ITS and the ITS box was not checked. Some project managers reported to the MPO that they better understood what to look for and had an increased awareness of ITS elements in their projects. The form (and the corresponding regional ITS Architecture) presented project managers with a different perspective regarding the ITS aspects of their projects. The form encouraged project managers to ask questions of their staff regarding potential ITS elements. Not only were they asking questions, but also, as project managers became aware of the ITS in their projects, some of them have joined the regional ITS Committee. This second outcome of greater awareness of ITS and of the architecture by project managers was a key result that the MPO can build upon in future TIP revision cycles.

7.5 Lessons Learned

One of the key lessons learned from the MRCOG effort was that opportunities to mainstream ITS projects were being lost because project managers were not aware of how ITS elements were a part of their projects. By providing additional information about ITS and showing project managers how to make the connection between the ITS Architecture and their projects, many additional opportunities to insert ITS into transportation projects were realized.

Another lesson learned was that project managers were able to identify the connection between projects and the architecture at each TIP cycle. By knowing which portion (or portions) of the architecture was being implemented by their projects, project managers were able to capture the information provided and begin their systems engineering analysis.

8 Case Study 6 - The Use of ITS During Evacuations

Emergency events requiring evacuation vary widely in type and are nearly all unique in nature and response. The most common types of emergencies requiring evacuation include wildfires, floods, fixed-site hazardous material releases, railroad accidents, and hurricanes¹. The NCHRP Synthesis 392 report notes that evacuation is a complex topic that can be influenced by an enormous number of interactive factors. As a result it points out that it is difficult to identify gaps in practice, “best” practices, or even “effective” practices because the types, scales, and characteristics of the hazards, populations, and transportation networks and resources are so variable across the country. No single type of practice or even group of practices is necessarily appropriate in all locations.

The project team chose to use the *NCHRP Synthesis 392, Transportation’s Role in Evacuation and Reentry*, and a Technical Memorandum titled “*Assessment of State of the Practice and State of the Art in Evacuation Transportation Management*” (prepared for the Intelligent Transportation Systems Joint Program Office (ITS JPO) of the U.S. Department of Transportation (U.S. DOT)) to provide a compilation of case studies related to the use of Intelligent Transportation Systems (ITS) and evacuations. As a result this best practice write-up deviates from the others in format and content and focuses on lessons learned from case studies in the NCHRP report. The material for this write-up was taken in part or in whole from the two aforementioned reports.

The goal of the NCHRP study was to collect and document information on transportation’s role in emergency evacuation and reentry by summarizing aspects of its planning, control, and research as well as highlighting effective and innovative practices. The stated outcome of the report was better knowledge and understanding of the characteristics and operational requirements, costs, and benefits associated with evacuations large and small, with the hope that as a result they could be carried out more safely and effectively in the future.

For the ITS-JPO technical memorandum, information from reports and numerous articles and publications were utilized to assess what is known about transportation management during evacuations associated with no-notice situations. The intent of the case studies was to identify commonalities and unique distinctions among the cross-section of incidents to identify successes, lessons learned, and best practices to provide guidance to agencies in planning for and managing evacuations. The case studies addressed not only the transportation aspects of a evacuations but also the necessary support from public safety and other public organizations with a role in managing evacuations.

8.1 Overview and Background

Transportation plays an active role in supporting and assisting in evacuations. Transportation personnel are involved before, during, and after evacuations by managing and maintaining transportation systems, including traffic control, monitoring, planning, and management. After an evacuation, these personnel are involved in managing debris removal and signal restoration for reentry and in the monitoring and inspection of critical infrastructure. Most importantly, transportation professionals bring expert knowledge and a situational awareness of transportation systems into an emergency response. In states with large rural areas and populations, departments of transportation (DOTs) are often one of the few, if not only, state agencies with staff, equipment, and communication assets in remote areas that can be used to evacuate people to safety. One area in which transportation does not, however, play a role is in the declaration and timing of evacuations. These are decisions that are made by emergency

¹ Sandia National Laboratories Report, 2005

management, law enforcement, and other first-responder agencies.

Among the best-defined and well-developed roles of transportation in evacuations are in the areas of direction and control of highway networks. This is not surprising because these are areas in which transportation agencies are the most knowledgeable, experienced, and best equipped to support. One high-profile and effective recent innovation has been the development of contraflow for “all lanes out” mass evacuations. In areas with the need to evacuate dispersed populations, the role played by transportation is to keep evacuees and decision makers informed about which routes are open and which routes could be used as alternates.

Communications during evacuations was another area of continuing improvement. Communications now appears to be looked upon within a wider context of a multi-information flow and data exchange in which details flow between agencies, evacuees, and remote data acquisition devices. The practice reviews showed that transportation-related communication takes place during all phases of evacuations and encompasses en-route guidance as well as public information, awareness, education, and outreach campaigns. Information is also conveyed using a wide variety of media, including television, radio, print, newspaper, Internet, regular mail, e-mail, phone (reverse 911 and 211), dynamic message signing, and highway advisory radio.

Among the needs and gaps in knowledge and practice is a lack of formal planning for post event reentry of evacuees and mass repopulation of impacted areas. Currently, the role of transportation in the reentry process is oriented toward the inspection of critical infrastructure; the immediate (and longer-term) repair of damaged roads, control systems, bridges, and so on; debris removal and the reopening of roads; and, to a limited extent, the coordination and use of buses for the return of assisted evacuees to their places of origin. Another unaddressed gap is the impact of highway work zones during evacuation. Construction activities on evacuation routes have been an issue during several past evacuations and will result in future evacuation problems if not addressed.

8.2 Lessons Learned

The lessons learned are taken from six case studies reviewed in the NCHRP report and are summarized in several key topical areas as bulleted lists. Those included here are elements that are most relevant to the FAMPO ITS SDP Architecture update.

Evacuation Direction and Control

- **Evacuation Staging and Contraflow.** The Louisiana evacuation plan used for Katrina included a staged evacuation and an improved contraflow plan and as a result it was estimated that approximately 92% of the threatened population in Louisiana had evacuated in advance of landfall.
- **Utilization of Transit Vehicles.** Following the mandatory evacuation order for New Orleans the Regional Transit Authority began running special transportation services from 12 sites across the city to take evacuees to the Superdome and later to take assisted evacuees and special needs persons to Baton Rouge.

Communication and Public Information

- **Portable Dynamic Message Signs.** During the Katrina evacuation, message signs were provided along the evacuation routes to inform evacuees of current traffic and storm conditions. During the 2003 Big Bear California wildfires, portable message signs were utilized by Caltrans and local sheriffs to disseminate relevant information to evacuees.

- **Dynamic Message Signs.** During the evacuation from a rail car toxic chemical spill in Utah, fixed dynamic message signs were activated on the interstate system and portable dynamic message signs were provided on both the interstate and surface streets to alert the public to the roadway closures and provide detour instructions.
 - The Utah Department of Transportation also used its fixed dynamic message signs outside of the incident zone to inform the public of the incident. Message signs approximately 50 miles to the north and 120 miles to the southeast of South Salt Lake City were activated.
 - Two tools suggested after this incident were:
 - Additional portable message signs for large-scale incidents.
 - Fixed message signs on more surface streets. In this instance, traffic was diverted away from the interstates to local surface streets, which could have used the additional information on traffic conditions.
- **Online Mapping of Road Closures.** During the 2007 wildfires in southern California, Caltrans assisted with road closures through the release of the “Caltrans Commuter Alert,” which provided location and details about road closures throughout the seven county area. These road closures were illustrated through geographic information systems by providing detailed maps that depicted the road closures as well as the perimeters of the wildfires. Both San Diego and Caltrans provided mapping services to assist responders and the citizenry during this period.
- **Internet Based Emergency Management Communication.** Another example of an effective tool in San Diego County was a web-based emergency management communication tool, such as WebEOC® software, which made it possible for up to 500 agency representatives to have complete, instantaneous, and full situational awareness. The primary function of the WebEOC® platform is for local government to process resource requests through a single system as well as to provide situational awareness reports that allow all those logged into the system to see what is going on throughout the disaster event. Because it is web-based, all local and state agencies, including Caltrans, were able to maintain situational awareness and respond to resource requests throughout the duration of the wildfires.
- **Targeted Reverse 911.** San Diego also utilized a reverse 911 system with ability to designate areas through the creation of polygons on a county map to call just the area that has been selected on the map. This is an ideal system for conducting evacuations in this type of environment, because once the fire departments identified an “evacuation box,” AlertSanDiego was able to notify just those individuals who were physically located within the area being evacuated. This allowed for only the necessary number of phone calls to be made and avoided calling out an entire zip code or area code. Through this system, San Diego reported that they were able to issue approximately 12,000 calls an hour.
- **Non-Emergency 211 System.** San Diego also utilized a 211 call system to relay non-emergency information to the public. During the 2007 wildfire, 211 received more than 120,000 calls and was staffed with more than 1,200 volunteers. By utilizing the 211 service, citizens in San Diego County were able to receive up-to-the-minute information about evacuations, shelters, road closures, and volunteer and recovery information and services. More important to emergency officials, the system was useful most notably to relay non-emergency-related agency contact numbers, allowing the general population to contact these offices directly instead of using emergency dispatchers to give out the number or transfer calls to others.

9 Case Study 7 - ACS LITE Adaptive Signal Corridors

This case study looks at a specific implementation of adaptive traffic control systems in Atlanta, Georgia, highlighting the performance improvements demonstrated by the system. In addition this case study will present some more general results and lessons learned taken from an Adaptive Traffic Control Systems State of the Practice survey published as an NCHRP paper in 2010.

9.1 Overview and Background

Adaptive traffic control systems (ATCS) have been in use for over 20 years, but have seen only limited deployment throughout the U.S. A recent survey (from 2010) identified about 30 jurisdictions that had implemented ATCS on some portion of the signal system. A decade ago FHWA began to look at why ATCS deployments were slow to occur in the U.S. Through surveys and roundtable discussions the following were the three top concerns expressed by public agencies:

- High cost (cited by 70% of responding agencies).
- System complexity.
- Uncertain benefits (cited by 40% of responding agencies).

The Federal Highway Administration (FHWA) initiated the Adaptive Control Software Lite (ACS Lite) project in 2002 to advance adaptive traffic signal control from state-of-the-art technology to state-of-the-practice technology that can be widely deployed. The research and development of ACS Lite has been carried out by Siemens, with collaboration and testing support from Purdue University, The University of Arizona, and ITT Industries. ACS Lite was designed to retrofit to existing traffic signal systems and to operate within the context of existing signal timing policies. The software is available through four vendors: Siemens, Econolite, McCain and Peek. The system improves progression and phase utilization for small scale arterial systems of 30 or fewer traffic signals, producing smoother flow and fewer traffic delays.

An ACS Lite system, portrayed in Figure 8 is composed of the following hardware:

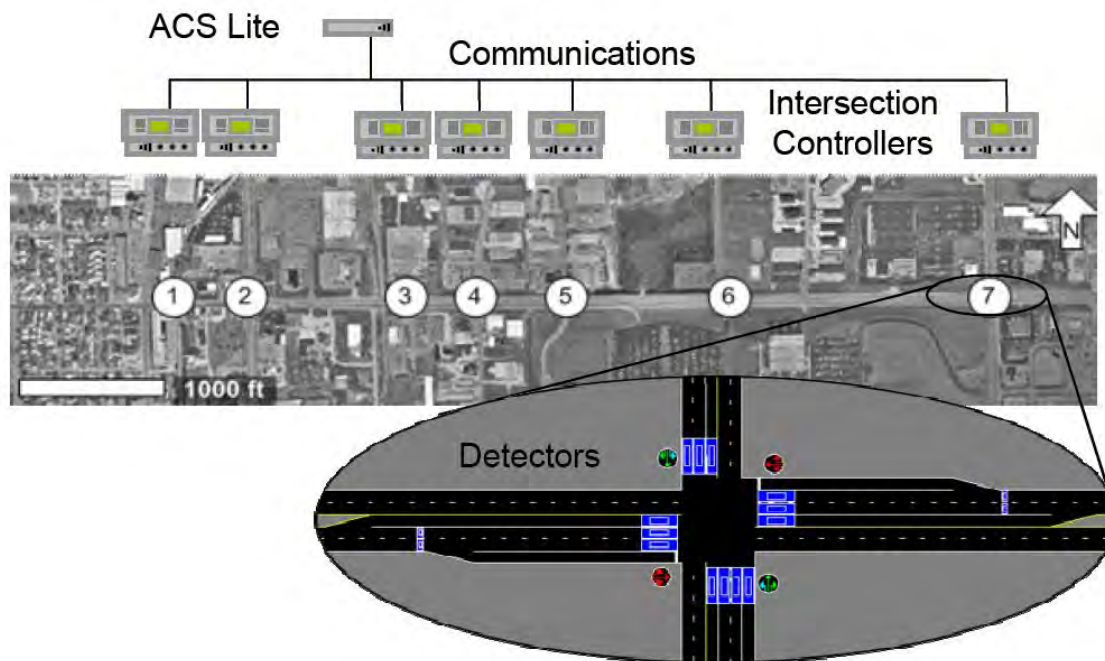


Figure 8. Example of a Typical ACS Lite Adaptive Traffic Signal Control System

- **ACS Lite** is deployed either as a small-scale central system on a Windows-based server at the traffic management center (TMC) or in the form of an on-street field-hardened processor replacing a legacy field master. This single processor, “centralized” architecture saves significant capital costs when compared to adaptive systems with a distributed architecture, which utilize dedicated processors at every intersection. The “on-street” configuration allows the flexibility for deployment in areas with limited communications infrastructure where adaptive traffic signal management has not historically been an option.
- **Controllers** at each intersection are NEMA or 2070 model controllers, where the firmware has been upgraded to a more recent version that supports NTCIP and ACS Lite status messages.
- **Communications** between ACS Lite and the controller may be IP-based, or serial, in order to retain existing twisted-pair infrastructure and forego the cost and complexity of peer-to-peer networking and fiber infrastructure. ACS Lite exchanges messages with each intersection on a per-minute basis; however, it obtains time-stamped status reports with the per-second resolution required for quality adaptive control. This infrequent messaging requirement largely eliminates the historical hypersensitivity found in adaptive systems that rely on flawless per-second real-time communications.
- **Detectors** are essential to effective adaptive signal control decisions. ACS Lite is designed to leverage typical detectors layouts, as commonly located in fully actuated operations, using a combination of stop line detectors and advance detectors (on arterial approaches). ACS Lite processes second-by-second detector presence data, in comparison with corresponding second-by-second phase indications, and accounts for detector lengths and movement speeds in its demand estimation algorithms. This design substantially reduces the costs and the historical hypersensitivity found in adaptive systems that require detectors in uncommon locations with precise zone dimensions and precise vehicle count requirements.

9.2 Development Requirements

In the particular implementation that is considered in this case study, an ACS Lite system was deployed in 2009 on five intersections of Cascade Road in the City of Atlanta, Georgia, as shown in Figure 9.

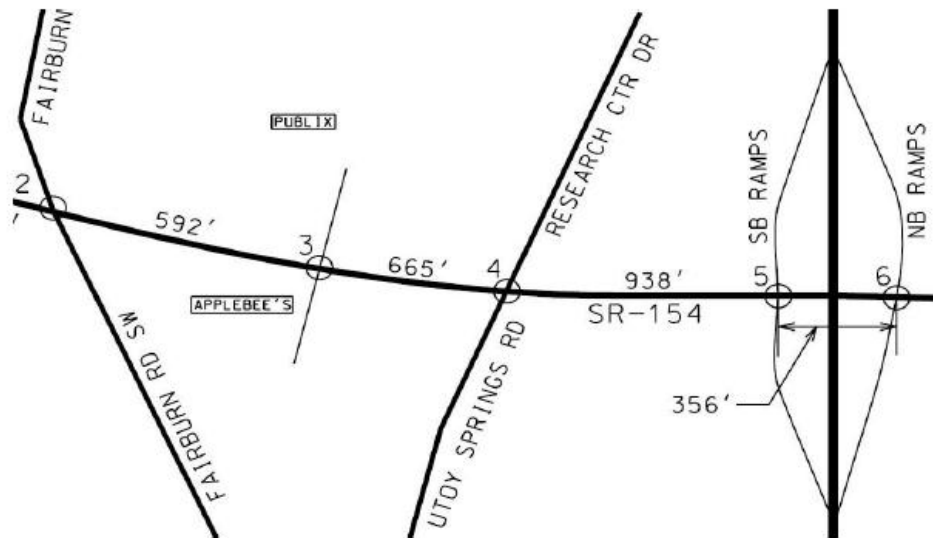


Figure 9. Extent of deployment

Note that the intersections designated 5 and 6 are at the bottom of ramps to/ from the limited access highway I-285.

One of the key features of this study was the effort that was taken to show the benefits of the adaptive traffic system. The installed signals were retimed in June 2009, so that the baseline represented a good example of what a non adaptive set of signals can provide in terms of performance. The second feature of this study was that the agency used a Sensys Arterial Travel Time System to measure arterial travel times in order to obtain an accurate measure of the performance improvement. The Sensys system uses wireless based magnetometer sensors to obtain the travel time measurements. The architecture of the Sensys Arterial Travel Time System is shown in Figure 10.

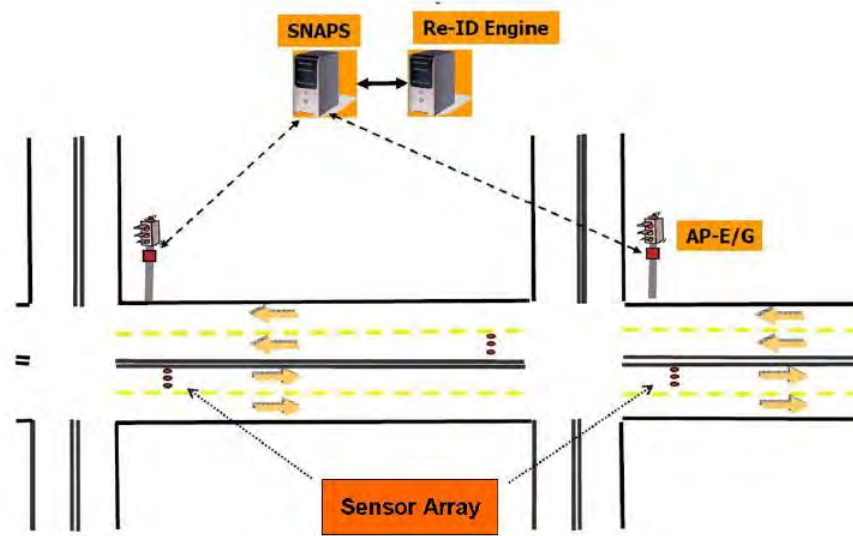


Figure 10. Sensys Arterial Travel Time System Architecture

This study collected arterial travel times for both directions and the queue length at side streets to do the before-and-after study. The arterial travel time was the travel time between the intersection of Fairburn and I-285 NB, which was collected by the Sensys Arterial Travel Time System. Queue length data was collected manually by a team of five people stationed at each intersection to record the maximum number of vehicles in the queue at the onset of each green cycle. The before data was collected during the morning peak time and evening peak time on two consecutive Thursdays.

9.3 Outcomes

The travel time study showed that the ASC-Lite system resulted in reduced travel times and reduced queue lengths at the freeway ramps. The following summarizes the travel time improvements measured:

- Eastbound travel time was reduced 32% during morning peak (46 vs. 67 seconds) and 14% during evening peak (147 vs. 159 seconds). Westbound travel time was reduced 16% (103 vs. 133 seconds) during morning peak and 6% (136 vs. 146 seconds) during evening peak.
- Significant reduction of queue length on the side streets, especially on the freeway ramps. I-285 NB ramp has a 21% (10.4 vs. 13.3 vehicles) and 19% (10.7 vs. 13.2 vehicles) reduction in queue length during morning and evening peak. I-285 SB ramp has a 48% (7.6 vs. 14.4 vehicles) and 20% (21.4 vs. 26.8 vehicles) reduction in queue length during morning and evening peak

Note: The traffic volumes on the arterial during the before-and-after time period are very similar, therefore excluding the traffic volume as a factor in the travel time reduction

9.4 Lessons Learned

The lesson learned from the Fulton County Study was that under the right circumstances the adaptive signal control provided real improvements to both travel times and queue lengths.

The NCHRP study also provided some general lessons learned from the survey of the adaptive signal control deployments across the US and worldwide. One caveat to provide to these lessons learned (in

the context of the ASC-Lite deployment that was the primary subject of this best practice) is that most of the deployments were not considering ASC-Lite.

The deployment of an ATCS is a challenging process for both ATCS users and the vendors and consultants who perform system installation and integration. No two ATCS deployments are the same. Idiosyncratic characteristics of deployment site, traffic conditions, an agency's legacy hardware and software, and the institutional and cultural characteristics of the agency, make each ATCS deployment unique. For this reason each new ATCS deployment represents a new learning experience both for the agency and the vendor.

Agencies were mostly pleasantly surprised by ATCS's abilities to provide what was observed as "efficient operations" and to adjust to within-day and day-to-day traffic fluctuations. The second important positive surprise related to a systems ability to store traffic data that previously required much more difficult data collection efforts. Negative surprises were mostly related to difficulties in learning how to operate the system and hardware issues (mostly communications). There were also some complaints about operational features of the systems (e.g., phases being skipped), which reflect a lack of hands-on expertise within the agency, availability of local technical support, or problems with hardware more than deficiencies in operational philosophies of their ATCSs.

When asked what they would in hindsight, have done differently during the implementation of their ATCSs, most agencies indicated that greater emphasis should have been given to local support, either through acquiring more in-house knowledge or by ascertaining that technical support for their ATCS is available locally. Better planning and preparation of the necessary infrastructure (communications and detection) are the next important issues that most agencies would have done differently. Finally, some agencies recognized that they would need more information on the costs and benefits associated with installation of ATCS.

10 Case Study 8 - Transportation Issues Around Military Bases

This case study looks at ITS related transportation improvements that can be made around military bases to ease congestion caused by significant increases in base personnel. The case study is based upon TRB Special Report 302, Federal Funding of Transportation Improvements in BRAC Cases. This report was the result of fiscal year 2010 defense appropriations requested a study by the National Academy of Sciences of federal funding of transportation improvements in Defense Base Closure and Realignment Commission (BRAC) cases. The study covers several tasks but the most relevant to this case study is the task to “Examine case studies of congestion caused on metropolitan road and transit facilities when BRAC requirements cause shifts in personnel to occur faster than facilities can be improved through the usual state and local processes”.

10.1 Overview and Background

The Defense Base Closure and Realignment Commission (BRAC) 2005 effort had the effect of concentrating tens of thousands of additional personnel at a number of bases, some of which are located in metropolitan areas with already congested transportation infrastructure. As stated in the report,

“The time period by which BRAC decisions were to be fully implemented (September 2011) was far also too short for some bases and surrounding communities to avoid significant added traffic congestion for military personnel and other commuters during peak travel periods. The resulting traffic delays will impose substantial costs on surrounding communities and may even be harmful to the military. The existing funding mechanisms, through the U.S. Department of Transportation and the Department of Defense (DoD), are incapable of addressing the problems in terms of both the speed with which they can be implemented and the resources they have available. Moreover, base commanders lack incentives, guidance, and resources to address the problems bases cause outside their gates. In cases documented in this report, base growth due to BRAC and other DoD policies outstrips communities’ abilities to respond. This problem is partly due to the controversy and difficulty of expanding capacity in built-up areas in response to growing populations and travel and partly due to severely constrained resources.”

BRAC 2005 affected 18 military bases in the continental US, including Fort Bragg (although the study did not consider Fort Bragg). The report looked specifically at six of the 18 military bases:

- Fort Belvoir, VA*
- National Naval Medical Center, MD
- Fort Meade, MD
- Fort Lewis/ McChord Air Force Base, WA*
- Eglin Air Force Base, FL
- Fort Bliss, TX*

The sites identified with an asterisk above share some similarities with Fort Bragg- they are located in an urbanized area and have a large number of people traveling into and out of the facility each day, with the resulting major impacts on the surrounding transportation network. Following is a short description of the relevant bases.

Fort Belvoir is a single base that includes three noncontiguous geographic areas located in Northern Virginia. It is the single largest employer in Fairfax County VA, and after BRAC consolidations are

[illegible]

(which is a couple miles away) and via US Route 1, a divided four-lane highway with frequent traffic lights and considerable development. The closest Metro station (urban light rail) is 7 miles away, and the area has limited transit. Road and transit access to Ft Belvoir is poor during peak periods, as the northern Virginia area has significant rush hour traffic. A map of the area around Fort Belvoir is shown in Figure 11.

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Figure 12. Lewis-McChord, WA

Fort Bliss, portions of which are contained in the City of El Paso, is the fastest-growing U.S. Army installation in the United States. The base has grown by 2,000 to 3,000 soldiers annually since 2006, for a 2009 total of roughly 19,000 soldiers, 29,000 dependents, 3,000 civilian workers, and 2,000 private contractors. The remainder of its contiguous acreage sprawls across portions of Texas and New Mexico. Fort Bliss's 1.12 million acres is larger than the state of Rhode Island. The base is a primary economic engine for greater El Paso and its 730,000 residents. Located in the western tip of Texas near the Mexico border, Fort Bliss is served east-west by I-10, US-180, and US-62; north-south by US-54 and Purple Heart Boulevard-SR-375; and by several city and base roads that intersect with these major routes. A map of the area around Fort Bliss is shown in Figure 13.



The majority of the solutions recommended and implemented are not ITS in nature, but there is an ITS context to some of the changes implemented or planned.

One of the suggested solutions was to increase public transit service to the base. This is not easily done as described by the report.

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delays, the relative advantages of using transit are reduced, particularly when a transit rider must wait for a shuttle after passing through the gate. The base is proposing running frequent shuttles both to the Main Post gates and within the base, but funding for this service has not been secured.”

The planned improvements at Joint Base Lewis–McChord described in the document include a number of added or improved ITS services.

“The Washington State DOT announced a series of actions to assist in relieving the growing congestion described above, including improving the timing of traffic signals at several interchanges and boosting incident response crews from two to five so disabled vehicles can be cleared away more quickly. Longer-term solutions under consideration by state transportation officials include installing metered on-ramps (traffic signals that allow only one car at a time to enter the freeway), more traffic cameras, and electronic signs displaying real-time traffic information so motorists will know whether the roadway is clogged.”

Transit alternatives have been considered at JBLM, but due to some unique constraints they have not been effective. As described in the report:

“Attempts to find alternatives to SOV commuting have been difficult in the military environment. Military personnel at JBLM have unique work schedules. Soldiers create two morning travel peaks because they participate in morning exercises and training, return home for cleanup, and then return to the base for duty. It would be difficult for transit to gain modal share in this context. Security concerns have prohibited priority access treatments for public transportation.²¹ Fixed bus routes are able to serve only the gates of the installation”

In Fort Bliss the primary improvement implemented was building a new road, Spur 601 that will ease access to the post. The document describes the unique funding scheme used to develop this road.

“In addition to the typical bond financing initiatives, the city and elected officials worked with TxDOT on a unique funding approach in constructing Spur 601 (known as the Inner Loop), a \$367 million highway project that will ease access to the post and relieve congestion in east and northeast El Paso. The 7.4-mi project will connect westward to US-54 (Patriot Freeway) at Fred Wilson Avenue and eastward to the Purple Heart Memorial Highway.”

TxDOT entered into an agreement with a private firm to develop the state’s first private-sector “pass-through” financing agreement. The firm will finance, design, and build Spur 601 at a cost of \$367 million. In pass-through tolling, motorists pay nothing. Vehicles are counted and the state reimburses the private firm over several years according to that number. Construction of the interchange between Fort Bliss and Biggs Army Airfield at Fred Wilson Avenue and Airport Road will help relieve congestion that has plagued the area for years; \$10 million in local funds is being used to improve connections between local roads and improved base gates.

10.3 Lessons Learned

One of the key lessons learned from the study of Defense Base Closure and Realignment Commission (BRAC) cases was the need for military bases to coordinate with local planning organizations in order to identify planned increases in base personnel and to understand the impact the changes will have on the

local transportation system. In addition, base public works directors need to be engaged in the MPO process so they are fully aware of carrying capacity of regional transportation infrastructure and its potential (or lack thereof) for expansion. Note that the active involvement of Fort Bragg Public Works personnel in this Deployment Plan effort is directly responding to this lesson learned.

11 Summary

This Best Practices report was developed to address FAMPO stakeholder interest in a national view of ITS technologies, architecture development and maintenance, integration of ITS projects into the planning process, and maintenance activities associated with other components of an SDP. The document will serve as a reference tool throughout the development of the SDP, but will not limit the best practices that are referenced in the Gap Assessment and other portions of the project. This document is intended to provide a greater level of detail regarding the subject areas that are most applicable to future deployments in the FAMPO region.

The following is an overview of key lessons learned collected from the case studies in this report that are important to bring forward into later stages of this project.

- Public education and outreach is an important component of project development. A clear communication of benefits to the public will increase the likelihood of project support and approval.
- Increased education concerning new technologies and policies also increases the potential for a project's success.
- Partnering with multiple agencies, including media and the private sector, can expand the availability of resources during an outreach effort.
- Analyze alternative approaches for contracting personnel and services to support ITS needs including operations, maintenance, management, and data collection.
- Involve policy makers, such as boards and commissions, in the development of new programs. Their support and buy-in will guide future funding opportunities for expansion and enhancements to the program.
- Coordination between multiple public agencies and potential public-private partnerships will improve consistency in addressing and achieving the regional goals and objectives. Improved coordination will enhance the participating agencies' understanding of each other's processes, resulting in a solution that addresses the needs of all stakeholders.
- When attempting to implement performance measures, begin with what you can measure. Do not wait for the perfect data.
- Develop comprehensive maintenance and operations plans for each project as part of the project programming process so adequate funding and resources are identified.
- Build deployments on the foundation of proven practices within the region. Once a long-term regional goal is established, develop the program in manageable and maintainable increments.
- In order to properly plan for Fort Bragg expansion, MPO staff, local transportation staff and base public works need to coordinate closely on transportation impacts and possible solutions.

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FAMPO Regional ITS Strategic Deployment Plan Update

Vision, Goals, Objectives, and Performance Measures Final Document



Prepared for:
Fayetteville Area Metropolitan Planning Organization
(FAMPO)

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In Association with:



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Revision History

Filename	Version	Date	Authors	Comment
FAMPO Task 2-ITS SDP Goals Objectives Performance Measures- Final-050712	1.0	May 2012	L. Byala, D. Miller	Incorporated Comments
FAMPO Goals Objectives Performance Measures- Final-2013-04-11	1.01	April 2013	B. Eisenhart	Finalized for Workbook
FAMPO Goals Objectives Performance Measures- Final-2013-05-24	1.02	May 2013	J. Baker	Finalized for Workbook and DVD

1 VISION, GOALS, OBJECTIVES, AND PERFORMANCE MEASURES

1.1 Introduction

It is critical that any plan start out with a well-defined vision, goals, and measurable objectives, as they are foundational for the entire project. These elements assist in guiding the subsequent tasks and are referred to throughout the project. By obtaining consensus early on as to the region's vision for the Intelligent Transportation Systems (ITS) Program, what the goals are for ITS in the Fayetteville Metropolitan Area, and what objectives the region is trying to achieve, the resulting ITS plan will better meet the needs of the stakeholders.

While this task is focused on the vision, goals, and objectives of ITS in the FAMPO region, it is also important at this stage to identify the associated performance measures. Because objectives are meant to be specific and performance toward those objectives needs to be tracked, it is important to ensure that any objective can actually be measured with either existing or easily obtainable data.

The following working definitions for are used to assist the development of this portion of the Strategic Deployment Plan (SDP):

Goals: A goal is a broad statement of what the agency hopes to achieve and is qualitative in nature.

Objectives: Objectives are specific, achievable, measurable statements of what will be done to achieve goals within a designated time and are typically achieved through work plans.

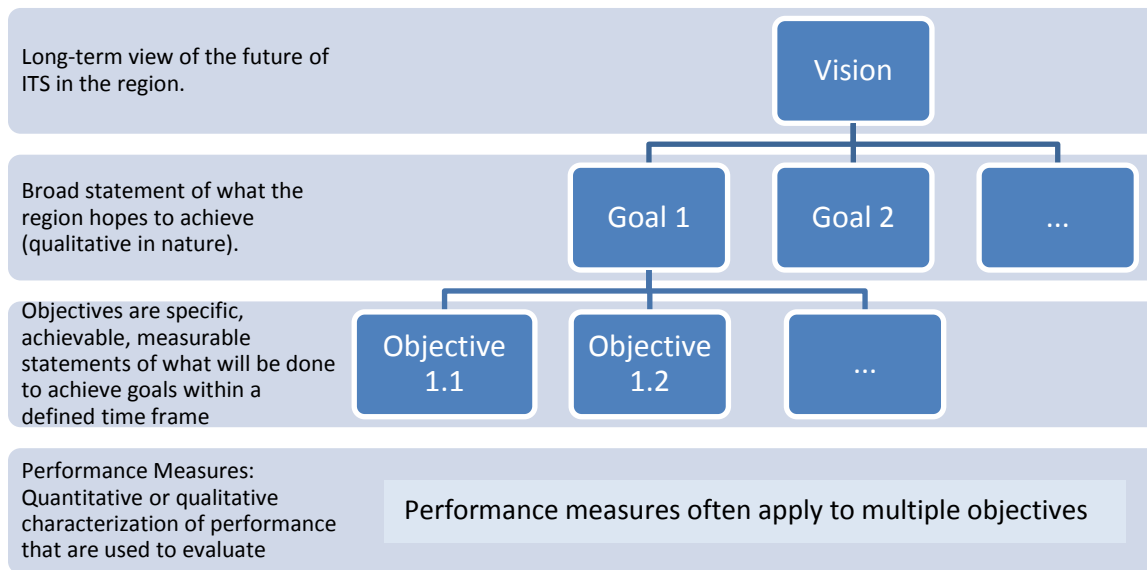
Performance Measures: Quantitative or qualitative characterization of performance that are used to evaluate progress toward objectives. They quantify the agency's efficiency or effectiveness in conducting business operations. For example, reducing the time required to clear incidents.

Performance Standard: The level that the performance measure should meet so that the objective is met. For example, clearing 90% of incidents within 60 minutes.

Defining the performance measures that relate to each objective has a dual purpose: first, to help guide the selection of ITS strategies in Task 3, the regional Gap Assessment, and second, to provide a basis for ongoing measurement of the plan's success as it is implemented. Task 3 involves a regional Gap Assessment to determine and identify solutions that address regional goals and objectives and result in service package-based projects that can be reflected in the Regional ITS Architecture developed in Task 4.

The relationship of the vision, goals, objectives, and performance measures is shown in Figure 1-1.

Figure 1-1 - Relationship of Vision, Goals, Objectives, and Performance Measures



The ConSysTec team followed a top-down approach to developing the vision, goals, objectives, and performance measures. This approach included working with stakeholders and using existing documentation to develop a draft set of vision, goals and objectives. It was important to achieve wide-spread buy-in early on in the planning process both to ensure that the plan meets the needs of the broad audience but also as a way to explain later down the line why the plan does or does not include particular strategies, by being able illustrate that they are all based on helping the region to achieve the goals and objectives. The following sections document the process by which the vision, goals, and objectives were developed, including the stakeholder outreach. Following that the vision, goals, objectives, the draft performance measures are presented.

1.2 Document Review and Research

The first step in this Task was to obtain and review as much existing documentation as possible on local visions, goals, objectives, and missions statements. This documentation focused not only on ITS plans, but on transportation plans in general, since the ITS SDP and Architecture need to consider the overall transportation goals and objectives for the region; the SDP is a plan to support transportation improvements, not to implement technology for technology's sake. The sources for the documentation that was reviewed included:

- FAMPO's Long-Range Transportation Plan (LRTP) and other long range plans;
- Jurisdictional long range plans and strategic plans;
- North Carolina Department of Transportation (NCDOT) long range transportation plans and ITS plans; and,
- Federal practices incorporated through Federal Highway Administration (FHWA) and Federal Transit Administration (FTA) guidance and the research programs of the Transportation Research Board.

The ConSysTec team began document collection prior to the Kickoff meeting and received additional feedback at the kickoff meeting on documents to mine for data. The consultants were able to acquire the majority of the documentation from existing online sources and worked directly with stakeholders to acquire any documents not readily available. Table 1-1 lists all of the documents that were reviewed.

Supplementing this data collection was the collection of stakeholder needs through the interview process performed as part of Task 1. Stakeholder feedback directly relevant to the vision, goals and objectives is documented in the following section.

Table 1-1 - List of Documents Acquired for Data Mining

Title	Source	Date
Long Range Plans		
FAMPO Mobility 2035: FAMPO's Long Range Transportation Plan	FAMPO	April 22, 2009
FAMPO Long Range Transportation Plan: Highway Plan	FAMPO	April 22, 2009
FAMPO Long Range Transportation Plan: Countywide Transit Plan	FAMPO	April 22, 2009
FAMPO Long Range Transportation Plan: Aviation Plan	FAMPO	April 22, 2009
FAMPO Long Range Transportation Plan: Congestion Management Program	FAMPO	April 22, 2009
FAMPO Long Range Plan: Fiscally Constrained Plan	FAMPO	April 22, 2009
FAMPO Long Range Plan: Freight Element	FAMPO	April 22, 2009
FAMPO Long Range Plan: Rail Plan	FAMPO	April 22, 2009
FAMPO Long Range Plan: Safety Plan	FAMPO	April 22, 2009
FAMPO Long Range Plan: Security Plan	FAMPO	April 22, 2009
FAMPO Long Range Plan: Waterways Plan	FAMPO	April 22, 2009
NCDOT Statewide Multimodal Transportation Plan	NCDOT	2004
NCDOT 2040 Plan: Documents in Process	NCDOT	Spring 2012
2008 Comprehensive Regional Growth Plan	Ft. Bragg	September 2008
NCDOT Weigh Station Plan	NCDOT	March 2004
Mid-Range Plans		
FAMPO STIP Supplement	FAMPO	July 2011
Draft MTIP 2012 – 2018	FAMPO	
F.A.S.T. Transit Development Plan	F.A.S.T.	March 25, 2009
Consolidated Transit Development Plan (F.A.S.T. and Cumberland County)	F.A.S.T.	September 2010
Ft. Bragg Regional Transportation Systems Plan	Ft. Bragg	
ITS Plans		
Fayetteville Regional ITS Deployment Plan	NCDOT	2000
RITA Strategic Research Plan	USDOT RITA	2010 - 2014
Strategic Plans / Performance Monitoring		
NCDOT 2010 Annual Performance Report	NCDOT	2011
City of Fayetteville Strategic Plan	City	March, 2011
Other Plans		
FAMPO Bicycle and Pedestrian Connectivity Study	FAMPO	March 2011
FAMPO Environmental Justice Plan	FAMPO	April 22, 2009
Coordinated Human Service Transportation Plan	FAMPO	October 28, 2009
US 401 Corridor Study: Recommendations (ITS)	FAMPO	
Triangle Region ITS Plan	Triangle	

1.3 Stakeholder Outreach

The consultant team held a series of stakeholder interviews to gather data on ITS infrastructure, ITS plans, coordination with regional partners, and several topics related to needs, issues, challenges, and problem areas from the agency's perspective. The list of questions and responses from the interviews are contained in Annex A of the Task 1 Report. . The stakeholders interviewed included NCDOT, City of Fayetteville, FAMPO, Ft. Bragg, and Fayetteville Area System of Transit (FAST). In addition, at the March meeting of the Cumberland County Incident Management Group, a brief presentation regarding the project was made and members were queried for their input through a facilitated discussion.

The following bullets summarize the feedback from the stakeholder interviews that helped inform the development of the vision, goals and objectives.

- The desire for a consolidated call center for Cumberland County Transit and FAST
- The ability for the Emergency Operations Center (EOC) to know bus locations through Automatic Vehicle Location (AVL).
- The ability for FAST to access City/State CCTV at their dispatch center.
- On-board transit vehicle real-time diagnostics.
- Utilizing ITS to assist in accommodating anticipated growth areas.
- Upgrade of Ft. Bragg traffic signals which would allow City to do signal and controller maintenance.
- Utilize ITS to mitigate traffic congestion to, from, and around Ft. Bragg.
- Information sharing between NCDOT, City of Fayetteville, and Ft. Bragg.
- Improve traffic signal systems and traffic monitoring.
- Improve coordination for incident management.
- Increase the ITS capabilities along I-95, including considerations for tolling or variable speed limit signs.
- Coordination with Raleigh for regionally significant events, e.g., coordination through the Statewide Traffic Operations Center to provide information to motorists in and around Fayetteville if there is a major incident in and around Raleigh.
- Utilize Dynamic Message Signs (DMS) to provide information on trip time through and around Fayetteville to assist travelers with route decision making based on real-time information.

1.4 Development of Draft and Final Vision, Goals, and Objectives

Draft Vision, Goals, and Objectives

Upon collection of the vision, goals and objectives from the existing plans and the stakeholder needs, the ConSysTec team developed a synthesis of the main themes and common goals and objectives. This synthesis was used to develop a draft vision statement, as well as a set of goals and objectives. The main themes identified are:

- System Efficiency, Reliability, and Mobility
- Regional Coordination
- Safety and Security

- Environmental and Economic Sustainability

While the draft vision, goals, and objectives are significantly reduced from the full synthesis of the many goals and objectives in the other studies, the other goals reviewed in the course of this process were retained as a resource. A complete list of vision/mission statements and goals and objectives acquired through the document review process is provided in Appendix A.

Final Vision, Goals, and Objectives

Once a draft vision and goals and objectives were developed, the sample list was presented to the project steering committee and a stakeholder committee, and facilitated discussions were held to create a final vision and agreed upon goals and objectives.

The following bullets summarize the type of discussion that ensued on the draft vision, goals, and objectives that were presented at both steering and stakeholder meetings that took place in March 2012. This feedback was used to refine the vision, goals and objectives.

- The group decided to refer to the “region” in general in the vision rather than listing specific locations, so as to be inclusive of all counties and cities within the FAMPO planning area.
- The need for an objective that got to the point that ITS can help make the most out of existing capital assets and simultaneously help the environment.
- The need to make sure that the objectives stress the point that stakeholders from a variety of agencies need to talk the same language and see things the same way, understanding what are the critical information requirements and what information each stakeholder needs to know.

Upon incorporating this feedback, the final vision, goals, and objectives were defined as follows.

Vision

Utilizing feedback from the kickoff meeting and vision and mission statements acquired through the document review, the consultant team and steering committee members developed a vision statement for the FAMPO ITS SDP that is supported by the participating agencies’ goals and objectives. This vision statement is broad by design, capturing themes that the stakeholders believe are important to the region that can be positively impacted by ITS and the ITS SDP.

The region’s vision for ITS is articulated as follows:

A safe and efficient multi-modal transportation system that uses appropriate technology to provide reliable service in an environmentally sustainable manner, improving the quality of life in the region.

Goals and Objectives

The ITS goals and objectives were formulated based on the vision statement and around the concept of establishing objectives that are specific, achievable, and measurable. In addition to stakeholder and steering committee meetings and stakeholder interviews, nearly 30 different sources were utilized to

develop the goals and objectives section of this report, as described in the document review and research section. The goals and objectives for the FAMPO ITS SDP have been identified as:

GOAL 1: Advance efficient movement of people and goods, improve reliability of transportation systems, and enhance mobility choices.

Objective 1.1: Effectively use management and operations strategies to reduce congestion and travel times and increase travel time reliability.

Objective 1.2: Enhance mobility choices through accurate, timely, and convenient information on all modes.

Objective 1.3: Increase the efficiency of the overall transportation system by facilitating the interconnection of transportation modes.

GOAL 2: Strengthen coordination and cooperation between municipalities, counties, Fort Bragg, the State, federal government, and public and private stakeholders to ensure effective service delivery in the region.

Objective 2.1: Provide coordinated static and dynamic transportation information, including road condition, closures, incident status updates, and transit information, to enable informed decision-making and effective use of resources.

Objective 2.2: Increase inter-agency sharing of construction updates, maintenance activities, planned special events, traveler information, and incident information.

Objective 2.3: Prioritize projects and their deployment to accommodate planned growth in the region, new or changing traffic patterns, and mode shift.

GOAL 3: Promote, maintain, and improve safety and security on individual facilities and on a system-wide basis.

Objective 3.1: Reduce the number of crashes, including those involving pedestrians, and decrease secondary incidents.

Objective 3.2: Improve the security of all transportation facilities across all modes.

Objective 3.3: Enhance the effectiveness of agencies responsible for disaster preparedness and emergency response.

GOAL 4: Provide strong fiscal stewardship that maximizes the cost-efficiency of transportation system investment while protecting the environment.

Objective 4.1: Provide cost-effective innovative and flexible technological solutions to transportation problems.

Objective 4.2: Reduce air pollution and fossil fuel use generated by transportation through reduced congestion and use of alternative modes.

Objective 4.3: Deploy ITS solutions that enhance and leverage existing infrastructure to minimize environmental impacts.

Objective 4.4: Provide transportation improvements and solutions that support economic development.

1.5 Performance Measures

ITS System Performance Measures

Performance measures are designed to address both the efficiency and effectiveness of ITS and should be specific, measurable and quantitative where feasible. A number of sources were utilized to develop the performance measures section of this report, including the National ITS Architecture and the documents listed in the section on document review and research.

The tables on the following pages list and describe all of the performance measures that have been developed as part of the FAMPO ITS SDP. Table 1-2 is made up of a set of performance measures that should be used to assess how the ITS system is meeting the objectives defined in this report. They are useful for monitoring how well the region is adhering to the SDP and benefitting from its implementation moving forward.

Of the 15 performance measures listed in Table 1-2, some are output measures and some are outcome. Output measures are those that just record what has been done, while outcome measures track the ensuing results. For example, percent of lane-miles equipped with ITS components is an output measure, but clearing an incident within a set time is an outcome of all of the communication, information, and emergency response working together and benefiting from the available technology. Outcome measures tend to be more difficult to track than output measures.

In summary, the 15 performance measures are as follows:

Outcome Measures:

- Time required to respond to incidents with proper personnel and equipment
- Time required to notify the traveling public of incidents
- Time to post incident and road condition/closure information
- Number of crashes/incidents
- Travel time variability on instrumented roadway segments
- Transit on-time performance
- Hours of congestion (i.e., air pollution and cost of delay).

Output Measures:

- Number of centerline miles equipped with ITS components suitable for network surveillance
- Availability of traffic and roadway condition surveillance along main line freeway
- Reporting of all scheduled construction and maintenance activities to the affected agencies in advance of start date

- Reporting of all scheduled special events with manual traffic control or requiring road closures to the affected agencies in advance of start date
- Provide real-time transit information and arrival times
- Improve traveling public route choice decision making
- Number of ITS projects and deployments supporting involving multiple agencies
- Security of transit vehicles and transportation facilities

Criteria for ITS System Performance Measures

Table 1-2 also provides criteria that the performance measures should meet. The performance measures will result in a number of qualitative descriptions of how the agency or service rates on a given performance measure, but without adopted criteria, it is impossible to know if the agency is doing well on a particular measure.

In certain cases, the desired performance measures are not presently measurable by the region with the data that they collect. Therefore, the criteria for these measures are suggested as a timeframe within which the region should have a system in place for being able to analyze that information.

ITS Project Performance Measures

The performance measures discussed heretofore in this section relate to the ITS system as a whole. To measure the impact of individual ITS projects, the IDAS tool will be used in Task 6. Detailed evaluation criteria to be used in the application of IDAS include:

- Benefits, including, Travel time savings/reliability, Emission reduction, V/C ratio and System preservation.
- Life-cycle costs, including Capital costs and Operating and maintenance (O&M) costs.
- Overall benefit/cost ratio

IDAS provides both specific measures (e.g., total travel time, number of fatal accidents) as well as monetized values of these parameters.

Table 1-2 - Performance Measures for ITS Implementation

Output/ Outcome	Performance Measure	Related Objectives	Parameters	Criteria	Source of Measure / Source of Data
Incident Management					
Outcome	1. Time required to respond to incidents with proper personnel and equipment	1.1	Law enforcement, emergency personnel, and response equipment (HAZMAT, properly equipped towing, etc.)	Begin recording and reporting this data to the Incident Management Committee before the interim update to the SDP.	Stakeholder identified gap / NCDOT Highway Incident Mgmt Inter-Agency Team
Outcome	2. Time required to notify the traveling public of incidents	1.2, 2.1	Traveler Information Notification Times (DMS, 511, media, etc.)	Begin recording and reporting this data before the interim update to the SDP.	NCDOT 2006 IM & ITS Conference / NCDOT Highway Incident Mgmt Inter-Agency Team
Outcome	3. Time to post incident and road condition/closure information	1.2,2.1	Incident information	Post data to a single source, such as the STOC or SmartLink in less than 10 minutes of incident notification.	Triangle ITS SDP / NCDOT
			Road condition/closures	Post data to a single source in less than 30 minutes* of notification.	Triangle ITS SDP NCDOT
Outcome	4. Number of crashes/incidents	3.1	Where ITS is applied (includes freeways/arterials, RR crossings, bike/ped, transit, and work zone incidents where this data is already being collected)	Decrease primary and secondary crash rates	Triangle ITS SDP / NCDOT

Output/ Outcome	Performance Measure	Related Objectives	Parameters	Criteria	Source of Measure / Source of Data
Output	5. Number of centerline miles equipped with ITS components suitable for network surveillance	3.3	Freeways with DMS, CCTV, etc.	Increase in number of centerline miles from previous SDP full or interim update.	Florida DOT ITS / NCDOT
Congestion and Planned Closures					
Output	6. Availability of traffic and roadway condition surveillance along main line freeway	2.1,3.3	-	Surveillance along mainline freeway to provide near-continuous coverage of the roadway.	Florida DOT ITS & National ITS Architecture / NCDOT
Output	7. Reporting of all scheduled construction and maintenance activities to the affected agencies in advance of start date	2.2	- Interstates: No less than 30-days in advance - Primary Arterials and access controlled roadways: two weeks - Secondary arterials and local roads: one week	-	Triangle ITS SDP / NCDOT Highway Incident Mgmt Inter-Agency Team
Output	8. Reporting of all scheduled special events with manual traffic control or requiring road closures to the affected agencies in advance of start date	2.2	No less than 30-days* in advance	-	Triangle ITS SDP / NCDOT Highway Incident Mgmt Inter-Agency Team

Output/ Outcome	Performance Measure	Related Objectives	Parameters	Criteria	Source of Measure / Source of Data
Outcome	9. Travel time variability on instrumented roadway segments	1.1	Tracked on all roadway segments where travel time data is available	Average travel time during peak periods (minutes) Percent of miles in region operating at agency-targeted LOS for each roadway type	Tennessee DOT & National ITS Architecture / NCDOT, Inrix
Transit					
Outcome	10. Transit on-time performance	1.1, 1.3	-	85% on-time performance for public transportation 50%* of transactions are electronic for transit payment	Triangle ITS SDP / FAST Florida DOT ITS & National ITS Architecture / FAST
Output	11. Provide real-time transit information and arrival times	1.2, 1.3	Available to public, at EOC, TMC, and FAST dispatch centers	On 90% of the transit network by interim SDP update	Triangle ITS SDP / FAST
Information Sharing					
Output	12. Improve traveling public route choice decision making	2.1,3.3	Incident and travel time information	DMS signs in advance of key decision points (e.g., I-95 / I-295, and I-95 / US 301) in both directions	Florida DOT ITS / NCDOT

Output/ Outcome	Performance Measure	Related Objectives	Parameters	Criteria	Source of Measure / Source of Data
ITS Planning					
Output	13. Number of ITS projects and deployments supporting existing transportation infrastructure and/or involving multiple agencies	2.3, 4.3	-	Increase in number of ITS projects involving multiple agencies and number of ITS projects supporting improvements to effectiveness of existing infrastructure by interim SDP update	Stakeholder identified gap / FAMPO
Emergency Management and Security					
Output	14. Security of transit vehicles and transportation facilities	3.2	Transit vehicles with on-board cameras	100%* of fleet before the interim update to the SDP.	National ITS Architecture / FAST
			Transit facilities with CCTV cameras whose feed is accessible by FAST Dispatch and PSAP	100%* of locations before the interim update to the SDP.	National ITS Architecture / FAST
			Number intermodal facilities (rail, truck, transfer locations, etc.) with CCTV cameras whose feed is accessible by PSAP	Increase in surveillance at identified locations from previous year until 100%* coverage is achieved	National ITS Architecture / NCDOT Highway Incident Mgmt Inter-Agency Team

Output/ Outcome	Performance Measure	Related Objectives	Parameters	Criteria	Source of Measure / Source of Data
Sustainability					
Outcome	15. Hours of congestion (i.e., air pollution and cost of delay).	4.2, 4.4	-	Reduction in vehicle hours of delay on instrumented roadway segments (perhaps measured with Inrix) by interim SDP update	National ITS Architecture / NCDOT, Inrix
Outcome	16. Cost-Benefit rating of implemented projects	4.1	Cost-benefit rating from IDAS	Increase in cost – benefit rating where costs are the total program costs and benefits are the total benefits of projects implemented within the region.	IDAS Tool and spreadsheets

* Concept from stated Source document; criteria developed by project team.

APPENDIX – Documented Vision/Mission statements and Goals and Objectives

VISION/MISSION STATEMENTS:

2030 Growth Vision Plan

The 2030 Growth Vision Plan Policies and Actions finalized in September 2008 was a cooperative effort between all of the jurisdictions in Cumberland County, public agencies and the community to devise a vision for the entire area. The plan addressed seventeen vision statements (only those relevant to transportation/ITS are listed):

- 2. *Well Managed Growth*
- 3. *Infrastructure That Keeps Pace*
- 4. *A Balanced Transportation System*
- 11. *A Healthy, Sustainable Environment*
- 16. *Intergovernmental Cooperation & Efficiency*

The Vision Statement for Vision No. 4 A Balanced Transportation System reads:

“Local governments in Cumberland County have worked proactively with the State DOT toward a balanced, multi-modal transportation system. Advanced planning and follow-through has resulted in an efficient system of streets and highways, and a well-connected network of sidewalks, trails and bike paths. It has become common practice for new road improvements to include bike lanes and well-designed cross walks. New public and private developments routinely include sidewalks and bikeway connections. Mixed use and urban level developments have been employed to encourage walkability. A rural transit service has joined the area public transportation system in serving the needs of senior citizens and others who cannot or choose not to drive a car. Nearly all roads have been paved; existing roads are well maintained. The outer loop and other important connectors have been completed.”

TRIANGLE ITS SDP

The proactive use of technology and system operation and management to support a multi-modal system that provides safe, efficient, reliable, and convenient transportation for people and goods while increasing mobility, enhancing economic development, and improving our region’s quality of life in an environmentally sustainable manner.

Fort Bragg Comprehensive Transportation Systems Plan, Thoroughfare Plan

The Garrison Mission: ‘Provide the people, infrastructure, and services to train, sustain, mobilize, and rapidly deploy America’s forces while enhancing the environment, security, and well-being of the greater Fort Bragg community.’

Fort Bragg Comprehensive Transportation Systems Plan, Alternative Transportation Study

Initial consultations with key Post and regional players established the following planning principles for guiding the scope and vision of this plan:

- Provide implementable short-term and long-term alternative transportation concepts for the Post.
- Consider and facilitate regional integration of planning concepts.

- Use the development and funding opportunities of short-term BRAC growth to align transportation infrastructure to achieve long-range Army and Garrison sustainability goals and objectives.
- Improve the quality of service and accessibility of all Fort Bragg transportation facilities.
- Serve a wide array of potential user groups (specifically soldiers without vehicles and wounded warriors).

Raeford Road Corridor Study Vision

To balance safety, mobility, and appearance without compromising economic vitality.

The Vision for the 2035 Mobility Plan is to:

“Achieve a true multi-modal transportation system that provides a safe, efficient and diverse way of travel to all citizens of FAMPO and Cumberland County, while preserving the natural and social environment and the network infrastructure; through the use of innovative strategies, context sensitive solutions and complete streets concepts.”

The NC SHSP’s mission statement, as developed by the ECHS is:

Establish highway safety goals and objectives and prioritize, implement and evaluate coordinated, multi-disciplinary policies and programs to reduce fatalities, injuries and economic losses related to crashes.

RITA & Partners:

To research and facilitate a national, multi-modal surface transportation system that features a connected transportation environment around vehicles of all types, the infrastructure, and portable devices to serve the public good by leveraging technology to maximize safety, mobility, and environmental performance.

USDOT ITS

- A system in which highway crashes and their tragic consequences are rare because vehicles of all types can sense and communicate the events and hazards happening around them.
- A fully-connected, information-rich environment within which travelers, transit riders, freight managers, system operators, and other users are aware of all aspects of the system's performance.
- Travelers who have comprehensive and accurate information on travel options—transit travel times, schedules, cost, and real-time locations; driving travel times, routes, and travel costs; parking costs, availability, and ability to reserve a space; and the environmental footprint of each trip.
- System operators who have full knowledge of the status of every transportation asset.
- Vehicles of all types that can communicate with traffic signals to eliminate unnecessary stops and help people drive in a more fuel efficient manner.
- Vehicles that can communicate the status of on-board systems and provide information that can be used by travelers and system operators to mitigate the vehicle's impact on the environment or make more informed choices about travel modes.

FAST TDP

The mission statement for FAST is “To provide safe, effective, reliable, courteous, and innovative public transportation to the citizens of Fayetteville.”

WEIGH STATION FEASIBILITY STUDY

“A comprehensive strategy to determine the disposition of existing weigh stations and recommend locations for future station deployment. The strategy shall support the expansion of CVISN and other DMV commercial vehicle enforcement and safety programs.”

Table 1-3 - Goals and Objectives Acquired Through the Document Review Process

Theme/Goal (standardized)	Plan	Goals	Objectives
Economic Sustainability	Consolidated Transit Development Plan - September 2010	To explore opportunities for creation of local dedicated funding sources for public transportation	Not included in document.
Economic Sustainability	FAST TDP - March 2009	Provide access to employment opportunities for City residents.	Not included in document.
Economic Sustainability	FAMPO Highway Plan - April 2009	• To provide for the orderly development of an adequate major street system as land development occurs; • To reduce travel and transportation costs; • To reduce the cost of major street improvements to the public through the coordination of the street system with private action;	Not included in document.
Economic Sustainability	City of Fayetteville March 2011	Greater Tax Base Diversity – Strong Local Economy	Not included in document.
Economic Sustainability	Fayetteville Regional ITS Deployment Plan - Regional Goals and Objectives - 2000	Increase economic development opportunities	Not included in document.
Economic Sustainability	Fayetteville Regional ITS Deployment Plan - Department Goals and Objectives -2000	Demonstrate responsible stewardship of fiscal resources.	Compare ITS solutions to new capacity solutions in order to obtain the most cost effective use of available funding.
Economic Sustainability	NCDOT Long-Range Multimodal Transportation Plan - September 2004	Protect the public investment in North Carolina's transportation system.	Not included in document.
	NCDOT Long-Range Multimodal Transportation Plan - September 2004	Provide transportation investments to support economic development for existing and new economic activity.	Not included in document.

Theme/Goal (standardized)	Plan	Goals	Objectives
	NCDOT Long-Range Multimodal Transportation Plan - September 2004	Provide strong fiscal stewardship that maximizes the cost-efficiency of transportation system investment and ensures adequate resources for transportation through traditional and non-traditional sources.	Not included in document.
Environmental Sustainability	FAMPO Highway Plan - April 2009	To reduce environmental impacts, such as air pollution, resulting from transportation.	Not included in document.
Environmental Sustainability	Congestion Management Plan - April 2009	Protect the environment while reducing congestion	A. Minimize environmental impacts of congestion relieving strategies B. Reduce air pollution through reduced congestion C. Reduce fossil fuel use related to transportation
Environmental Sustainability	NCDOT Long-Range Multimodal Transportation Plan - September 2004	Maximize compatibility of the transportation system with environmental considerations, as well as with the historic and cultural resources of the state	Not included in document.
Equity	FAST TDP - March 2009	Help ensure that the City's senior citizens can continue to participate fully in the community without driving a car.	Not included in document.
	FAST TDP - March 2009	Provide transportation options for city residents with disabilities.	Not included in document.
Livability	City of Fayetteville March 2011	Growing City, Livable Neighborhoods – A Great Place to Live	Not included in document.
	City of Fayetteville March 2011	More Attractive City – Clean and Beautiful	Not included in document.
	City of Fayetteville March 2011	Greater Community Unity – Pride in Fayetteville	Not included in document.
	City of Fayetteville March 2011	Revitalized Downtown – A Community Focal Point	Not included in document.

Theme/Goal (standardized)	Plan	Goals	Objectives
Accessibility	FAST TDP - March 2009	Offer convenient transit access to City medical facilities, employment areas, shopping centers, schools, and community agencies.	Not included in document.
Accessibility	Congestion Management Plan - April 2009	Effectively and efficiently manage accessibility	A. Use access management strategies on congested corridors B. Coordinate with planning departments to address accessibility for new developments
Efficiency	TRIANGLE ITS Strategic Deployment Plan	Advance safe and efficient movement of people and goods throughout the region.	1.1 Clear 90% of incidents in 60 minutes or less on the principle arterial network 1.2 Reduce the number of crashes per 100 million vehicle miles by 10% over a three-year floating average on the principle arterial network 1.3 Decrease secondary incidents by 10% on the principle arterial network
Efficiency	NCDOT Annual Performance Report - 2011	Make our transportation network move people and goods more efficiently.	Not included in document.
Efficiency	Fayetteville Regional ITS Deployment Plan - Regional Goals and Objectives - 2000	Ensure transportation system efficiency	Not included in document.
Efficiency	Fayetteville Regional ITS Deployment Plan - Department Goals and Objectives - 2000	Develop efficient processes to provide quality transportation services.	Investigate ITS technologies and applications in appropriate projects to provide innovative and flexible solutions and incorporate those technologies where cost-benefit ratios are greater than other solutions.
Efficiency	NCDOT Long-Range Multimodal Transportation Plan - September 2004	Increase the efficiency of the overall transportation system by facilitating the interconnection of transportation modes.	Not included in document.

Theme/Goal (standardized)	Plan	Goals	Objectives
Efficiency	Fort Bragg Comprehensive Transportation Systems Plan - Thoroughfare Plan	Improved distribution of traffic within the cantonment area.	• Develop a near- and long-term plan for major roadway and street and traffic control systems that: ○ Defines thoroughfare circulation, ○ Secures future right-of-ways for traffic improvements, ○ Proposes engineering and corrective actions, and creates a long-term plan for an Old Post Historic District pedestrian corridor with a near-term plan for traffic reduction and efficiency. • Develop a street network that addresses the near and long-term needs related to the Fort Bragg cantonment area including street designs that are: ○ Safe and efficient means of improving traffic flow and movement, ○ Effective in accommodating safe pedestrian and troop movements, and ○ Planned to mitigate potential environmental impacts. • Reduce travel demand via: ○ Land use practices that foster a reduction in trip lengths, ○ Design that encourages walking or bicycling, and ○ Measures to encourage shuttle/transit usage. • Enhance traffic system efficiency via system coordination and layout based upon origin and destination, cordon points, and flow patterns.
Efficiency	Weigh Station Feasibility Study	Provide high quality customer service to the motor carrier industry.	• Minimize congestion costs for motor carriers. • Minimize processing time at weigh stations. • Minimize the number of trucks stopped.

Theme/Goal (standardized)	Plan	Goals	Objectives
Reliability	TRIANGLE ITS Strategic Deployment Plan	Improve reliability of transportation systems throughout the region.	2.1 Report all construction and maintenance activities to the TMC in advance of start date on the principle arterial network 2.2 Report all planned special events with manual traffic control, attendance greater than 10,000, or requiring road closures to the TMC in advance of start date on the principle arterial network 2.3 Provide assistance to 90% of disabled vehicles on roadways designated on the network within 15 minutes (the principle arterial network) 2.4 Provide 85% on-time performance for public transportation on closed networks 2.5 Increase travel time reliability by 2% per year to improve network performance for all users on the principle arterial network
Reliability	NCDOT Annual Performance Report - 2011	Make our infrastructure last longer.	Not included in document.
Reliability	Fayetteville Regional ITS Deployment Plan - Regional Goals and Objectives - 2000	Preserve infrastructure and services	Not included in document.
Reliability	Weigh Station Feasibility Study	Protect highway infrastructure	• Achieve satisfactory size and weight compliance. • Support CVISN expansion.
Manage Effectively and Efficiently	FAST TDP - March 2009	Manage, maintain, and enhance the existing public transit system.	Not included in document.
Manage Effectively and Efficiently	Consolidated Transit Development Plan - September 2010	To develop specialized skills necessary to operate public transportation, such as bus operator training, drug and alcohol testing compliance, DBE, procurement, safety, etc.	Not included in document.
	Consolidated Transit Development Plan - September 2010	To provide the most efficient, effective, and safe countywide transportation services	Not included in document.

Theme/Goal (standardized)	Plan	Goals	Objectives
Manage Effectively and Efficiently	City of Fayetteville March 2011	More Efficient City Government – Cost-Effective Service Delivery	Not included in document.
Manage Effectively and Efficiently	FAMPO Rail Plan - April 2009	To provide fuel efficient, environmentally sound rail passenger and freight service to the citizens of Cumberland County.	• Equitable distribution of costs for improvements and maintenance of crossing construction. • Consolidation of existing rail facilities and corridors. • Centralize terminal facilities; preserve all existing right-of-way; identify and protect proposed right-of-way.
Manage Effectively and Efficiently	Congestion Management Plan - April 2009	Effectively use management and operations to reduce congestion	A. Preserve existing system infrastructure B. Advocate for land use patterns that reduce congestion inducing development
Manage Effectively and Efficiently	Fayetteville Regional ITS Deployment Plan - Department Goals and Objectives - 2000	Maintain a quality workforce.	Use the technological skills of communications and electronics engineers to upgrade the level of technical expertise in the Department and upgrade other disciplines with cross-training in ITS technology applications.
	Fayetteville Regional ITS Deployment Plan - Department Goals and Objectives - 2000	Make decisions in a manner that builds trust and mutual respect.	Develop strong, effective partnerships within the various units of the Department.
Manage Effectively and Efficiently	Weigh Station Feasibility Study	Develop Strategic Plan	• Accommodate traffic growth. • Address staffing and equipment resources for operations (enforcement) and maintenance. • Prioritize projects and their deployment. • Identify capital and operating costs.
Manage Effectively and Efficiently	FAMPO Highway Plan - April 2009	• To enable private interest to plan their actions, improvements, and development with full knowledge of public intent; • To minimize disruption and displacement of people and businesses through long range advance planning for major street improvements;	Not included in document.

Theme/Goal (standardized)	Plan	Goals	Objectives
Regional Coordination	FAMPO Rail Plan - April 2009	To enhance and expand the system by providing a clean, efficient, affordable, convenient and safe service.	• Coordination of public transportation facilities with other modes of transportation. ○ Strategies: Use of light rail in conjunction with the public transit system. • Cooperative planning to eliminate the rail/motor vehicle conflicts. ○ Strategies: Coordinate roadway construction with future rail plans; stress the location of public facilities convenient to rail facilities. • Development of public education programs.
Regional Coordination	Consolidated Transit Development Plan - September 2010	To create more effective mechanisms to address countywide problems, such as traffic congestion and air quality	Not included in document.
	Consolidated Transit Development Plan - September 2010	To coordinate activities of city and county governments to take advantage of economies of scale in capital acquisition, transit operating costs, and administrative functions	Not included in document.
Regional Coordination	FAST TDP - March 2009	Strengthen coordination and explore partnerships between the City, the County, Fort Bragg, major employers, educational facilities, and other private entities to ensure effective service delivery in the community.	Not included in document.
Regional Coordination	Congestion Management Plan - April 2009	Collaborate with military development	A. Improve traffic conditions around the base B. Enhance security of the base
Regional Coordination	Fayetteville Regional ITS Deployment Plan - Regional Goals and Objectives - 2000	Incorporating all stakeholders' input in the planning process	Not included in document.
Regional Coordination	Fayetteville Regional ITS Deployment Plan - Department Goals and Objectives - 2000	Demonstrate responsible stewardship of other resources.	Incorporate the entire ITS stakeholder base into local community efforts to support sustainable community initiatives.

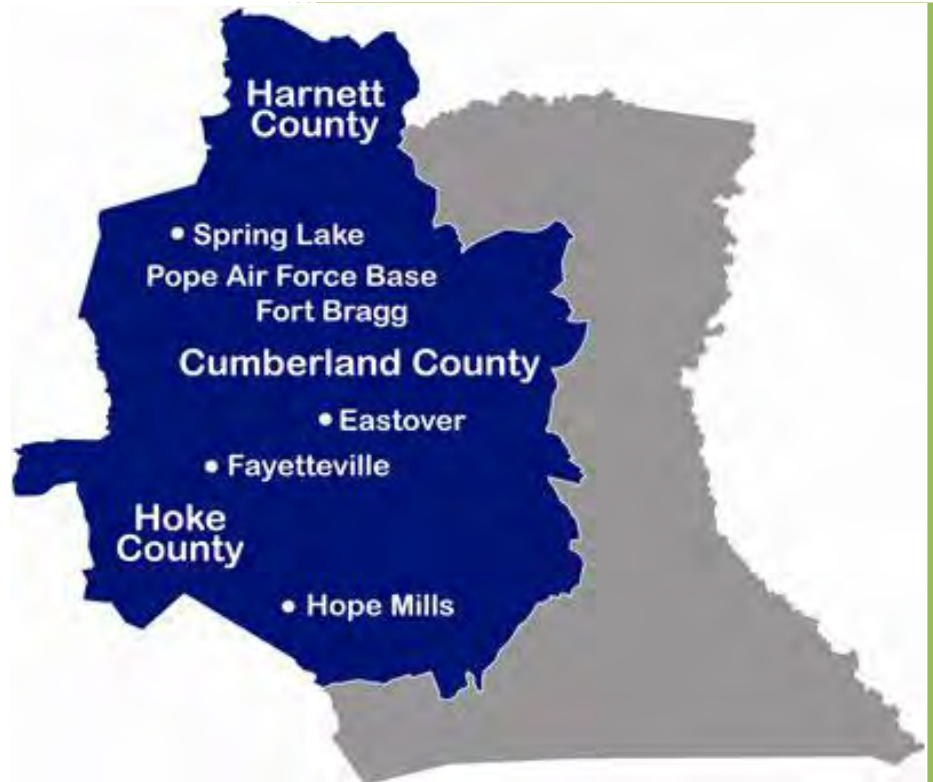
Theme/Goal (standardized)	Plan	Goals	Objectives
	Fayetteville Regional ITS Deployment Plan - Department Goals and Objectives - 2000	Support the development of sustainable, vibrant communities.	Incorporate the entire ITS stakeholder base into local community efforts to support sustainable community initiatives.
Regional Coordination	NCDOT Long-Range Multimodal Transportation Plan - September 2004	Encourage the development of growth management mechanisms intended to coordinate infrastructure investment with development.	Not included in document.
	NCDOT Long-Range Multimodal Transportation Plan - September 2004	Provide increased responsibility and continuing cooperation, coordination, and participation with NCDOT's customers the public, stakeholders, private sector, and local, regional, state, and federal governments.	Not included in document.
Safety	Congestion Management Plan - April 2009	Maintain and improve the safety of the transportation system	A. Reduce vehicle accidents B. Reduce vehicle pedestrian related accidents C. Provide safer alternative means of transportation
Safety	NCDOT Annual Performance Report - 2011	Make our transportation network safer.	Not included in document.
Safety	Fayetteville Regional ITS Deployment Plan - Regional Goals and Objectives - 2000	Increase motorist safety and security	Not included in document.
Safety	Fayetteville Regional ITS Deployment Plan - Department Goals and Objectives - 2000	Provide a safe and well-maintained transportation system that offers modal choices for the movement of all people and goods.	Use ITS technologies to provide information among modes of routes, schedules, incidents, fares, real-time vehicle tracking, and other traveler and shipper information.
Safety	NCDOT Long-Range Multimodal Transportation Plan - September 2004	Promote safety on individual facilities and on a system-wide basis in a cost-effective manner.	Not included in document.

Theme/Goal (standardized)	Plan	Goals	Objectives
Safety	Weigh Station Feasibility Study	Provide a safe highway environment.	• Increase weighing capacity commensurate with increases in commercial vehicle VMT (vehicle miles traveled). • Improve station coverage. • Monitor weigh station bypass routes for compliance and enforcement. • Achieve better than average commercial vehicle accident rates near weigh stations. • Increase higher-level inspection opportunities and sites.
Safety	FAMPO Highway Plan - April 2009	To increase travel safety.	Not included in document.
Transportation Alternatives	Consolidated Transit Development Plan - September 2010	To provide enhanced customer benefits, such as better and increased services that cross county lines	Not included in document.
Transportation Alternatives	FAST TDP - March 2009	Develop, maintain, and encourage the use of viable alternatives to the single occupant vehicle.	Not included in document.
Transportation Alternatives	NCDOT Long-Range Multimodal Transportation Plan - September 2004	Provide a variety of transportation options for personal travel and goods movement.	Not included in document.
Mobility	TRIANGLE ITS Strategic Deployment Plan	Enhance mobility choices through accurate, timely, and convenient information.	3.1 Increase person throughput on the principle arterial network and transit networks by 10% during peak periods 3.2 Integrate travel information from all public agencies into a single source 3.3 Post incident information to a single source in less than 10 minutes of incident notification on the principle arterial network 3.4 Make available real-time transit arrival times on 90% of the transit network 3.5 Provide traveler information through no less than three clicks or voice commands 3.6 Nationally accepted data quality standards as outlined in the "Data Processing Procedures and Quality Control" document

Theme/Goal (standardized)	Plan	Goals	Objectives
Mobility	Congestion Management Plan - April 2009	Improve the mobility of people and freight	A. Improve travel times in congested corridors B. Improve reliability C. Increase use of alternative transportation D. Increase coordination and convenience of transit
Mobility	Fort Bragg Comprehensive Transportation Systems Plan - Thoroughfare Plan	Overall improved capacity for internal traffic circulation.	Improve operational efficiency by incorporating engineering design features that increase traffic capacity via increased available lanes, intersection improvements, turning movement reduction, and signalization and signage improvements
Mobility	NCDOT Long-Range Multimodal Transportation Plan - September 2004	Provide the infrastructure necessary to optimize mobility and reliability in the transportation of passengers and freight.	Not included in document.
Information Dissemination	Fayetteville Regional ITS Deployment Plan - Statewide Goals and Objectives - 2000	Provide both static and dynamic transportation information, including road condition, closures, and incident status updates.	Not included in document.
Information Dissemination	Weigh Station Feasibility Study	Leverage technology to increase industry productivity and agency efficiency.	o Facilitate data sharing with NCDOT and DMV Enforcement. o Integrate weigh station operations with Regional Traffic Management Centers (TMC's) for travel information and data sharing.
Customer Service	Fayetteville Regional ITS Deployment Plan - Department Goals and Objectives - 2000	Provide quality customer service.	Use advanced technologies available in ITS solutions to provide "user friendly" interface between users and transportation systems and services.

FAMPO Regional ITS Strategic Deployment Plan Update

Gap Assessment Final Report



Prepared for:
Fayetteville Area Metropolitan Planning Organization
(FAMPO)

Prepared by:
Consensus Systems Technologies

ConSysTec 

In Association with:

CAMBRIDGE
SYSTEMATICS



FOURSQUARE INTEGRATED
TRANSPORTATION PLANNING

May 2013

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Revision History

Filename	Version	Date	Authors	Comment
GapAssessment-Draft5-22-12.doc	Draft	05/22/12	JBaker, PChan, BEisenhart	Draft
Final FAMPO Gap Assessment	Final	10/22/12	JBaker, BEisenhart	Final Document
FAMPO Gap Assessment Final 2013-04-05	Final	4/5/2013	JBaker, BEisenhart	Updated for Final Workbook
FAMPO Gap Assessment Final 2013-05-24	Final	5/24/2013	JBaker	Updated for Final Workbook and DVD

1. INTRODUCTION

1.1. Background

On January 19, 2012, Consensus Systems Technologies (ConSysTec) was contracted by the County of Cumberland in the State of North Carolina, on behalf of the Fayetteville Area Metropolitan Planning Organization (FAMPO), to provide a Fayetteville (FAMPO) Regional Intelligent Transportation Systems (ITS) Strategic Deployment Plan Update in support of FAMPO's Long Range Transportation Planning process.

Under this agreement, ConSysTec and its subcontractors, Cambridge Systematics, and Foursquare ITP will perform 8 Tasks that collectively will update the FAMPO Strategic Deployment Plan. The following summarizes the tasks and deliverables for the FAMPO Regional ITS Strategic Deployment Plan Update.

- **Task 1:** A *Best Practices Report* that identifies solutions that may address regional deficiencies
- **Task 2:** A *Vision, Goals, and Objectives Report* that updates the FAMPO ITS Program's vision, goals and objectives
- **Task 3:** This *Gap Assessment Report*, which determines and identifies solutions that address regional goals and objectives and results in service-package based projects that can be reflected in the Regional ITS Architecture
- **Task 4:** The *Regional ITS Architecture*, developed with stakeholder input and including project architectures
- **Task 5:** *Cost Estimates of ITS Projects* delivered as a spreadsheet
- **Task 6:** A *Project Evaluation and Prioritization Report* based on an IDAS model
- **Task 7:** A *Report on Strategies for Integration of ITS into the FAMPO Transportation Planning Process*
- **Task 8:** A *Final Strategic Deployment Plan* that incorporates the previous 7 documents into one comprehensive plan

1.2. Purpose

This document is the Gap Assessment Report, the output of Task 3. The purpose of the gap assessment report is to determine and identify solutions that address regional goals and objectives and result in service package-based projects consistent with the ITS National Architecture.

1.3. Document Overview

This document is organized into 6 sections.

- **Section 1: Introduction.** This section provides introductory and background information about this document, its purpose and why it is needed.
- **Section 2: Process.** This section describes the process used to perform the gap assessment.
- **Section 3: Current and Planned Deployments.** This section summarizes existing and planned deployments in the FAMPO region.
- **Section 4: Gap Assessment of Objectives.** This section presents the gap assessment based on an analysis of the vision, goals and objectives that were identified for the region in Task 2.

- **Section 5: Gap Assessment Table.** This section identifies the gaps related to technology and deployments.
- **Section 6: Assessment of Gaps Identified by Stakeholders**
- **Section 7: Next Steps**
- **Appendix A: Acronyms.** This section provides a list of acronyms and their descriptions.
- **Appendix B: Service Packages from the National ITS Architecture**
- **Appendix C: Regional Deployment Maps.** This section contains GIS images of planned and existing ITS deployments in the FAMPO region.
- **Appendix D: Projects.** This section contains a list of currently identified regional projects.

2. PROCESS

The first step of the gap assessment task was to inventory the existing ITS network. The project team interviewed stakeholders, reviewed documents detailing existing ITS deployments, such as closed circuit television cameras (CCTV), traffic signals, and dynamic message signs (DMS), and updated the inventory with recent changes to the system. In addition, the project team received detailed inventory information from NCDOT that is graphically displayed in Section 3.

The next step was to identify the service packages from the current version of the National ITS Architecture (NITSA) (v7.0) that could address each of the 13 objectives that were identified in the *Task 2: Vision, Goals, Objectives and Performance Report*. Service packages represent slices of the National ITS Architecture that provide specific ITS services. They are composed of stakeholder elements and information flows used to deliver an ITS service or ITS applications (such as network surveillance or transit fare collection management). A service package can represent several projects or a single project. A service package also can address multiple objectives. These service packages, or solutions, are technology independent and allow stakeholders to select high level solutions to address the identified objectives.

Of the 97 service packages in the National ITS Architecture, 39 were identified as addressing regional objectives. These service packages drive the development of projects that also align with the regional objectives so the regional ITS deployments remain needs-driven and do not become projects that simply deploy technology for technology's sake. Each service package identified as addressing a regional objective was given a status of "Existing", "Planned" or "Future", depending on the level of current or planned deployment.

Finally, specific gaps were identified by comparing existing and planned deployments to regional goals and objectives. Two types of gaps were considered. *Technological gaps* are present when the infrastructure base is lacking or the desired technology is not currently being used in the FAMPO Region. For example, the technological gap for electronic toll collection is identified as significant since there are no existing sub-systems to support toll collections. *Geographic gaps* are present when the ITS equipment covers less physical area than is shown in the regional target. For example, network surveillance has a geographic gap due to Route 74 having no current deployment of CCTV or traffic sensors. Overall, the ratings for existing deployments and regional goals are qualitative assessments in nature, based on the understanding of the regional system and targets.

3. EXISTING AND PLANNED DEPLOYMENTS

This section summarizes existing and planned deployments in the FAMPO region. The deployments are organized by stakeholder, and then by device/system. Maps of existing and planned deployments are included in Appendix C.

3.1. *City of Fayetteville*

The City of Fayetteville operates 42 CCTV cameras within the city limits. The majority of these cameras are along the Route 401 corridor and the All American Expressway leading into Fort Bragg. CCTV cameras are monitored at the City of Fayetteville Traffic Operations Center (TOC). The City of Fayetteville does not own or operate any DMS.

Traffic signals in the City of Fayetteville are operated by the City of Fayetteville TOC. The city owns 12% of the traffic signals in the city, while the North Carolina Department of Transportation (NCDOT) owns the remaining 88%. All traffic signals in Fayetteville interface with the TOC.

The City of Fayetteville Central Dispatch is responsible for emergency response within Fayetteville. City of Fayetteville Central Dispatch is capable of dispatching emergency response vehicles using mobile data terminals, and additionally has a hard-wired connection with the Cumberland County Communications Center, which is responsible for emergency response throughout the rest of Cumberland County.

City of Fayetteville Fire/EMS Vehicles and City of Fayetteville Police vehicles also are equipped with Automatic Vehicle Location (AVL) systems. Fire/EMS and Police vehicle locations are tracked by the City of Fayetteville Central Dispatch

3.2. *North Carolina Department of Transportation (NCDOT)*

NCDOT owns the majority of traffic devices in the FAMPO region. NCDOT owns 64 CCTV cameras along the I-95 corridor. The CCTV cameras are operated from the NCDOT Division 6 TMC.

NCDOT owns 88% of the traffic signals in the City of Fayetteville. All traffic signals within Fayetteville are operated by the City of Fayetteville TOC.

NCDOT owns 28 DMS in the Fayetteville area. The majority of these are located along the I-95 and I-295 corridors, with a small number deployed along US 401, NC 24 and the outer loop. These DMSs within the FAMPO region are operated by the NCDOT Division 6 TMC.

The NCDOT has a number of planned deployments in the FAMPO Transportation Improvement Plan (TIP). In addition to life cycle replacements of DMS and CCTV, additional deployments of DMS and CCTV are planned along I-95, I-295, NC 24, NC 87, and US 401.

3.3. *Fayetteville Areas System of Transportation (FAST)*

FAST transit vehicles are equipped with an AVL system that reports transit vehicle locations to the FAST Operations Center. FAST paratransit vehicles and FAST service vehicles are also equipped with AVL.

FAST fixed route transit vehicles are equipped with an in-vehicle transit fare payment system based on a local transit pass. In addition, FAST fixed route transit vehicles are equipped with automatic stop annunciation based on the FAST AVL system.

FAST transit facilities are equipped with security cameras. The security camera feeds are monitored by the FAST Operations Center.

The FAST Multimodal Transfer Center has a planned bus arrival prediction system. The Center will be equipped with large screen televisions that will broadcast bus arrival predictions.

3.4. Fort Bragg.

Fort Bragg owns and operates traffic signals on the base. The traffic signals are an older system and should be updated in the near future. Fort Bragg has no TOC, but signals are operated from the Fort Bragg Integrated Incident Management Center (IIMC).

Fort Bragg operates a number of CCTV cameras that are used to monitor road conditions on and around Fort Bragg. The camera feeds are monitored and controlled by the Fort Bragg IIMC. In addition, Fort Bragg operates a highway advisory radio (HAR) system.

Fort Bragg Emergency Response Vehicles are equipped with an AVL system. The AVL system is monitored by the Fort Bragg IIMC.

Fort Bragg plans to deploy DMSs near Access Control Points (ACP).

4. GAP ASSESSMENT BASED ON OBJECTIVES

This section presents the gap assessment based on an analysis of the vision, goals and objectives that were identified for the region in Task 2. The gap assessment was performed by comparing the goals and objectives stated, with the service packages currently supported by the U. S. National ITS Architecture (NITSA) Version 7.0.

Table 1 presents the regional goals and objectives identified in Task 2, and maps relevant service packages from NITSA 7.0 to each objective. In addition, each service is identified as existing, planned or future. Existing means that there are existing implementations of this service package. Planned means that the implementation do not exist yet, but are planned. By planned, it means that projects and funding have been identified in the Transportation Improvement Plan, or a stakeholder's plan. Future means that this service package would address this objective, but no definitive projects have identified or funded. These services packages would be considered gaps.

Table 2 summarizes the service packages from NITSA 7.0 that are relevant to the FAMPO region.

Table 1. Regional Goals and Objectives versus Service Packages

Objective/Goal	Service Package	Service Package Name	Existing Planned Future
Goal 1: Advance efficient movement of people and goods, improve reliability of transportation systems, and enhance mobility choices.			
Objective 1.1: Effectively use management and operations strategies to reduce congestion and travel times and increase travel time reliability	ATMS03	Traffic Signal Control	Existing
	ATMS04	Traffic Metering	Future
	ATMS06	Traffic Information Dissemination	Existing
	ATMS07	Regional Traffic Management	Planned
	ATMS08	Traffic Incident Management System	Planned
	ATMS10	Electronic Toll Collection	Future
	ATMS13	Standard Railroad Grade Crossing	Planned
	ATMS16	Parking Facility Management	Future
	ATMS18	Reversible Lane Management	Future
	ATMS21	Roadway Closure Management	Future
	ATMS22	Variable Speed Limits	Future
Objective 1.2: Enhance mobility choices through accurate, timely, and convenient information on all modes.	APTS01	Transit Vehicle Tracking	Existing
	APTS02	Transit Fixed-Route Operations	Existing
	APTS03	Demand Response Transit Operations	Existing
	APTS08	Transit Traveler Information	Planned
	ATIS01	Broadcast Traveler Information	Existing
	ATIS02	Interactive Traveler Information	Existing

Objective/Goal	Service Package	Service Package Name	Existing Planned Future
	ATMS01	Network Surveillance	Planned
	ATMS06	Traffic Information Dissemination	Existing
	ATMS10	Electronic Toll Collection	Future
Objective 1.3: Increase the efficiency of the overall transportation system by facilitating the interconnection of transportation modes.	APTS07	Multi-modal Coordination	Future
	ATMS06	Traffic Information Dissemination	Planned
	ATMS07	Regional Traffic Management	Planned
Goal 2: Strengthen coordination and cooperation between municipalities, counties, Fort Bragg, the State, federal government, and public and private stakeholders to ensure effective service delivery in the region.			
Objective 2.1: Provide coordinated static and dynamic transportation information, including road condition, closures, incident status updates, and transit information, to enable informed decision-making and effective use of resources.	AD1	ITS Data Mart	Existing
	AD2	ITS Data Warehouse	Future
	APTS01	Transit Vehicle Tracking	Existing
	APTS02	Transit Fixed-Route Operations	Existing
	APTS03	Demand Response Transit Operations	Existing
	APTS05	Transit Security	Existing
	APTS08	Transit Traveler Information	Existing
	ATIS01	Broadcast Traveler Information	Existing
	ATIS02	Interactive Traveler Information	Existing
	ATMS01	Network Surveillance	Existing
	ATMS06	Traffic Information Dissemination	Existing
	ATMS07	Regional Traffic Management	Planned
	ATMS08	Traffic Incident Management System	Existing
	ATMS21	Roadway Closure Management	Future
	EM10	Disaster Traveler Information	Future
	MC03	Road Weather Data Collection	Future
	MC07	Roadway Maintenance and Construction	Existing
	MC08	Work Zone Management	Existing
	MC10	Maintenance and Construction Activity Coordination	Future
Objective 2.2: Increase inter-agency sharing of construction updates, maintenance activities, planned special events, traveler information, and incident information.	AD1	ITS Data Mart	Existing
	AD2	ITS Data Warehouse	Future
	APTS02	Transit Fixed-Route Operations	Planned
	APTS03	Demand Response Transit Operations	Planned
	APTS07	Multi-modal Coordination	Planned
	APTS08	Transit Traveler Information	Existing
	ATIS01	Broadcast Traveler Information	Existing
	ATIS02	Interactive Traveler Information	Existing
	ATMS06	Traffic Information Dissemination	Existing
	ATMS07	Regional Traffic Management	Future
	ATMS08	Traffic Incident Management System	Existing
	EM10	Disaster Traveler Information	Future
	MC03	Road Weather Data Collection	Future
	MC08	Work Zone Management	Existing
	MC10	Maintenance and Construction Activity Coordination	Future
Objective 2.3: Prioritize projects	AD1	ITS Data Mart	Existing

Objective/Goal	Service Package	Service Package Name	Existing Planned Future
and their deployment to accommodate planned growth in the region, new or changing traffic patterns, and mode shift.	AD2	ITS Data Warehouse	Future
Goal 3: Promote, maintain, and improve safety and security on individual facilities and on a system-wide basis.			
Objective 3.1: Reduce the number of crashes, including those involving pedestrians, and decrease secondary incidents.	ATMS01	Network Surveillance	Existing
	ATMS03	Traffic Signal Control	Existing
	ATMS07	Regional Traffic Management	Future
	ATMS08	Traffic Incident Management System	Existing
	ATMS13	Standard Railroad Grade Crossing	Future
	ATMS18	Reversible Lane Management	Existing
	ATMS21	Roadway Closure Management	Future
	ATMS22	Variable Speed Limit	Future
Objective 3.2: Improve the security of all transportation facilities across all modes.	APTS05	Transit Security	Existing
	EM05	Transportation Infrastructure Protection	Planned
Objective 3.3: Enhance the effectiveness of agencies responsible for disaster preparedness and emergency response.	AD1	ITS Data Mart	Existing
	ATMS07	Regional Traffic Management	Planned
	EM01	Emergency Call-Taking and Dispatch	Existing
	EM02	Emergency Routing	Existing
	EM05	Transportation Infrastructure Protection	Existing
	EM06	Wide-Area Alert	Existing
	EM07	Early Warning System	Existing
	EM08	Disaster Response and Recovery	Planned
	EM09	Evacuation and Reentry Management	Future
	EM10	Disaster Traveler Information	Future
	MC08	Work Zone Management	Future
	MC10	Maintenance and Construction Activity Coordination	Future
Goal 4: Provide strong fiscal stewardship that maximizes the cost-efficiency of transportation system investment while protecting the environment.			
Objective 4.1: Provide cost-effective innovative and flexible technological solutions to transportation problems.	APTS04	Transit Fare Collection Management	Existing
	ATMS03	Traffic Signal Control	Existing
	ATMS04	Traffic Metering	Future
	ATMS07	Regional Traffic Management	Planned
Objective 4.2: Reduce air pollution and fossil fuel use generated by transportation through reduced congestion and use of alternative modes.	APTS01	Transit Vehicle Tracking	Existing
	APTS02	Transit Fixed-Route Operations	Existing
	APTS03	Demand Response Transit Operations	Future
	APTS04	Transit Fare Collection Management	Existing
	APTS05	Transit Security	Existing
	APTS06	Transit Fleet Management	Future
	APTS07	Multi-modal Coordination	Planned
	APTS08	Transit Traveler Information	Existing
	APTS10	Transit Passenger Counting	Planned
	ATIS01	Broadcast Traveler Information	Existing
	ATIS02	Interactive Traveler Information	Existing
	ATMS03	Traffic Signal Control	Existing
	ATMS04	Traffic Metering	Future
	ATMS06	Traffic Information Dissemination	Existing
	ATMS10	Electronic Toll Collection	Future

Objective/Goal	Service Package	Service Package Name	Existing Planned Future
	ATMS13	Standard Railroad Grade Crossing	Existing
	ATMS16	Parking Facility Management	Future
	MC10	Maintenance and Construction Activity Coordination	Future
Objective 4.3: Deploy ITS solutions that enhance and leverage existing infrastructure to minimize environmental impacts.	APTS01	Transit Vehicle Tracking	Existing
	APTS08	Transit Traveler Information	Existing
	ATMS03	Traffic Signal Control	Existing
	ATMS06	Traffic Information Dissemination	Existing
	MC02	Maintenance and Construction Vehicle Coordination	Future
Objective 4.4: Provide transportation improvements and solutions that support economic development.	MC03	Road Weather Data Collection	Future
	APTS01	Transit Vehicle Tracking	Existing
	APTS02	Transit Fixed-Route Operations	Existing
	APTS03	Demand Response Transit Operations	Future
	APTS04	Transit Fare Collection Management	Existing
	APTS08	Transit Traveler Information	Existing
	ATMS03	Traffic Signal Control	Existing
	ATMS07	Regional Traffic Management	Planned

Appendix B contains descriptions of National ITS Architecture Service Packages utilized in the FAMPO ITS Architecture. Only those packages relevant to the FAMPO region are included in Appendix B.

5. GAP ASSESSMENT TABLE

This section lists the gaps that were identified by stakeholders during interviews and stakeholder meetings. Most of these gaps are related to technology and the geographic extent of technology deployments. Table 3 provides a summary of gaps identified for the FAMPO region. Each gap is listed, and mapped to its relevant objectives and service packages. In addition, a short description or rationale for the gap is provided.

A more detailed account of each gap is provided in section 6. The analysis conducted in Section 4: Gap Assessment of Objectives has been used to map objectives to the identified gaps. In addition, as part of the detailed gap definition, each gap is identified as a Technological Gap or a Deployment Gap. Technological Gaps require updated technology to close a gap. Deployments gaps can be closed by adding additional geographic deployments to the region.

In addition, the Gap Table maps each Gap to relevant projects that address each gap. The full list of project can be found in Appendix D.

Table 2: Gaps Identified by Stakeholders

Section	Gap	Gap Descriptor	Relevant Service Packages	Objectives	Description of Gap/Rationale	Associated Projects
6.1	Inter-jurisdictional Incident Information Coordination between Fort Bragg, City of Fayetteville and NCDOT	Technology	ATMS08 ATMS07 EM08	1.1 2.1 2.2 3.3	Fort Bragg would like to share incident information with City of Fayetteville and NCDOT. This includes both incident information for planning purposes, as well as notification of incidents.	FAM-ATMSI295-001 Communications
6.2	Inter-jurisdictional Device Coordination between Fort Bragg and NCDOT	Technology	ATMS07	1.1 2.2	Fort Bragg identified the ability to access NCDOT ITS devices as a gap. Fort Bragg would like the ability to access NCDOT DMS signs. In addition, Fort Bragg would like the capability to access cameras owned by DOT – both access to images and potential control of cameras. This includes both local cameras and devices, particularly on I-295, as well as the ability to interface with the Statewide Transportation Operations Center.	FAM-ATMSI295-002FMS
6.3	Improved information at	Deployment	ATMS06	2.1	Fort Bragg is currently planning	FAM-ATMSBRA-002

Section	Gap	Gap Descriptor	Relevant Service Packages	Objectives	Description of Gap/Rationale	Associated Projects
	Fort Bragg Gates			3.3	to install DMS signs just before access points at the base	
6.4	Centralized Traffic Operations at Fort Bragg	Technology	ATMS01 ATMS03 ATMS06 ATMS07 ATMS08	1.1 1.2 1.3 2.1 2.2 2.3 3.3	Fort Bragg does not currently have a Traffic Operations Center. The IIMC was identified as the most likely location to house a TOC.	FAM-ATMSBRAR-001 Traffic Signal Upgrades
6.5	Transit Service Coordination between FAST and County Transit	Technology	APTS07	1.2 1.3 2.1 2.2 4.2	FAST identified coordination with Cumberland County Community Transportation (CCCT) system as a gap. In addition, FAST identified coordination with Veterans One Stop Call Center as a gap	FAM-APTSFAST-001 Intermodal Center FAM-APTSFAST-006
6.6	Improved Transit Security at FAST	Technology	APTS05	3.2 3.3	All FAST vehicles are currently equipped with security cameras that save to an on-board DVR. However, the FAST AVL system is not coordinated with the Emergency Operations Center. Currently, bus drivers have an emergency call button that allows drivers to send a message to the EOC, but the EOC is not able to track the vehicles.	FAM-APTSFAST-004
6.7	Improved Passenger Information at FAST	Technology	APTS08	1.2 2.1 4.2	FAST does not provide consistent customer information on transit operations. AVL was recently activated on FAST vehicles – this includes in-vehicle real-time information (notices on stops, including an audio system). Plans have been discussed for integrating the CCCT and FAST call centers, but the project did	FAM-APTSFAST-001 Intermodal Center FAM-APTSFAST-002

Section	Gap	Gap Descriptor	Relevant Service Packages	Objectives	Description of Gap/Rationale	Associated Projects
					not move forward. FAST is currently developing a trip planner, as well as a system map to be posted online. In addition, multimodal transit centers are to be equipped with screens posting bus arrival prediction information.	
6.8	Traffic and Incident Information Coordination with Transit	Technology	APTS02 APTS03	1.3 2.1 2.2	FAST identified coordination with TOCs as a gap. One solution could include integrating AVL data into a center that includes traffic cameras.	FAM-APTSFAST-002
6.9	Improved Dispatching and Routing Capabilities at FAST	Technology	APTS02 APTS03	1.3 2.1 2.2	Transit and paratransit routing is run by one FAST employee. During operations hours, one person at the FAST transfer center runs dispatch, maintains radio contact with bus operators, and sells bus passes. Another reservationist takes advance calls for paratransit. APTS03 is existing, but dispatching is not automated.	FAM-APTSFAST-002
6.10	FAST Transit Fare Management	Technology	APTS04	1.3 4.1	Smart card or open payment systems have been considered, but not identified as a current high priority.	FAM-APTSFAST-005
6.11	FAST Automation of Transit Maintenance	Technology	APTS06	2.2	Transit vehicle maintenance is currently performed by written work orders.	FAM-APTSFAST-008 Transit Maintenance Automation
6.12	Improved Interjurisdictional Incident Management Coordination	Technology	ATMS08 EM06 EM08 EM09 EM10	1.1 2.1 2.2 3.3	NCDOT facilitates an incident management program, including a team for each county in the state. The Cumberland County incident management meetings include Fayetteville Police, Fire,	STA-ATMSMULTI-015 - ATMS Software

Section	Gap	Gap Descriptor	Relevant Service Packages	Objectives	Description of Gap/Rationale	Associated Projects
					Emergency Responders, State Highway Patrol, and Fort Bragg. While coordination between agencies responsible for incident management has been excellent so far, there are a number of improvements that could be made. While the NCDOT has an operating TIMS system, information must be entered manually at this time, and it does not provide the capability to share traffic camera information. Capabilities for wide area alerts, Disaster Response and Recovery, and Evacuated Management are planned.	
6.13	Alternate Routing Information I-95 Travelers	Deployment	ATMS06	1.2 2.1	DMS is currently deployed on the US 401 overpass. This capability is particularly needed on I-95 and US-301 – specifically to coordinate traveler information concerning I-95 and US-301. FAMPO would particularly be interested in travel times on I-95 and US-301 DMS. I-295 on the outer loop of Fayetteville is scheduled to have DMS installed in the near future.	FAM-ATMSI95-001FMS STA-ATMSMULTI-001 STA-ATMSMULTI-006 - Detour Maps STA-ATMSMULTI-013 - ATMS Software
6.14	Archived Data Sharing and Data Integration	Technology	AD1 AD2	2.1 2.2	NCDOT has ITS Data Mart capabilities in connection to statewide systems, but FAMPO has no data archiving capabilities. One particular issue is interoperability of GIS systems between the city of Fayetteville and NCDOT. In addition, the	FAM-ADMULTI-001 ITS Data Archive

Section	Gap	Gap Descriptor	Relevant Service Packages	Objectives	Description of Gap/Rationale	Associated Projects
					state is responsible for pavement condition surveys and assessments. The City of Fayetteville has had difficulty accessing these studies.	
6.15	Improving Traffic Systems	Technology	ATMS03	1.1 2.1 2.3	Improving traffic signal systems was identified as a gap by the City of Fayetteville. Fort Bragg has an outdated traffic signal system that should be upgraded.	FAM-ATMSBRAR-001 FAM-ATMSDunn-001 Traffic Signals FAM-ATMSFaye-003 Replacement FAM-ATMSLumb-001 Traffic Signals
6.16	Full CCTV and Detection Coverage	Deployment	ATMS01	1.2 2.1 2.2 3.2 3.3	More cameras and monitoring capabilities are needed throughout the region.	FAM-ATMS24-87-001FMS FAM-ATMSI295-002FMS FAM-ATMSI301-001DMS FAM-ATMSI95-001FMS FAM-ATMSNC24-001 FMS FAM-ATMSNC24-002 FMS FAM-ATMSNC87-001 FMS FAM-ATMSNC87-002 FMS FAM-ATMSNC87-003 FMS FAM-ATMSUS401-001 FMS
6.17	Improved Parking Management	Technology	ATMS16	1.1 4.3	The City of Fayetteville has identified parking management as a planned capability	None
6.18	Improved Maintenance and Construction Operations	Technology	MC01 MC02 MC07 MC08 MC10 MC12	2.1 2.2	NCDOT and the City of Fayetteville AVL systems for maintenance and construction vehicles as a planned capability. Both city and state plan on vehicle maintenance, roadway maintenance, work zone management, and maintenance and construction activity coordination as planned capabilities. NCDOT plans on future deployment of infrastructure monitoring.	None

Section	Gap	Gap Descriptor	Relevant Service Packages	Objectives	Description of Gap/Rationale	Associated Projects
6.19	Improved Commercial Vehicle Operations	Technology	CVO03 CVO06	4.4	A gap exists in commercial vehicle operations. Specifically, the region could deploy electronic vehicle clearance, as well as weigh-in-motion and Hazmat management. These capabilities would most likely be managed by the NCDOT. No plans currently exist for these capabilities.	FAM-CVOI95-Robeson County Weigh Station

6. ASSESSMENT OF GAPS IDENTIFIED BY STAKEHOLDERS

6.1. *Inter-jurisdictional Incident Information Coordination between Fort Bragg, City of Fayetteville, and NCDOT*

Description: Fort Bragg, the City of Fayetteville, and NCDOT would like to be able to share information with each other. This information could range from information for planning purposes, such as transportation system statuses, to notification of incidents.

Gap Descriptor: This gap is identified as a technology gap – the gap could be closed by developing interfaces between these CAD systems and traffic management systems.

Existing Status: Currently, the majority of information sharing between NCDOT, City of Fayetteville, and Fort Bragg is performed manually. NCDOT and City of Fayetteville jointly operate the City of Fayetteville TOC. However, incidents are still entered manually into the NCDOT TIMS/Smartlink database.

Relevant Service Packages:

ATMS07: Regional Traffic Management

ATMS08: Incident Management

EM08: Disaster Response and Recovery

Relevant Objectives:

1.1 Effectively use management and operations strategies to reduce congestion and travel times and increase travel time reliability

2.1 Provide coordinated static and dynamic transportation information, including road condition, closures, incident status updates, and transit information, to enable informed decision-making and effective use of resources.

2.2 Increase inter-agency sharing of construction updates, maintenance activities, planned special events, traveler information, and incident information.

3.3 Enhance the effectiveness of agencies responsible for disaster preparedness and emergency response.

Regional Target:

The regional target for interjurisdictional information sharing is to develop interfaces between the systems at Fort Bragg IIMC, City of Fayetteville Central Dispatch, and NCDOT traffic operations centers.

6.2. *Interjurisdictional Device Coordination between Fort Bragg and NCDOT.*

Description: Fort Bragg identified the ability to access NCDOT ITS devices as a gap. Fort Bragg would like the ability to access NCDOT DMS signs. In addition, Fort Bragg would like the capability to access cameras owned by DOT – both access to images and potential control of cameras. This includes both local cameras and devices, particularly on I-295, as well as the ability to interface with the Statewide Transportation Operations Center.

Gap Descriptor: This gap is identified as a technology gap – the gap could be closed by installing hard-wired CAD connections between traffic management centers

Existing Status: Currently, Fort Bragg does not have the ability to access any ITS devices owned or operated by NCDOT

Relevant Service Packages:

ATMS07: Regional Traffic Management

Relevant Objectives:

1.1 Effectively use management and operations strategies to reduce congestion and travel times and increase travel time reliability.

2.2 Increase inter-agency sharing of construction updates, maintenance activities, planned special events, traveler information, and incident information.

Regional Target:

The regional target for interjurisdictional device coordination is for Fort Bragg to have the ability to access all ITS devices in the FAMPO region, as well as the NCDOT STOC

6.3. Improved Information at Fort Bragg Gates

Description: Fort Bragg is currently planning to install DMS just before access points at the base.

Existing Status: Currently, there are no DMS signs controlled by Fort Bragg near ACPs.

Gap Descriptor: This gap is identified as a deployment gap. The gap could be closed by installing DMS just before ACPs at Fort Bragg

Relevant Service Packages:

ATMS06: Traffic Information Dissemination

Relevant Objectives:

2.1 Provide coordinated static and dynamic transportation information, including road condition, closures, incident status updates, and transit information, to enable informed decision-making and effective use of resources.

3.3 Enhance the effectiveness of agencies responsible for disaster preparedness and emergency response.

Regional Target:

The regional target for traveler information is to install DMSs outside Fort Bragg ACPs.

6.4. Centralized Traffic Operations at Fort Bragg

Description: Fort Bragg does not currently have a Traffic Operations Center to control its traffic control devices, such as traffic signals and DMSs. Currently, Fort Bragg devices are controlled from the Fort Bragg IIMC. The IIMC was identified as the most likely location to house a TOC.

Existing Status: Fort Bragg devices are controlled from the Fort Bragg IIMC.

Gap Descriptor: This gap is identified as a technology gap. The gap could be closed by building a traffic management center at Fort Bragg that would serve as a centralized traffic operations center.

Relevant Service Packages:

ATMS01: Network Surveillance

ATMS03: Traffic Signal Control

ATMS06: Traffic Information Dissemination

ATMS07: Regional Traffic Management

ATMS08: Incident Management

Relevant Objectives:

1.1 Effectively use management and operations strategies to reduce congestion and travel times and increase travel time reliability.

1.2 Enhance mobility choices through accurate, timely, and convenient information on all modes.

1.3 Increase the efficiency of the overall transportation system by facilitating the interconnection of transportation modes.

2.1 Provide coordinated static and dynamic transportation information, including road condition, closures, incident status updates, and transit information, to enable informed decision-making and effective use of resources.

2.2 Increase inter-agency sharing of construction updates, maintenance activities, planned special events, traveler information, and incident information.

2.3 Prioritize projects and their deployment to accommodate planned growth in the region, new or changing traffic patterns, and mode shift.

3.3 Enhance the effectiveness of agencies responsible for disaster preparedness and emergency response.

6.5. Transit Service Coordination between FAST and County Transit

Description: FAST identified coordination with Cumberland County Community Transportation system as a gap. In addition, FAST identified coordination with Veterans One Stop Call Center as a gap.

Existing Status: Transit service is currently not coordinated between FAST and County Transit or the Veterans One Stop Call Center.

Gap Descriptor: This gap is identified as a technology gap. The gap could be closed by installing CAD connections between FAST dispatch and County Transit dispatch or Veterans One Stop Call Center.

Relevant Service Packages:

APTS07: Multi-modal Coordination

Relevant Objectives:

1.2 Enhance mobility choices through accurate, timely, and convenient information on all modes.

1.3 Increase the efficiency of the overall transportation system by facilitating the interconnection of transportation modes.

2.1 Provide coordinated static and dynamic transportation information, including road condition, closures, incident status updates, and transit information, to enable informed decision-making and effective use of resources.

2.2 Increase inter-agency sharing of construction updates, maintenance activities, planned special events, traveler information, and incident information.

4.2 Reduce air pollution and fossil fuel use generated by transportation through reduced congestion and use of alternative modes.

6.6. Improved Transit Security at FAST

Description: FAST identified improved transit security as a gap.

Existing Status: All FAST vehicles are currently equipped with security cameras that save to an on-board DVR. However, the FAST AVL system is not coordinated with the Emergency Operations Center. Currently, bus drivers

have an emergency call button that allows drivers to send a message to the EOC, but the EOC is not able to track the vehicles.

Gap Descriptor: This gap is identified as a technology gap. The gap could be closed by monitoring FAST vehicle security cameras from the FAST Operations Center. In addition, the FAST AVL system could be coordinated with local emergency operations dispatch.

Relevant Service Packages:

APTS05: Transit Security

Relevant Objectives:

3.2 Improve the security of all transportation facilities across all modes.

3.3 Enhance the effectiveness of agencies responsible for disaster preparedness and emergency response.

6.7. Improved Passenger Information at FAST

Description: FAST does not provide consistent customer information on transit operations. AVL was recently activated on FAST vehicles – this includes in-vehicle real-time information (notices on stops, including an audio system).

Existing Status: Plans have been discussed for integrating the CCCT and FAST call centers, but the project did not move forward. FAST is currently developing a trip planner, as well as a system map to be posted online. In addition, multimodal transit centers are to be equipped with screens posting bus arrival prediction information. However, real-time information is not available on the FAST website, nor through an API to enable thirty-party development of real-time information tools. The FAST multimodal transit center does not currently post real-time information.

Gap Descriptor: This gap is identified as a technology gap. The gap could be closed by posting real-time information on the FAST web site, or through third party tools. In addition, real-time information could be posted on dynamic signs at bus stops or the FAST multimodal transit center

Relevant Service Packages:

APTS08: Transit Traveler Information

Relevant Objectives:

1.2 Enhance mobility choices through accurate, timely, and convenient information on all modes.

2.1 Provide coordinated static and dynamic transportation information, including road condition, closures, incident status updates, and transit information, to enable informed decision-making and effective use of resources.

4.2 Reduce air pollution and fossil fuel use generated by transportation through reduced congestion and use of alternative modes.

6.8. Traffic and Incident Information Coordination with Transit

Description: FAST identified coordination with TOCs as a gap. Coordination could include exchanging incident information, or sending road network conditions to transit dispatch centers. Another solution could include integrating AVL data into a traffic management center as a source of traffic probe data.

Existing Status: There is no current coordination between traffic and transit management centers.

Gap Descriptor: This gap is identified as a technology gap. The gap could be closed by connecting security and CCTV camera feeds between respective agencies, as well as providing connected CAD terminals between traffic and transit management centers.

Relevant Service Packages:

APTS02: Transit Fixed-Route Operations

APTS03: Demand Response Transit Operations

Relevant Objectives:

1.3 One solution could include integrating AVL data into a center that includes traffic cameras.

2.1 Provide coordinated static and dynamic transportation information, including road condition, closures, incident status updates, and transit information, to enable informed decision-making and effective use of resources.

2.2 Increase inter-agency sharing of construction updates, maintenance activities, planned special events, traveler information, and incident information.

6.9. Improved Dispatching and Routing Capabilities at FAST

Description: FAST identified advanced dispatching and routing capabilities as a gap. This would involve automated dispatching and routing from the FAST Operations Center.

Existing Status: Transit and paratransit routing is run by one FAST employee. During operations hours, one person at the FAST transfer center runs dispatch, maintains radio contact with bus operators, and sells bus passes. Another reservationist takes advance calls for paratransit. APTS03 is existing, but dispatching is not automated.

Gap Descriptor: This gap is identified as a technology gap. The gap could be closed by installing an automated transit routing system.

Relevant Service Packages:

APTS02: Transit Fixed-Route Operations

APTS03: Demand Response Transit Operations

Relevant Objectives:

1.3 One solution could include integrating AVL data into a center that includes traffic cameras.

2.1 Provide coordinated static and dynamic transportation information, including road condition, closures, incident status updates, and transit information, to enable informed decision-making and effective use of resources.

2.2 Increase inter-agency sharing of construction updates, maintenance activities, planned special events, traveler information, and incident information.

6.10. FAST Transit Fare Management

Description: FAST identified fare management as a gap. This would involve a smart card or an open payment system.

Existing Status: FAST currently utilizes a regional fare card. However, it has no vending equipment. Cards can be purchased at city hall, or recently have begun to be sold at local grocery stores. Cash can be used as payment on FAST vehicles.

Gap Descriptor: This gap is identified as a technology gap. The gap could be closed by installing a smart card or an open payment system

Relevant Service Packages:

APTS04: Transit Fare Collection Management

Relevant Objectives:

1.3 One solution could include integrating AVL data into a center that includes traffic cameras.

4.1 Provide cost-effective innovative and flexible technological solutions to transportation problems.

6.11. FAST Automation of Transit Maintenance

Description: FAST identified automated transit maintenance. This would involve on-board condition centers on FAST vehicles to monitor equipment status, and in the case of a critical status, a message would be sent to the FAST Operations Center. In addition, software would be installed in the FAST Operations Center to automatically schedule preventative and corrective maintenance

Existing Status: Transit vehicle maintenance is currently performed by written work orders.

Gap Descriptor: This gap is identified as a technology gap. The gap could be closed by installing an automated maintenance scheduling system, or maintenance sensors on transit vehicles.

Relevant Service Packages:

APTS06: Transit Fleet Management

Relevant Objectives:

2.2 Increase inter-agency sharing of construction updates, maintenance activities, planned special events, traveler information, and incident information.

6.12. Improved Interjurisdictional Incident Management Coordination

Description: Interjurisdictional incident management coordination between city, county, and state emergency management was identified as a gap. While coordination is excellent so far, it could be greatly improved by automation.

Existing Status: NCDOT facilitates an incident management program, including a team for each county in Division 6. The Cumberland County incident management meetings include Fayetteville Police, Fire, Emergency Responders, State Highway Patrol, and Fort Bragg. However, all incident management coordination is not currently automated. NCDOT has an operating TIMS system, information must be entered manually at this time, and it does not provide the capability to share traffic camera information. Capabilities for wide area alerts, Disaster Response and Recovery, and Evacuated Management are planned. NCDOT is planning on upgrading or replacing their TIMS system with a Smartlink system.

Gap Descriptor: This gap is identified as a technology gap. The gap could be closed by installing a Transportation Incident Management (TIMS) system.

Relevant Service Packages:

ATMS08: Traffic Incident Management System

EM06: Wide Area Alert

EM08: Disaster Response and Recovery

EM09: Evacuation and Reentry Management

EM10: Disaster Traveler Information

Relevant Objectives:

1.1: Effectively use management and operations strategies to reduce congestion and travel times and increase travel time reliability.

2.1: Provide coordinated static and dynamic transportation information, including road condition, closures, incident status updates, and transit information, to enable informed decision-making and effective use of resources.

2.2: Increase inter-agency sharing of construction updates, maintenance activities, planned special events, traveler information, and incident information.

3.3: Enhance the effectiveness of agencies responsible for disaster preparedness and emergency response.

6.13. Alternate Routing Information for I-95 Travelers

Description: Alternate routing information for I-95 traveler was identified as a gap by FAMPO and NCDOT. This capability is particularly needed on I-95 and US-301 – specifically to coordinate traveler information concerning I-95 and US-301. FAMPO would particularly be interested in travel times on I-95 and US-301 DMS.

Existing Status: DMS is currently deployed on the US 401 overpass. I-295 on the outer loop of Fayetteville is scheduled to have DMS installed in the near future.

Gap Descriptor: This gap is identified as a deployment gap. The gap could be closed by installing additional DMSs on I-95 and I-295.

Relevant Service Packages:

ATMS06: Traffic Information Dissemination

Relevant Objectives:

1.2: Enhance mobility choices through accurate, timely, and convenient information on all modes.

2.1: Provide coordinated static and dynamic transportation information, including road condition, closures, incident status updates, and transit information, to enable informed decision-making and effective use of resources.

6.14. Archived Data Sharing and Data Integration

Description: Archived data sharing and data integration was identified as a gap. For instance, one particular issue is interoperability of GIS systems between the City of Fayetteville and NCDOT. In addition, NCDOT is responsible for pavement condition surveys and assessments. The City of Fayetteville has had difficulty accessing these studies.

Existing Status: NCDOT has ITS Data Mart capabilities in connection to statewide systems, but FAMPO has no data archiving capabilities.

Gap Descriptor: This gap is identified as a technology gap. The gap could be closed by installing an archived data management system.

Relevant Service Packages:

AD1: ITS Data Mart

AD2: ITS Data Warehouse

Relevant Objectives:

2.1: Provide coordinated static and dynamic transportation information, including road condition, closures, incident status updates, and transit information, to enable informed decision-making and effective use of resources.

2.2: Increase inter-agency sharing of construction updates, maintenance activities, planned special events, traveler information, and incident information.

6.15. Improving Traffic Systems

Description: Improving traffic signal systems was identified as a gap by the City of Fayetteville. Fort Bragg has an outdated traffic signal system that should be upgraded.

Existing Status: City of Fayetteville and NCDOT run a traffic signal system out of the City of Fayetteville TOC. Fort Bragg has an outdated traffic signal system, and currently no TOC.

Gap Descriptor: This gap is identified as a technology gap. The gap could be closed by installing updated technology, such as a Traffic Adaptive System or a BLUETOAD system.

Relevant Service Packages:

ATMS03: Traffic Signal Control

Relevant Objectives:

1.1: Effectively use management and operations strategies to reduce congestion and travel times and increase travel time reliability.

2.1: Provide coordinated static and dynamic transportation information, including road condition, closures, incident status updates, and transit information, to enable informed decision-making and effective use of resources.

2.3: Prioritize projects and their deployment to accommodate planned growth in the region, new or changing traffic patterns, and mode shift.

6.16. Full CCTV and Detection Coverage

Description: More cameras and improved monitoring capabilities are needed throughout the FAMPO region.

Existing Status: The City of Fayetteville operates 42 CCTV cameras within the city limits. The majority of these cameras are along the Route 401 corridor and the All American Expressway leading into Fort Bragg. CCTV cameras are monitored at the City of Fayetteville Traffic Operations Center (TOC). The City of Fayetteville does not own or operate any DMS. Fort Bragg operates a number of CCTV cameras that are used to monitor road conditions on and around Fort Bragg. The camera feeds are monitored and controlled by the Fort Bragg IIMC. In addition, Fort Bragg operates a highway advisory radio (HAR) system.

NCDOT owns the majority of traffic devices in the FAMPO region. NCDOT owns 64 CCTV cameras along the I-95 corridor. The CCTV cameras are operated from the NCDOT Division 6 TMC. NCDOT owns 28 DMS in the Fayetteville area. The majority of these are located along the I-95 and I-295 corridors, with a small number deployed along US 401, NC 24 and the outer loop. These DMSs within the FAMPO region are operated by the NCDOT Division 6 TMC.

Gap Descriptor: This gap is identified as a deployment gap. The gap could be closed by installing additional CCTV cameras and traffic sensors along I-295 and other important routes.

Relevant Service Packages:

ATMS01: Network Surveillance

Relevant Objectives:

- 1.2: Enhance mobility choices through accurate, timely, and convenient information on all modes.
- 2.1: Provide coordinated static and dynamic transportation information, including road condition, closures, incident status updates, and transit information, to enable informed decision-making and effective use of resources.
- 2.2: Increase inter-agency sharing of construction updates, maintenance activities, planned special events, traveler information, and incident information.
- 2.3: Prioritize projects and their deployment to accommodate planned growth in the region, new or changing traffic patterns, and mode shift.
- 3.2: Improve the security of all transportation facilities across all modes.
- 3.3: Enhance the effectiveness of agencies responsible for disaster preparedness and emergency response.

6.17. Improved Parking Management

Description: The City of Fayetteville has identified parking management as a planned capability.

Existing Status: There are currently no parking management systems in the region.

Gap Descriptor: This gap is identified as a technology gap. The gap could be closed by installing a parking management system.

Relevant Service Packages:

ATMS16: Parking Facility Management

Relevant Objectives:

- 1.1: Effectively use management and operations strategies to reduce congestion and travel times and increase travel time reliability.
- 4.3: Deploy ITS solutions that enhance and leverage existing infrastructure to minimize environmental impacts.

6.18. Improved Maintenance and Construction

Description: NCDOT and the City of Fayetteville AVL systems for maintenance and construction vehicles as a potential future capability. Both the City and NCDOT plan on vehicle maintenance, roadway maintenance, work zone management, and maintenance and construction activity coordination as future capabilities. NCDOT plans on future deployment of infrastructure monitoring.

Existing Status: There are currently no maintenance and construction ITS systems in the region

Gap Descriptor: This gap is identified as a technology gap. The gap could be closed by installing AVL systems for maintenance and construction vehicles, as well as CAD systems for maintenance and construction activity coordination. In addition, infrastructure monitoring systems could be installed.

Relevant Service Packages:

MC01: Maintenance and Construction Vehicle and Equipment Tracking

MC02: Maintenance and Construction Vehicle Maintenance

MC07: Roadway and Maintenance Construction

MC08: Work Zone Management

MC10: Maintenance and Construction Activity Coordination

Relevant Objectives:

2.1: Provide coordinated static and dynamic transportation information, including road condition, closures, incident status updates, and transit information, to enable informed decision-making and effective use of resources.

2.2: Increase inter-agency sharing of construction updates, maintenance activities, planned special events, traveler information, and incident information.

6.19. Improved Commercial Vehicle Operations

Description: A gap exists in commercial vehicle operations. Specifically, the region could deploy electronic vehicle clearance, as well as weigh-in-motion and HazMat management. These capabilities would most likely be managed by the NCDOT. No plans currently exist for these capabilities.

Existing Status: There are currently no commercial vehicle ITS systems in the region

Gap Descriptor: This gap is identified as a technology gap. The gap could be closed by installing commercial vehicle ITS.

Relevant Service Packages:

CVO03-

CVO06-

Relevant Objectives:

4.4: Provide transportation improvements and solutions that support economic development.

7. NEXT STEPS

The results of this Gap Assessment will allow stakeholders in the FAMPO region to identify solutions that address regional goals and objectives and result in service package-based projects consistent with the ITS National Architecture. Together with the FAMPO Regional ITS Architecture, this analysis identifies potential solutions to gaps in the FAMPO region. In addition, this document allows stakeholders in the FAMPO region to assess current projects and identify any projects that do not address high priority regional gaps.

The next steps in the FAMPO Regional ITS Strategic Deployment Plan Update are to conduct an IDAS Modeling Analysis and to recommend strategies for mainstreaming ITS into the MPO Planning Process. The IDAS Modeling Analysis will provide an in-depth analysis of the FAMPO region's current projects and suggest alternate avenues for regional investment in ITS. The Mainstreaming ITS into the MPO Planning Process will develop a methodology for incorporating ITS into the current regional planning process, allowing regional stakeholders to identify appropriate avenues and venues to invest in ITS.

Appendix A - Acronyms

Acronym	Description
ACP	Access Control Point
AD	Archived Data
APTS	Advanced Public Transportation
ATMS	Advanced Traffic Management Systems
AVL	Automatic Vehicle Location
CAD	Computer Aided Dispatch
CCTV	Closed Circuit Television
CVO	Commercial Vehicle Operations
DMS	Dynamic Message Sign
EM	Emergency Management
EOC	Emergency Operations Center
FAMPO	Fayetteville Area Metropolitan Planning Organization
FAST	Fayetteville Area System of Transit
GIS	Geographic Information System
HAR	Highway Advisory Radio
HRI	Highway Railroad Intersection
IIMC	Integration Incident Management Center
IMS	Incident Management System
ITS	Intelligent Transportation Systems
MC	Maintenance and Construction
NCDOT	North Carolina Department of Transportation
NITSA	National ITS Architecture
TIP	Transportation Improvement Program
TOC	Transportation Operations Center

Appendix B – Service Package Descriptions from the National ITS Architecture

Service Package	Service Package Name	Description
AD1	ITS Data Mart	This service package provides a focused archive that houses data collected and owned by a single agency, private sector provider, or other organization. This focused archive typically includes data covering a single transportation mode and one jurisdiction that is collected from an operational data store and archived for future use. It provides the basic data quality, data privacy, and meta data management common to all ITS archives and provides general query and report access to archive data users.
AD2	ITS Data Warehouse	This service package includes all the data collection and management capabilities provided by the ITS Data Mart, and adds the functionality and interface definitions that allow collection of data from multiple agencies and data sources spanning across modal and jurisdictional boundaries. It performs the additional transformations and provides the additional meta data management features that are necessary so that all this data can be managed in a single repository with consistent formats. The potential for large volumes of varied data suggests additional on-line analysis and data mining features that are also included in this service package in addition to the basic query and reporting user access features offered by the ITS Data Mart.
APTS01	Transit Vehicle Tracking	This service package monitors current transit vehicle location using an Automated Vehicle Location System. The location data may be used to determine real time schedule adherence and update the transit system's schedule in real-time. Vehicle position may be determined either by the vehicle (e.g., through GPS) and relayed to the infrastructure or may be determined directly by the communications infrastructure. A two-way wireless communication link with the Transit Management Subsystem is used for relaying vehicle position and control measures. The Transit Management Subsystem processes this information, updates the transit schedule and makes real-time schedule information available to the Information Service Provider.
APTS02	Transit Fixed-Route Operations	This service package performs automated dispatch and system monitoring for fixed-route and flexible-route transit services. This service performs scheduling activities including the creation of schedules, blocks and runs, as well as operator assignment. This service determines the transit vehicle trip performance against the schedule using AVL data and provides information displays at the Transit Management Subsystem. Static and real time transit data is exchanged with Information Service Providers where it is integrated with that from other transportation modes (e.g. rail, ferry, air) to provide the public with integrated and personalized dynamic schedules.

Service Package	Service Package Name	Description
APTS03	Demand Response Transit Operations	This service package performs automated dispatch and system monitoring for demand responsive transit services. This service performs scheduling activities as well as operator assignment. In addition, this service package performs similar functions to support dynamic features of flexible-route transit services. This package monitors the current status of the transit fleet and supports allocation of these fleet resources to service incoming requests for transit service while also considering traffic conditions. The Transit Management Subsystem provides the necessary data processing and information display to assist the transit operator in making optimal use of the transit fleet. This service includes the capability for a traveler request for personalized transit services to be made through the Information Service Provider (ISP) Subsystem.
APTS04	Transit Fare Collection Management	This service package manages transit fare collection on-board transit vehicles and at transit stops using electronic means. It allows transit users to use a traveler card or other electronic payment device. Readers located on-board the transit vehicles enable electronic fare payment. Data is processed, stored, and displayed on the transit vehicle and communicated as needed to the Transit Management Subsystem. Two other service packages, ATMS10: Electronic Toll Collection and ATMS16: Parking Facility Management, also provide electronic payment services. These three service packages in combination provide an integrated electronic payment system for transportation services.
APTS05	Transit Security	This service package provides for the physical security of transit passengers and transit vehicle operators. On-board equipment is deployed to perform surveillance monitoring in order to warn of potentially hazardous situations. The surveillance equipment includes video (e.g., CCTV cameras), audio systems and/or event recorder systems. Transit user or transit vehicle operator activated alarms are provided on-board. Public areas (e.g., transit stops, park and ride lots, stations) are also monitored with similar surveillance equipment. The surveillance and sensor information is transmitted to the Emergency Management Subsystem.
APTS06	Transit Fleet Management	This service package supports automatic transit maintenance scheduling and monitoring. On-board condition sensors monitor system status and transmit critical status information to the Transit Management Subsystem. Hardware and software in the Transit Management Subsystem processes this data and schedules preventative and corrective maintenance.
APTS07	Multi-modal Coordination	This service package establishes two way communications between multiple transit and traffic agencies to improve service coordination. Multimodal coordination between transit agencies can increase traveler convenience at transit transfer points and clusters (a collection of stops, stations, or terminals where transfers can be made conveniently) and also improve operating efficiency. Transit transfer information is shared between Multimodal Transportation Service Providers and Transit Agencies.
APTS08	Transit Traveler Information	This service package provides transit users at transit stops and on-board transit vehicles with ready access to transit information. The information services include transit stop annunciation, imminent arrival signs, and real-time transit schedule displays that are of general interest to transit users. Systems that provide custom transit trip itineraries and other tailored transit information services are also represented by this service package.

Service Package	Service Package Name	Description
APTS10	Transit Passenger Counting	This service package counts the number of passengers entering and exiting a transit vehicle using sensors mounted on the vehicle and communicates the collected passenger data back to the management center. The collected data can be used to calculate reliable ridership figures and measure passenger load information at particular stops.
ATIS01	Broadcast Traveler Information	This service package collects traffic conditions, advisories, general public transportation, toll and parking information, incident information, roadway maintenance and construction information, air quality and weather information, and broadcasts the information to travelers using technologies such as FM subcarrier, satellite radio, cellular data broadcasts, and Internet web casts. The information may be provided directly to travelers or provided to merchants and other traveler service providers so that they can better inform their customers of travel conditions. Different from the service package ATMS06 - Traffic Information Dissemination, which provides localized HAR and DMS information capabilities, ATIS01 provides a wide area digital broadcast service. Successful deployment of this service package relies on availability of real-time traveler information from roadway instrumentation, probe vehicles or other sources.
ATIS02	Interactive Traveler Information	This service package provides tailored information in response to a traveler request. Both real-time interactive request/response systems and information systems that "push" a tailored stream of information to the traveler based on a submitted profile are supported. The traveler can obtain current information regarding traffic conditions, roadway maintenance and construction, transit services, ride share/ride match, parking management, detours and pricing information. A variety of interactive devices may be used by the traveler to access information prior to a trip or en route including phone via a 511-like portal and web pages via kiosk, personal digital assistant, personal computer, and a variety of in-vehicle devices. This service package also allows value-added resellers to collect transportation information that can be aggregated and be available to their personal devices or remote traveler systems to better inform their customers of transportation conditions. Successful deployment of this service package relies on availability of real-time transportation data from roadway instrumentation, transit, probe vehicles or other means.
ATMS01	Network Surveillance	This service package includes traffic detectors, other surveillance equipment, the supporting field equipment, and fixed-point to fixed-point communications to transmit the collected data back to the Traffic Management Subsystem. The derived data can be used locally such as when traffic detectors are connected directly to a signal control system or remotely (e.g., when a CCTV system sends data back to the Traffic Management Subsystem). The data generated by this service package enables traffic managers to monitor traffic and road conditions, identify and verify incidents, detect faults in indicator operations, and collect census data for traffic strategy development and long range planning. The collected data can also be analyzed and made available to users and the Information Service Provider Subsystem.

Service Package	Service Package Name	Description
ATMS03	Traffic Signal Control	This service package provides the central control and monitoring equipment, communication links, and the signal control equipment that support traffic control at signalized intersections. A range of traffic signal control systems are represented by this service package ranging from fixed-schedule control systems to fully traffic responsive systems that dynamically adjust control plans and strategies based on current traffic conditions and priority requests. This service package is generally an intra-jurisdictional package. Systems that achieve coordination across jurisdictions by using a common time base or other strategies that do not require real time coordination would also be represented by this package. Coordination of traffic signal systems using real-time communications is covered in the ATMS07-Regional Traffic Management service package. This service package is consistent with typical traffic signal control systems.
ATMS04	Traffic Metering	This service package provides central monitoring and control, communications, and field equipment that support metering of traffic. It supports the complete range of metering strategies including ramp, interchange, and mainline metering. This package incorporates the instrumentation included in the Network Surveillance service package (traffic sensors are used to measure traffic flow and queues) to support traffic monitoring so responsive and adaptive metering strategies can be implemented. Also included is configurable field equipment to provide information to drivers approaching a meter, such as advance warning of the meter, its operational status (whether it is currently on or not, how many cars per green are allowed, etc.), lane usage at the meter (including a bypass lane for HOVs) and existing queue at the meter.
ATMS06	Traffic Information Dissemination	This service package provides driver information using roadway equipment such as dynamic message signs or highway advisory radio. A wide range of information can be disseminated including traffic and road conditions, closure and detour information, travel restrictions, incident information, and emergency alerts and driver advisories. This package provides information to drivers at specific equipped locations on the road network. Careful placement of the roadway equipment provides the information at points in the network where the drivers have recourse and can tailor their routes to account for the new information. This package also covers the equipment and interfaces that provide traffic information from a traffic management center to the media (for instance via a direct tie-in between a traffic management center and radio or television station computer systems), Transit Management, Emergency Management, and Information Service Providers. A link to the Maintenance and Construction Management subsystem allows real time information on road/bridge closures and restrictions due to maintenance and construction activities to be disseminated. The sharing of transportation operations data described in this service package also supports other services like ATMS09- Traffic Decision Support and Demand Management.

Service Package	Service Package Name	Description
ATMS07	Regional Traffic Management	This service package provides for the sharing of traffic information and control among traffic management centers to support regional traffic management strategies. Regional traffic management strategies that are supported include inter-jurisdictional, real-time coordinated traffic signal control systems and coordination between freeway operations and traffic signal control within a corridor. This service package advances the ATMS03-Traffic Signal Control and ATMS04-Traffic Metering service packages by adding the communications links and integrated control strategies that enable integrated, interjurisdictional traffic management. The nature of optimization and extent of information and control sharing is determined through working arrangements between jurisdictions. This package relies principally on roadside instrumentation supported by the Traffic Signal Control and Traffic Metering service packages and adds hardware, software, and fixed-point to fixed-point communications capabilities to implement traffic management strategies that are coordinated between allied traffic management centers. Several levels of coordination are supported from sharing of information through sharing of control between traffic management centers.
ATMS08	Traffic Incident Management System	This service package manages both unexpected incidents and planned events so that the impact to the transportation network and traveler safety is minimized. The service package includes incident detection capabilities through roadside surveillance devices (e.g. CCTV) and through regional coordination with other traffic management, maintenance and construction management and emergency management centers as well as rail operations and event promoters. Information from these diverse sources is collected and correlated by this service package to detect and verify incidents and implement an appropriate response. This service package supports traffic operations personnel in developing an appropriate response in coordination with emergency management, maintenance and construction management, and other incident response personnel to confirmed incidents. The response may include traffic control strategy modifications or resource coordination between center subsystems. Incident response also includes presentation of information to affected travelers using the Traffic Information Dissemination service package and dissemination of incident information to travelers through the Broadcast Traveler Information or Interactive Traveler Information service packages. The roadside equipment used to detect and verify incidents also allows the operator to monitor incident status as the response unfolds. The coordination with emergency management might be through a CAD system or through other communication with emergency field personnel. The coordination can also extend to tow trucks and other allied response agencies and field service personnel.

Service Package	Service Package Name	Description
ATMS10	Electronic Toll Collection	This service package provides toll operators with the ability to collect tolls electronically and detect and process violations. The fees that are collected may be adjusted to implement demand management strategies. Field-Vehicle Communication between the roadway equipment and the vehicle is required as well as Fixed Point-Fixed Point interfaces between the toll collection equipment and transportation authorities and the financial infrastructure that supports fee collection. Toll violations are identified and electronically posted to vehicle owners. Standards, inter-agency coordination, and financial clearinghouse capabilities enable regional, and ultimately national, interoperability for these services. Two other service packages, APTS04: Transit Fare Collection Management and ATMS16: Parking Facility Management also provide electronic payment services. These three service packages in combination provide an integrated electronic payment system for transportation services. The vehicle equipment and roadside readers that these systems utilize can also be used to collect road use statistics for highway authorities. This data can be collected as a natural by-product of the toll collection process or collected by separate readers that are dedicated to probe data collection.
ATMS13	Standard Railroad Grade Crossing	This service package manages highway traffic at highway-rail intersections (HRIs) where operational requirements do not dictate more advanced features (e.g., where rail operational speeds are less than 80 miles per hour). Both passive (e.g., the crossbuck sign) and active warning systems (e.g., flashing lights and gates) are supported. (Note that passive systems exercise only the single interface between the roadway subsystem and the driver in the architecture definition.) These traditional HRI warning systems may also be augmented with other standard traffic management devices. The warning systems are activated on notification by interfaced wayside equipment of an approaching train. The equipment at the HRI may also be interconnected with adjacent signalized intersections so that local control can be adapted to highway-rail intersection activities. Health monitoring of the HRI equipment and interfaces is performed; detected abnormalities are reported to both highway and railroad officials through wayside interfaces and interfaces to the traffic management subsystem.
ATMS16	Parking Facility Management	This service package provides enhanced monitoring and management of parking facilities. It assists in the management of parking operations, coordinates with transportation authorities, and supports electronic collection of parking fees. This service package collects current parking status, shares this data with Information Service Providers and Traffic Management, and collects parking fees using the same in-vehicle equipment utilized for electronic toll collection or contact or proximity traveler cards used for electronic payment. Two other service packages, APTS04: Transit Fare Collection Management and ATMS10: Electronic Toll Collection also provide electronic payment services. These three service packages in combination provide an integrated electronic payment system for transportation services.

Service Package	Service Package Name	Description
ATMS18	Reversible Lane Management	This service package provides for the management of reversible lane facilities. In addition to standard surveillance capabilities, this service package includes sensory functions that detect wrong-way vehicles and other special surveillance capabilities that mitigate safety hazards associated with reversible lanes. The package includes the field equipment, physical lane access controls, and associated control electronics that manage and control these special lanes. This service package also includes the equipment used to electronically reconfigure intersections and manage right-of-way to address dynamic demand changes and special events.
ATMS21	Roadway Closure Management	This service package closes roadways to vehicular traffic when driving conditions are unsafe, maintenance must be performed, and other scenarios where access to the roadway must be prohibited. The service package includes automatic or remotely controlled gates or barriers that control access to roadway segments including ramps and traffic lanes. Remote control systems allow the gates to be controlled from a central location or from a vehicle at the gate/barrier location, improving system efficiency and reducing personnel exposure to unsafe conditions during severe weather and other situations where roads must be closed. Surveillance systems allow operating personnel to visually verify the safe activation of the closure system and driver information systems (e.g., DMS) provide closure information to motorists in the vicinity of the closure. The equipment managed by this service package includes the control and monitoring systems, the field devices (e.g., gates, warning lights, DMS, CCTV cameras) at the closure location(s), and the information systems that notify other systems of a closure. This service package covers general road closure applications; specific closure systems that are used at railroad grade crossings, drawbridges, reversible lanes, etc. are covered by other ATMS service packages.
ATMS22	Variable Speed Limits	This service package sets variable speed limits along a roadway to create more uniform speeds, to promote safer driving during adverse conditions (such as fog), and/or to reduce air pollution. Also known as speed harmonization, this service monitors traffic and environmental conditions along the roadway. Based on the measured data, the system calculates and sets suitable speed limits, usually by lane. Equipment over and along the roadway displays the speed limits and additional information such as basic safety rules and current traffic information. The system can be centrally monitored and controlled by a traffic management center or it can be autonomous. This service establishes variable speed limits and communicates the speed limits to drivers. Speed warnings and enforcement of speeds limits, including variable speed limits, is covered in the ATMS19-Automated Speed Warning and Enforcement service package. Variable speed limits are an Active Traffic Management (ATM) strategy and are typically used in conjunction with other ATM strategies (such as ATMS23-Dynamic Lane Management and Shoulder Use and ATMS24-Dynamic Roadway Warning).

Service Package	Service Package Name	Description
CVO03	Electronic Clearance	This service package provides for automated clearance at roadside check facilities. The roadside check facility communicates with the Commercial Vehicle Administration subsystem to retrieve infrastructure snapshots of critical carrier, vehicle, and driver data to be used to sort passing vehicles. This allows a good driver/vehicle/carrier to pass roadside facilities at highway speeds using transponders and Field-Vehicle Communications to the roadside. Results of roadside clearance activities will be passed on to the Commercial Vehicle Administration. The roadside check facility may be equipped with Automated Vehicle Identification (AVI), weighing sensors, transponder read/write devices and computer workstations.
CVO06	Weigh-In-Motion	This service package provides for high speed weigh-in-motion with or without Automated Vehicle Identification (AVI) capabilities. This service package provides the roadside equipment that could be used as a stand-alone system or to augment the Electronic Clearance (CVO03) service package.
EM01	Emergency Call-Taking and Dispatch	This service package provides basic public safety call-taking and dispatch services. It includes emergency vehicle equipment, equipment used to receive and route emergency calls, and wireless communications that enable safe and rapid deployment of appropriate resources to an emergency. Coordination between Emergency Management Subsystems supports emergency notification between agencies. Wide area wireless communications between the Emergency Management Subsystem and an Emergency Vehicle supports dispatch and provision of information to responding personnel.
EM02	Emergency Routing	This service package supports automated vehicle location and dynamic routing of emergency vehicles. Traffic information, road conditions, and suggested routing information are provided to enhance emergency vehicle routing. Special priority or other specific emergency traffic control strategies can be coordinated to improve the safety and time-efficiency of responding vehicle travel on the selected route(s). The Emergency Management Subsystem provides the routing for the emergency fleet based on real-time conditions and has the option of requesting a route from the Traffic Management subsystem. The Emergency Vehicle may also be equipped with dedicated short range communications for local signal preemption and the transmission of alerts to surrounding vehicles. The service provides for information exchange between care facilities and both the Emergency Management Subsystem and emergency vehicles.

Service Package	Service Package Name	Description
EM05	Transportation Infrastructure Protection	This service package includes the monitoring of transportation infrastructure (e.g., bridges, tunnels and management centers) for potential threats using sensors and surveillance equipment and barrier and safeguard systems to control access, preclude an incident, and mitigate the impact of an incident if it occurs. Threats can result from acts of nature (e.g., hurricanes, earthquakes), terrorist attacks or other incidents causing damage to the infrastructure (e.g., stray barge hitting a bridge support). Infrastructure may be monitored with acoustic, environmental threat (such as nuclear, biological, chemical, and explosives), infrastructure condition and integrity, motion and object sensors and video and audio surveillance equipment. Data from such sensors and surveillance equipment may be processed in the field or sent to a center for processing. The data enables operators at the center to detect and verify threats. When a threat is detected, agencies are notified. Detected threats or advisories received from other agencies result in an increased level of system preparedness. In response to threats, barrier and safeguard systems may be activated by Traffic Management Subsystems to deter an incident, control access to an area or mitigate the impact of an incident. Barrier systems include gates, barriers and other automated and remotely controlled systems that manage entry to transportation infrastructure. Safeguard systems include blast shields, exhaust systems and other automated and remotely controlled systems that mitigate impact of an incident.
EM06	Wide Area Alert	This service package uses ITS driver and traveler information systems to alert the public in emergency situations such as child abductions, severe weather events, civil emergencies, and other situations that pose a threat to life and property. The alert includes information and instructions for transportation system operators and the traveling public, improving public safety and enlisting the public's help in some scenarios. The ITS technologies will supplement and support other emergency and homeland security alert systems such as the Emergency Alert System (EAS). When an emergency situation is reported and verified and the terms and conditions for system activation are satisfied, a designated agency broadcasts emergency information to traffic agencies, transit agencies, information service providers, toll operators, and others that operate ITS systems. The ITS systems, in turn, provide the alert information to transportation system operators and the traveling public using ITS technologies such as dynamic message signs, highway advisory radios, in-vehicle displays, transit displays, 511 traveler information systems, and traveler information web sites.
EM07	Early Warning System	This service package monitors and detects potential, looming, and actual disasters including natural disasters (hurricanes, earthquakes, floods, winter storms, tsunamis, etc.) and technological and man-made disasters (hazardous materials incidents, nuclear power plant accidents, and acts of terrorism including nuclear, chemical, biological, and radiological weapons attacks). The service package monitors alerting and advisory systems, ITS sensors and surveillance systems, field reports, and emergency call-taking systems to identify emergencies and notifies all responding agencies of detected emergencies.
EM8	Disaster Response and Recovery	This service package enhances the ability of the surface transportation system to respond to and recover from disasters. It addresses the most

Service Package	Service Package Name	Description
		severe incidents that require an extraordinary response from outside the local community. All types of disasters are addressed including natural disasters (hurricanes, earthquakes, floods, winter storms, tsunamis, etc.) and technological and man-made disasters (hazardous materials incidents, nuclear power plant accidents, and national security emergencies such as nuclear, chemical, biological, and radiological weapons attacks). The service package supports coordination of emergency response plans, including general plans developed before a disaster as well as specific tactical plans with short time horizon that are developed as part of a disaster response. The service package provides enhanced access to the scene for response personnel and resources, provides better information about the transportation system in the vicinity of the disaster, and maintains situation awareness regarding the disaster itself. In addition, this service package tracks and coordinates the transportation resources - the transportation professionals, equipment, and materials - that constitute a portion of the disaster response. The service package identifies the key points of integration between transportation systems and the public safety, emergency management, public health, and other allied organizations that form the overall disaster response. In this service package, the Emergency Management subsystem represents the federal, regional, state, and local Emergency Operations Centers and the Incident Commands that are established to respond to the disaster. The interface between the Emergency Management Subsystem and the other center subsystems provides situation awareness and resource coordination among transportation and other allied response agencies. In its role, traffic management implements special traffic control strategies and detours and restrictions to effectively manage traffic in and around the disaster. Maintenance and construction provides damage assessment of road network facilities and manages service restoration. Transit management provides a similar assessment of status for transit facilities and modifies transit operations to meet the special demands of the disaster. As immediate public safety concerns are addressed and disaster response transitions into recovery, this service package supports transition back to normal transportation system operation, recovering resources, managing on-going transportation facility repair, supporting data collection and revised plan coordination, and other recovery activities. This service package builds on the basic traffic incident response service that is provided by ATMS08, the Traffic Incident Management service package. This service package addresses the additional complexities and coordination requirements that are associated with the most severe incidents that warrant an extraordinary response from outside the local jurisdictions and require special measures such as the activation of one or more emergency operations centers. Many users of the National ITS Architecture will want to consider both ATMS08 and this service package since every region is concerned with both day-to-day management of traffic-related incidents and occasional management of disasters that require extraordinary response.

Service Package	Service Package Name	Description
		Disaster Response and Recovery is also supported by EM10, the "Disaster Traveler Information" service package that keeps the public informed during a disaster response. See that service package for more information.
EM9	Evacuation and Reentry Management	This service package supports evacuation of the general public from a disaster area and manages subsequent reentry to the disaster area. The service package addresses evacuations for all types of disasters, including disasters like hurricanes that are anticipated and occur slowly, allowing a well-planned orderly evacuation, as well as disasters like terrorist acts that occur rapidly, without warning, and allow little or no time for preparation or public warning. This service package supports coordination of evacuation plans among the federal, state, and local transportation, emergency, and law enforcement agencies that may be involved in a large-scale evacuation. All affected jurisdictions (e.g., states and counties) at the evacuation origin, evacuation destination, and along the evacuation route are informed of the plan. Information is shared with traffic management agencies to implement special traffic control strategies and to control evacuation traffic, including traffic on local streets and arterials as well as the major evacuation routes. Reversible lanes, shoulder use, closures, special signal control strategies, and other special strategies may be implemented to maximize capacity along the evacuation routes. Transit resources play an important role in an evacuation, removing many people from an evacuated area while making efficient use of limited capacity. Additional shared transit resources may be added and managed in evacuation scenarios. Resource requirements are forecast based on the evacuation plans and the necessary resources are located, shared between agencies if necessary, and deployed at the right locations at the appropriate times. Evacuations are also supported by EM10, the "Disaster Traveler Information" service package, which keeps the public informed during evacuations. See that service package for more information.

Service Package	Service Package Name	Description
EM10	Disaster Traveler Information	This service package uses ITS to provide disaster-related traveler information to the general public, including evacuation and reentry information and other information concerning the operation of the transportation system during a disaster. This service package collects information from multiple sources including traffic, transit, public safety, emergency management, shelter provider, and travel service provider organizations. The collected information is processed and the public is provided with real-time disaster and evacuation information using ITS traveler information systems. A disaster will stress the surface transportation system since it may damage transportation facilities at the same time that it places unique demands on these facilities to support public evacuation and provide access for emergency responders. Similarly, a disaster may interrupt or degrade the operation of many traveler information systems at the same time that safety-critical information must be provided to the traveling public. This service package keeps the public informed in these scenarios, using all available means to provide information about the disaster area including damage to the transportation system, detours and closures in effect, special traffic restrictions and allowances, special transit schedules, and real-time information on traffic conditions and transit system performance in and around the disaster. This service package also provides emergency information to assist the public with evacuations when necessary. Information on mandatory and voluntary evacuation zones, evacuation times, and instructions are provided. Available evacuation routes and destinations and current and anticipated travel conditions along those routes are provided so evacuees are prepared and know their destination and preferred evacuation route. Information on available transit services and traveler services (shelters, medical services, hotels, restaurants, gas stations, etc.) is also provided. In addition to general evacuation information, this service package provides specific evacuation trip planning information that is tailored for the evacuee based on origin, selected destination, and evacuee-specified evacuation requirements and route parameters. This service package augments the ATIS service packages that provide traveler information on a day-to-day basis for the surface transportation system. This service package provides focus on the special requirements for traveler information dissemination in disaster situations.
MC1	Maintenance and Construction Vehicle and Equipment Tracking	This service package will track the location of maintenance and construction vehicles and other equipment to ascertain the progress of their activities. These activities can include ensuring the correct roads are being plowed and work activity is being performed at the correct locations.
MC2	Maintenance and Construction Vehicle Maintenance	This service package performs vehicle maintenance scheduling and manages both routine and corrective maintenance activities on vehicles and other maintenance and construction equipment. It includes on-board sensors capable of automatically performing diagnostics for maintenance and construction vehicles, and the systems that collect this diagnostic information and use it to schedule and manage vehicle maintenance.

Service Package	Service Package Name	Description
MC3	Road Weather Data Collection	This service package collects current road and weather conditions using data collected from environmental sensors deployed on and about the roadway (or guideway in the case of transit related rail systems). In addition to fixed sensor stations at the roadside, sensing of the roadway environment can also occur from sensor systems located on Maintenance and Construction Vehicles. The collected environmental data is used by the Weather Information Processing and Distribution service package to process the information and make decisions on operations. The collected environmental data may be aggregated, combined with data attributes and sent to meteorological systems for data qualification and further data consolidation. The service package may also request and receive qualified data sets from meteorological systems.
MC7	Roadway Maintenance and Construction	This service package supports numerous services for scheduled and unscheduled maintenance and construction on a roadway system or right-of-way. Maintenance services would include landscape maintenance, hazard removal (roadway debris, dead animals), routine maintenance activities (roadway cleaning, grass cutting), and repair and maintenance of both ITS and non-ITS equipment on the roadway (e.g., signs, traffic controllers, traffic detectors, dynamic message signs, traffic signals, CCTV, etc.). Environmental conditions information is also received from various weather sources to aid in scheduling maintenance and construction activities.
MC8	Work Zone Management	This service package manages work zones, controlling traffic in areas of the roadway where maintenance, construction, and utility work activities are underway. Traffic conditions are monitored using CCTV cameras and controlled using dynamic message signs (DMS), Highway Advisory Radio (HAR), gates and barriers. Work zone information is coordinated with other groups (e.g., ISP, traffic management, other maintenance and construction centers). Work zone speeds and delays are provided to the motorist prior to the work zones. This service package provides control of field equipment in all maintenance and construction areas, including fixed, portable, and truck-mounted devices supporting both stationary and mobile work zones.
MC10	Maintenance and Construction Activity Coordination	This service package supports the dissemination of maintenance and construction activity to centers that can utilize it as part of their operations, or to the Information Service Providers who can provide the information to travelers.

Appendix C- Regional Deployment Maps

This appendix provides detailed maps of the ITS device deployments in the Fayetteville Area. The maps identify current, funded, and proposed deployment locations.

Figure C-1: ITS Device Deployments- Overall Regional View with IDAS Model Area Highlighted

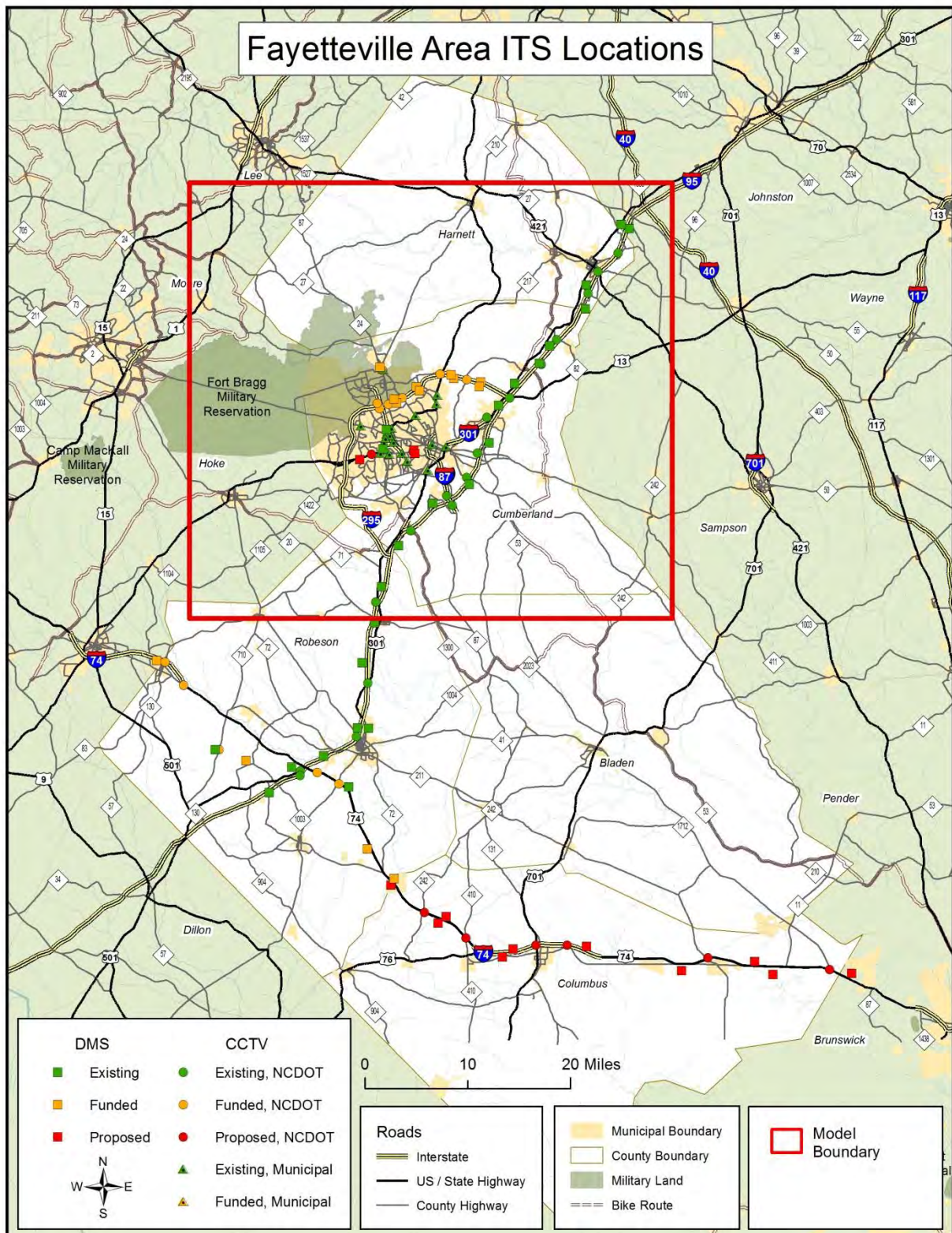


Figure C-2 provides a more detailed view of the device deployments within (and nearby) the City of Fayetteville.

Figure C-2: ITS Device Deployments- City of Fayetteville Details

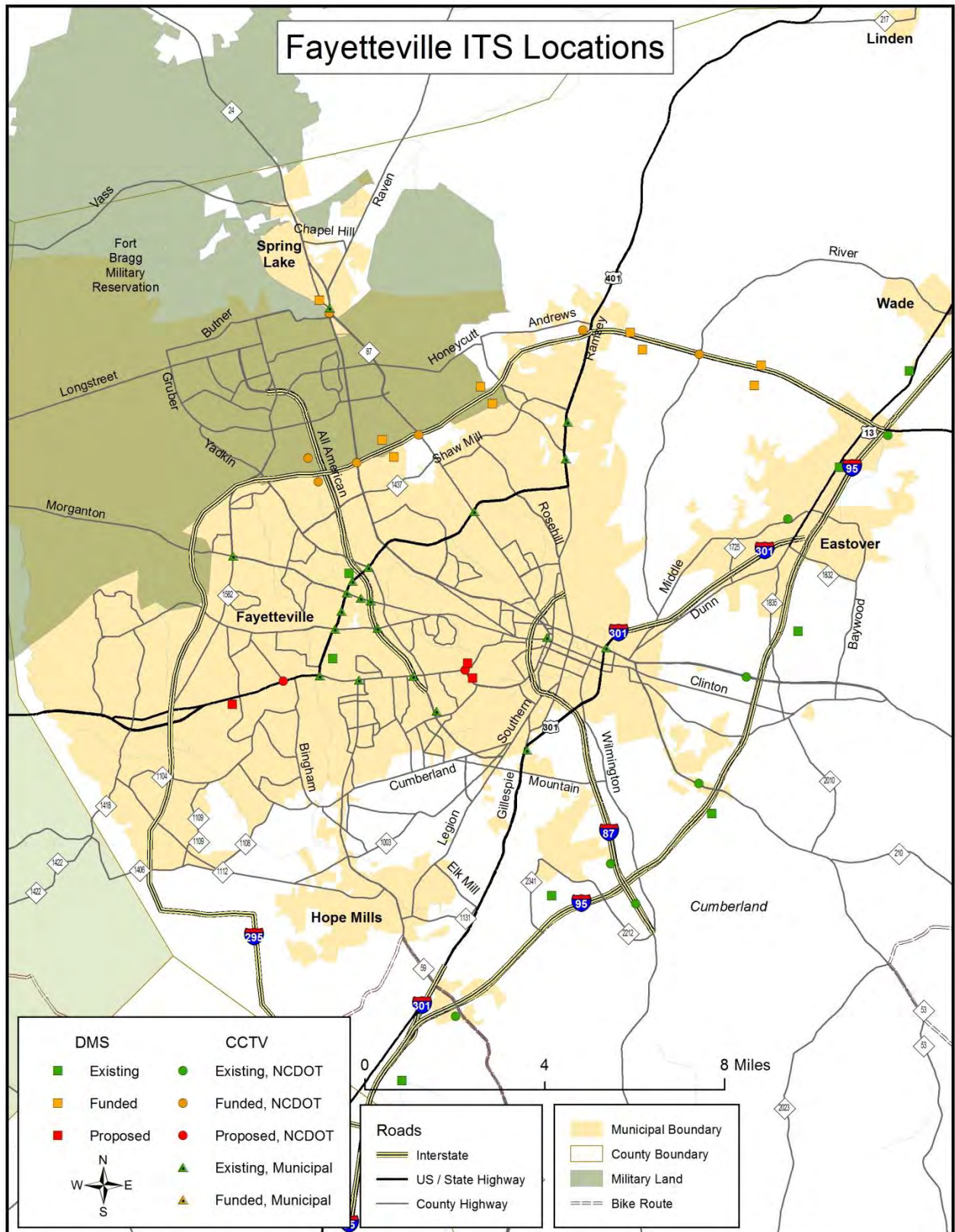


Figure 3 provides a detailed view of the ITS Device deployments in the northern part of the overall region.

Figure 3: ITS Device Deployments- Northern Portion of Region

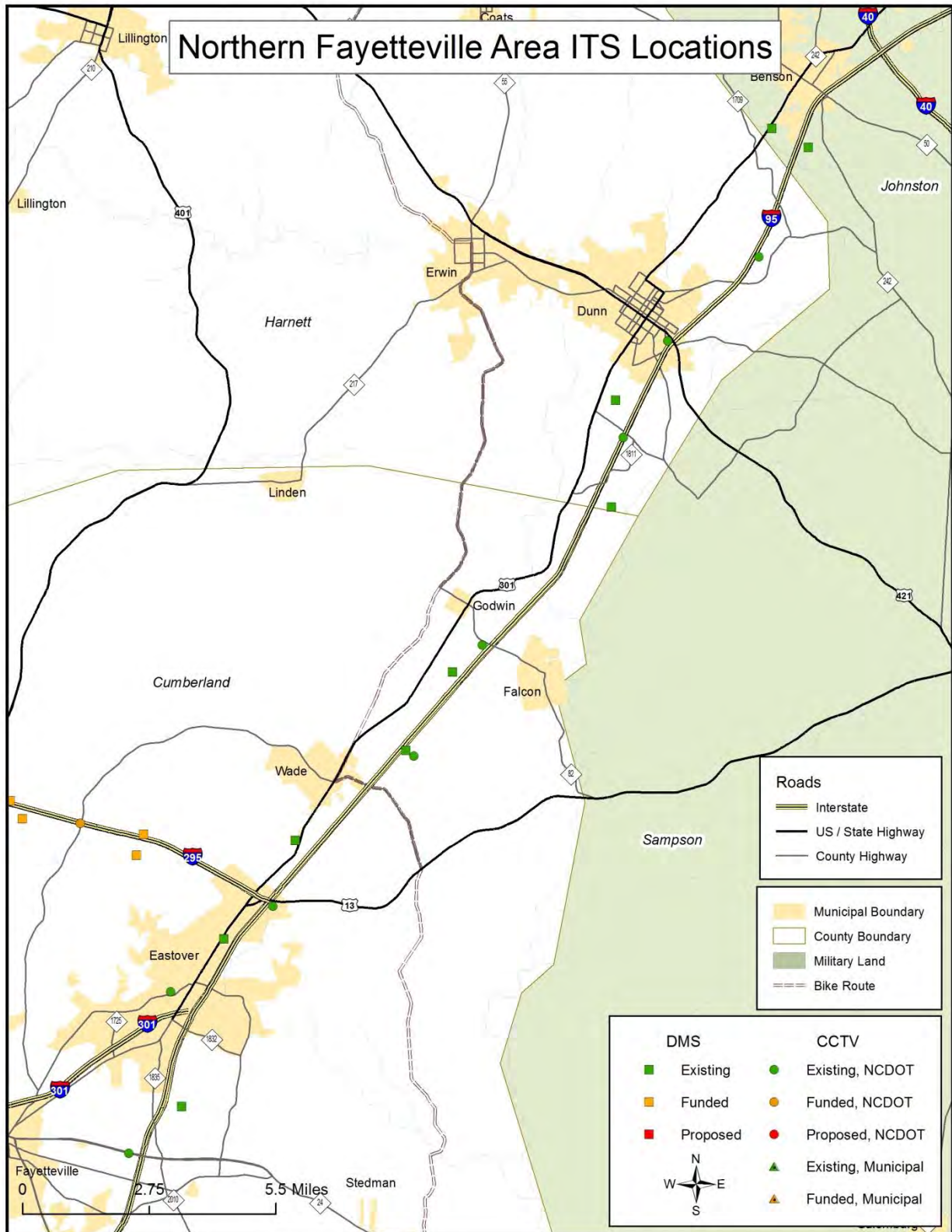
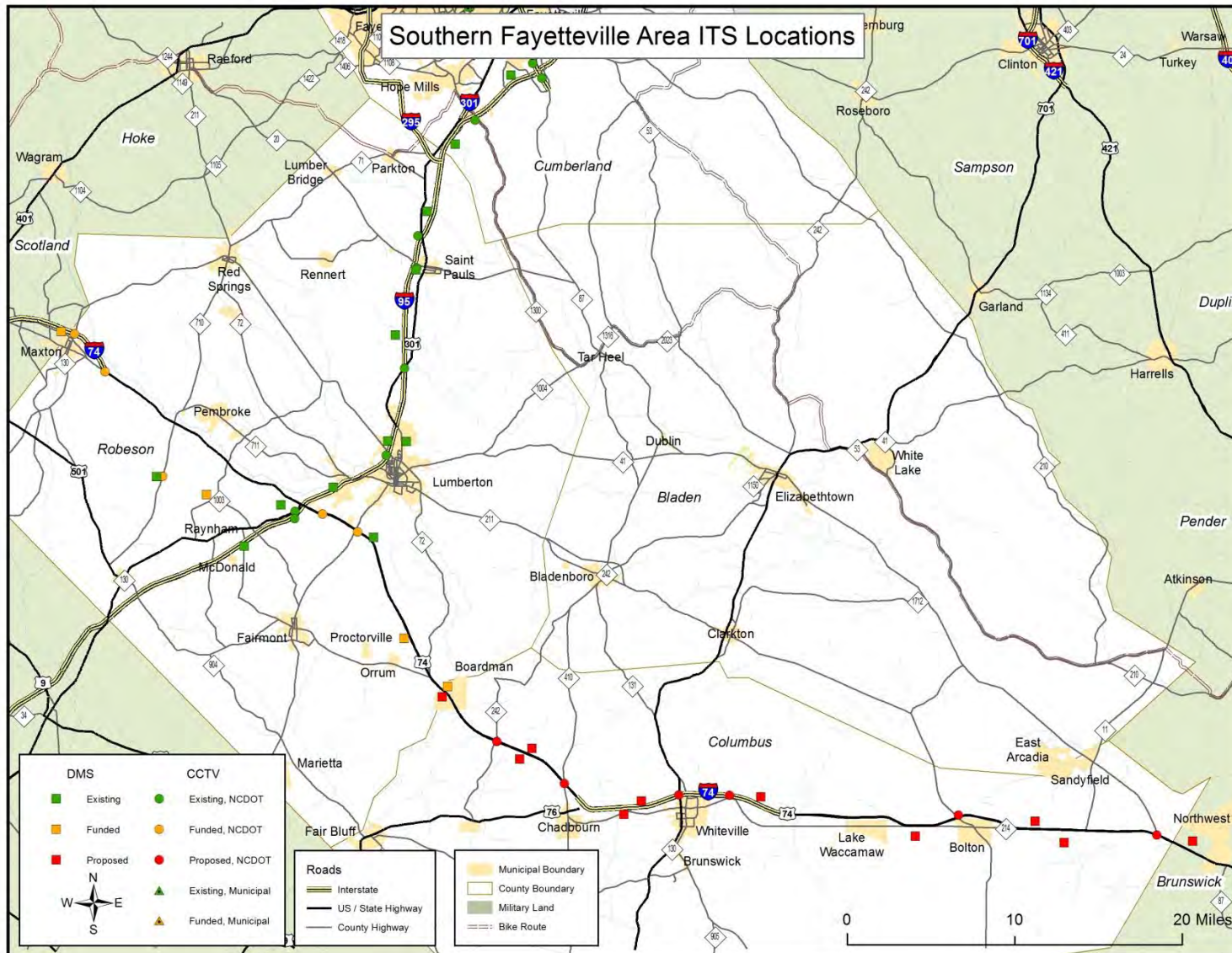


Figure 4 provides a detailed view of the ITS Device deployments in the southern part of the overall region.

Figure 4: ITS Device Deployments in the Southern Portion of Region



Appendix D Projects

Name	Description	Timeframe	Geographic Scope	Cost
FAM-ADFAMPO-001	Regional Data Warehouse. Includes data collection and management capabilities provided by the ITS Data Mart, and adds the functionality and interface definitions that allow collection of data from multiple agencies and data sources across modes and jurisdictional bound.	Medium Term	FAMPO Region	
FAM-ADMULTI-001	ITS Data Archive. Collects data and data catalogs from one or more data sources and stores data in repository. This focused archive typically includes data covering a single transportation mode and one jurisdiction that is collected from an operational data store and archived for future use. It provides the basic data quality, data privacy, and meta data management common to all ITS archives and provides general query and report access to archive data users.	Medium Term	One per agency	

Name	Description	Timeframe	Geographic Scope	Cost
FAM-APTSFAST-001 Intermodal Center	Multimodal transfer center. Includes traveler information system to provide estimated or actual time of arrival information systems for travelers.	Short Term	Fayetteville Transit	\$297,769
FAM-APTSFAST-002	AVL System. Complete upgrade of AVL system. Includes interface for Google Transit.	Short Term	Fayetteville Transit	\$265,533
FAM-APTSFAST-003	Complete upgrade of APC System.	Short Term	Fayetteville Transit	
FAM-APTSFAST-004	Safety and Security	Short Term	Fayetteville Transit	
FAM-APTSFAST-005	Regional Transit Payment Card. Manages transit fare collection on-board transit vehicles and at transit stops using electronic means. It allows transit users to use a traveler card or other electronic payment device. Readers located either in the infrastructure or on-board the transit vehicle allow electronic fare payment. Data is processed, stored, and displayed on the transit vehicle and communicated as needed to the Transit Management Subsystem.	Long Term	Fayetteville Transit	
FAM-APTSFAST-006	Coordination with One Stop Call Center. Coordination with Veterans One Stop call center for paratransit system.	Medium Term	Fayetteville Transit	

Name	Description	Timeframe	Geographic Scope	Cost
FAM-APTSFAST-007	Coordination with PSAP. Provide capability for PSAP to view location of Transit vehicles to assist in emergency response	Medium Term	Fayetteville Transit	
FAM-APTSFAST-008 Transit Maintenance Automation	Automate the download of maintenance information from the FAST vehicles using the AVL system, and automate the generation of work orders.	Medium Term	Fayetteville Transit	
FAM-ATMSNC24-87-001	Deploy ITS on NC 24-87. Add (4) CCTV cameras and (2) DMS.	Medium Term	NC 24-87 from I-295 to NC 27	\$517,953
FAM-ATMSBRA-001	Update Fort Bragg Traffic Signal System. Update the traffic signal control system and traffic signal controllers on Fort Bragg.	Medium Term	Fort Bragg	
FAM-ATMSBRA-002	Fort Bragg Traveler Information System. Install DMS near Fort Bragg entrances about current queues.	Medium Term	Fort Bragg entry gates	
FAM-ATMSDunn-001	Dunn Citywide Traffic Signal System. Signals and Communications	Medium Term	Dunn	\$1,475,182
FAM-ATMSFayer-001CCTV	Life Cycle Replacement. (12) Fayetteville CCTVs	Short Term	Fayetteville	\$222,370
FAM-ATMSFayer-002CCTV	Life Cycle Replacement. (12) Fayetteville CCTVs	Short Term	Fayetteville	\$222,370

Name	Description	Timeframe	Geographic Scope	Cost
FAM-ATMSFayer-003SS	Life Cycle Replacement. Fayetteville Signal System Upgrade	Medium Term	Fayetteville	\$15,079,633
FAM-ATMSFaye-004	Deploy ITS on Santa Fe and Yadkin (3) Fayetteville CCTVs.	Short Term	Fayetteville	\$60,647
FAM-ATMSFaye-005	Deploy ITS on US 401 Ramsey Street (4) Fayetteville CCTVs	Short Term	Fayetteville	\$80,862
FAM-ATMSI295-001	Add Communications Infrastructure. Add optical fiber infrastructure. (16 miles)	Medium Term	I-295 NC/24/N87 (Bragg Boulevard) to I-95.	\$2,534,400
FAM-ATMSI295-002	Add ITS Devices. Add (8) CCTV cameras and (8) DMS on I-295 from NC 24-87 (Bragg Blvd) to north I-95.	Short Term	I-295 NC/24/N87 (Bragg Boulevard) to I-95.	\$1,910,087
FAM-ATMSI295-003	Add Communications Infrastructure. Add optical fiber infrastructure. (23 miles)	Medium Term	I-295 West of NC/24/N87 (Bragg Boulevard) to I-95 in Robeson County.	\$3,643,200
FAM-ATMSI295-006	Add ITS Devices. Add (8) CCTV cameras and (4) DMS on I-295 West of NC 24-87 (Bragg Boulevard) to south I-95 in Robeson Co. I-295 from NC/24/N87 (Bragg Boulevard) to South I-95.	Long Term	I-295	\$1,035,906
FAM-ATMSI74R-001CCTV	Life Cycle Replacement. Replace CCTVs on I-74 in Robeson Co. (8)	Medium Term	I-74 - US 74	\$141,509

Name	Description	Timeframe	Geographic Scope	Cost
FAM-ATMSI74R-002DMS	Life Cycle Replacement. Replace DMS on I-74 in Robeson Co. (7)	Medium Term	I-74 - US 74	\$1,092,727
FAM-ATMSI74R-003CCTV	Life Cycle Replacement. Replace CCTVs on I-74 in Columbus Co. (6)	Long Term	I-74 - US 74	\$20,216
FAM-ATMSI74R-004DMS	Life Cycle Replacement. Replace DMS on I-74 in Columbus Co. (10)	Long Term	I-74 - US 74	\$1,750,000
FAM-ATMSI95B-001	Deploy ITS on I-95 Business/US 301. Add (6) CCTV cameras I-95 Bus. from I-95 (Exit 56) to I-95 (Exit 40)	Short Term	US 401	\$558,384
FAM-ATMSI95-002	Add Communications Infrastructure. Add optical fiber infrastructure. (20 miles)	Medium Term	I-95 from Johnston Co. line (mm 78) to I-295 (mm 58)	\$3,168,000
FAM-ATMSI95-003	Add Communications Infrastructure. Add optical fiber infrastructure. (20 miles)	Medium Term	I-95 from I-295 (mm 58) to Robeson Co. line (mm 38)	\$3,168,000
FAM-ATMSI95-004	Add Communications Infrastructure. Add optical fiber infrastructure. (20 miles)	Medium Term	I-95 from Robeson Co. line (mm 38) to Lumberton (mm 20)	\$3,000,000
FAM-ATMSI95R-005CCTV	Life Cycle Replacement. Replace CCTVs on I-95 in Cumberland Co. (9)	Medium Term	I-95	\$181,940

Name	Description	Timeframe	Geographic Scope	Cost
FAM-ATMSI95R-006DMS	Life Cycle Replacement. Replace DMS on I-95 in Cumberland Co. (8)	Medium Term	I-95	\$1,966,909
FAM-ATMSI95R-007CCTV	Life Cycle Replacement. . Replace CCTVs on I-95 in Robeson Co. (6)	Medium Term	I-95	\$121,293
FAM-ATMSI95R-008DMS	Life Cycle Replacement. Replace DMS on I-95 in Robeson Co. (8)	Medium Term	I-95	\$1,748,364
FAM-ATMSI95R-009CCTV	Life Cycle Replacement. Replace CCTVs on I-95 in Harnett Co. (2)	Medium Term	I-95	\$60,647
FAM-ATMSI95R-010DMS	Life Cycle Replacement. Replace DMS on I-95 in Harnett Co. (2)	Medium Term	I-95	\$218,546
FAM-ATMSI95-011VSL	Variable Speed Limit System. Install variable speed limit (VSL) signs for inclement weather.	Medium Term	I-95	
FAM-ATMSLumb-001	Lumberton Citywide Traffic Signal System. Signals and Communications	Medium Term	Lumberton	\$2,950,363
FAM-ATMSNC24-001	Deploy ITS on NC 24 from I-295 Loop to I-95. Add (3) CCTV cameras and (2) DMS.	Medium Term	NC 24 from Outer Loop to I-95	\$517,953
FAM-ATMSNC24-002	Deploy ITS on NC 24 from I-95 to Sampson Co. line. Add (1) CCTV cameras and (1) DMS.	Long Term	NC 24 from I-95 to Sampson Co. line	\$238,761
FAM-ATMSNC87-001	Deploy ITS on NC 87. Add (6) CCTV cameras and (0) DMS.	Medium Term	NC 87 from Ramsey St. to I-95	\$121,293

Name	Description	Timeframe	Geographic Scope	Cost
FAM-ATMSNC87-002	Deploy ITS on NC 87. Add (3) CCTV cameras and (0) DMS.	Long Term	NC 87 from I-95 to Elizabethtown	\$60,647
FAM-ATMSNC87-003	Deploy ITS on NC 87 from Elizabethtown to US 74. Add (3) CCTV cameras and (0) DMS.	Long Term	NC 87 from Elizabethtown to US 74	\$60,647
FAM-ATMSUS401-001	Deploy ITS on US 401 Bypass. Add (4) CCTV cameras and (0) DMS.	Medium - Long Term	US 401 Bypass from Ramsey St. to Hoke Co. line	\$80,862
FAM-ATMSUS401R-002DMS	Life Cycle Replacement. Replace DMS on Skibo Rd. (2)	Short Term	US 401 Byp	\$437,091
FAM-EMI95-001	The Safety Patrol Service would monitor roads that aid motorists, and offer rapid response to minor incidents (flat tire, accidents, out of gas) to minimize disruption to the traffic stream. If problems are detected, the roadway service patrol vehicles will provide assistance to the motorist (e.g., push a vehicle to the shoulder or median).	Medium Term	NCDOT Division 6	\$262,255
FAM-EMCC-001	Connection from the PSAP to TOCs (NCDOT and City of Fayetteville) to provide video and DMS info to PSAP and for PSAP to provide incident info to TOCs.	Medium Term	Cumberland County	
FAM-EMCC-002	Additional Mobile Communications Terminals in Public Safety Vehicles (County Sheriff)	Short Term	Cumberland County	

Name	Description	Timeframe	Geographic Scope	Cost
STA-ATMSMULTI-001	An interface that allows users to customize information on trips, routes, time of day, day of week, and notification. System to alert users when an incident occurs on their pre-defined routes.		Statewide	
STA-ATMSMULTI-004 - ATMS Software	Basic event management integrated into Smartlink software. This is the replacement for the TIMS (Traffic Incident Management System).		Statewide	\$300,000
STA-ATMSMULTI-005 - ATMS Software	Add Center-to-Field (C2F) Communications to the NCDOT Smartlink Software. Add Dynamic Message Sign (DMS) contro, reversible lane sign control, Closed Circuit Television (CCTV) camera control, and video wall control capabilities to the NCDOT SmartLink system.	Short Term	Statewide	
STA-ATMSMULTI-006 - Detour Maps	Detour Database - Detour maps in a GIS format to be integrated into Smartlink to be placed on the web quickly and efficiently. Develop detour maps in a GIS format to be integrated into TIMS to be placed on the web quickly and efficiently.		Statewide	\$198,000

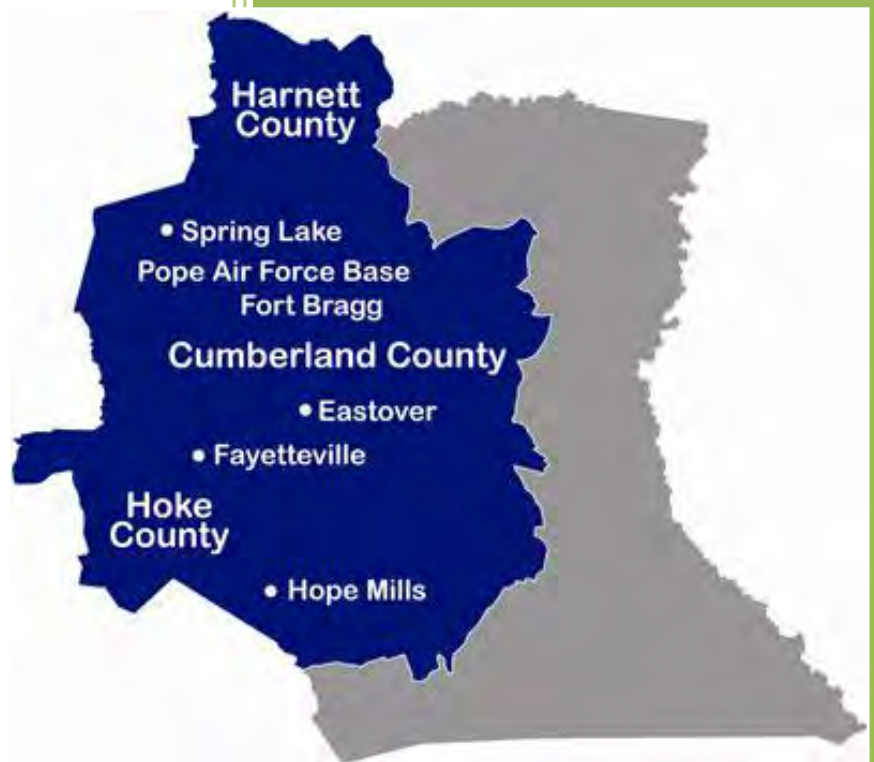
Name	Description	Timeframe	Geographic Scope	Cost
STA-ATMSMULTI-008 - ATMS Software	Integrate CAD feeds into the NCDOT SmartLink system, including the State Highway Patrol CAD/AVL.	Short Term	Statewide	
STA-ATMSMULTI-009 - ATMS Software	Smartlink will be an integrated software system that will be installed at NCDOT facilities statewide providing command and control capabilities to NCDOT operators at various locations throughout the state. All 14 NCDOT Divisions will have the capability to use Smartlink to see what the status of the transportation system is in real time at any of the Divisions connected through Center-to-Center, while Divisions and the three RTMCs and selected other facilities will have the ability to control ITS devices in the field to enhance mobility across their areas of influence.	Short Term	Statewide	
STA-ATMSMULTI-010 - ATMS Software	Add AMBER and SILVER alert messaging to the NCDOT SmartLink system.	Short Term	Statewide	

Name	Description	Timeframe	Geographic Scope	Cost
STA-ATMSMULTI-011 - ATMS Software	Add emergency management links and performance measures reporting to the NCDOT SmartLink system, as well as semi-automatic Incident Management Assistance Patrol (IMAP) dispatch and e-mail alerting for designated personnel.	Short Term	Statewide	
STA-ATMSMULTI-013 - ATMS Software	NCDOT Smartlink Interface with traffic sensors to obtain speed, volume, occupancy to support travel time calculation with automatic DMS messaging for travel times.	Short Term	Statewide	
STA-ATMSMULTI-014 - ATMS Software	Allow electronic files, such as documents and pictures, to be attached to incident records in the NCDOT SmartLink system.	Short Term	Statewide	
STA-ATMSMULTI-015 - ATMS Software	Add the capability to show other agencies (towing, EMS, law enforcement, etc.) response times in the NCDOT SmartLink incident timelines for the purposes of performance measure reporting		Statewide	
STA-ATMSMULTI-016 - ATMS Software	Add the capability for automatic incident detection based on traffic sensor data with dynamic response plan generation to NCDOT SmartLink software	Short Term	Statewide	

Name	Description	Timeframe	Geographic Scope	Cost
STA-ATMSMULTI-017 - ATMS Software	Add the capability for Highway Advisory Radio (HAR), Road Weather Information System (RWIS), automatic Safety Patrol Service AVL tracking and integration with a contractor provided Computer-Aided-Dispatch software and in-vehicle Mobile Data Terminal (MDT) and digital communications radio to NCDOT SmartLink software.	Short Term	Statewide	

FAMPO Regional ITS
Strategic Deployment Plan
Update

FAMPO Regional ITS Architecture Final Document



Prepared for:

Fayetteville Area Metropolitan Planning Organization
(FAMPO)

Prepared by:

Consensus Systems Technologies

ConSysTec 

In Association with:



May 2013

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Revision History

Filename	Version	Date	Authors	Comment
Draft FAMPO Architecture Document-061912.docx	0.1	6/19/12	J. Baker	Initial Release of Draft Architecture
Draft FAMPO Architecture Document	0.2	7/13/12	J. Baker	Draft Architecture Document
Final FAMPO Architecture Document	1.0	9/19/12	J. Baker	Final Architecture Document
Final FAMPO Architecture Document	1.01	04/04/13	J. Baker	Update for Final Workbook
Final FAMPO Regional ITS Architecture Final Document 2013-05-24	1.02	05/24/13	J. Baker	Update for Final Workbook and DVD

Note: This document uses the basic outline and incorporates relevant sections of the following document developed as part of the Triangle effort: Final ITS Architecture Document, March 2010.

1 Introduction

On January 19, 2012, Consensus Systems Technologies (ConSysTec) was contracted by the County of Cumberland in the State of North Carolina, on behalf of the Fayetteville Area Metropolitan Planning Organization (FAMPO), to provide a Fayetteville (FAMPO) Regional Intelligent Transportation Systems (ITS) Strategic Deployment Plan Update in support of FAMPO's Long Range Transportation Planning process.

Under this agreement, ConSysTec and its subcontractors, Cambridge Systematics, and Foursquare ITP (project team) delivered 8 documents that collectively updates the FAMPO Strategic Deployment Plan. The following summarizes the deliverables for the FAMPO Regional ITS Strategic Deployment Plan Update.

- **Task 1:** A *Best Practices Report* that identifies solutions that may address regional deficiencies
- **Task 2:** A *Vision, Goals, and Objectives Report* that updates the FAMPO ITS Program's vision, goals and objectives
- **Task 3:** This *Gap Assessment Report*, which determines and identifies solutions that address regional goals and objectives and results in service-package based projects that can be reflected in the Regional ITS Architecture
- **Task 4:** The *Regional ITS Architecture*, developed with stakeholder input and including project architectures
- **Task 5:** *Cost Estimates of ITS Projects* delivered as a spreadsheet
- **Task 6:** A *Project Evaluation and Prioritization Report* based on an IDAS model
- **Task 7:** A *Report on Strategies for Integration of ITS into the FAMPO Transportation Planning Process*
- **Task 8:** A *Final Strategic Deployment Plan* that incorporates the previous 7 documents into one comprehensive plan

1.1 Purpose

This document is the Regional ITS Architecture document, the output of Task 4. The ***FAMPO Regional Intelligent Transportation Systems (ITS) Architecture*** is a roadmap for transportation systems integration in the Fayetteville, North Carolina region over the next 25 years. The architecture has been developed through a cooperative effort by the region's transportation agencies, covering all modes and all roads in the region. The architecture represents a shared vision of how each agency's systems will work together in the future, sharing information and resources to provide a safer, more efficient, and more effective transportation system for travelers in the region.

The architecture is an important tool that will be used by:

- Operating Agencies to recognize and plan for transportation integration opportunities in the region;
- Planning Agencies to better reflect integration opportunities and operational needs into the transportation planning process; and
- Other organizations and individuals that use the transportation system in the region.

The architecture provides an overarching framework that spans all of these organizations and individual transportation projects. Using the architecture, each transportation project can be viewed as an element of the overall transportation system, providing visibility into the relationship between individual transportation projects and ways to cost-effectively build an integrated transportation system over time.

The architecture is described by this document and by a Turbo Architecture database. In addition, a website, located at <http://www.consystec.com/fampo/web/index.htm>, contains provides access to the FAMPO ITS Architecture. While not a baseline document, this website is a reference meant to provide convenient access to the information in the architecture.

This architecture is not static, but will be revised and updated as plans change, ITS projects are implemented, and the ITS needs and services evolve in the region. This document, which describes the architecture, is a “living document” that will be updated each time the architecture is updated.

The FAMPO Regional ITS Architecture represents a consensus blueprint for ITS investments in the Fayetteville Area Metropolitan Planning Organization (FAMPO) region. The Regional ITS Architecture starts by identifying the potential ITS agencies (stakeholders) within the region. It goes on to define possible integration opportunities between agencies within the region and identifies how cooperation between the agencies in the deployment of ITS systems can be used to satisfy the region’s surface transportation needs.

This Regional ITS Architecture can be used to efficiently structure implementations of ITS technologies. By creating a long range plan for the implementation of these systems and technologies, agencies can:

- Prepare for future expansion;
- Develop coordinated deployment of ITS;
- Leverage funding; and
- Identify standard interfaces.

In addition to structuring implementations of ITS technologies, the Regional ITS Architecture allows the transportation agencies in the region to comply with the FHWA Rule/FTA Policy on Architecture and Standards. The FHWA Final Rule, 23 CFR 940, (and corresponding FTA policy) to implement Section 5206(e) of the TEA-21 requires that ITS projects funded through the Highway Trust Fund conform to the United States (U.S.) National ITS Architecture (NITSA) and applicable standards. The Rule/Policy requires that the National ITS Architecture be used to develop a local implementation of the National ITS Architecture, which is referred to as a “Regional ITS Architecture.” This Regional ITS Architecture allows identified existing and planned projects in the region to be fully compliant with this Rule/Policy, which will facilitate the approval of federal funds to support ITS projects in the region.

1.2 Document Overview

This document is organized into nine (9) main sections.

- **Section 1: Introduction.** This section provides introductory and background information about this document, its purpose and why it is needed.
- **Section 2: Regional ITS Architecture Development Process.** This section describes the process used to develop the FAMPO Regional ITS Architecture.
- **Section 3: ITS Architecture Concepts.** This section gives a brief introduction and overview of the National ITS Architecture, and how it relates to this Regional ITS Architecture.

- **Section 4: Identification of Stakeholders.** This section identifies the agencies and organizations who have an interest and participate in this Regional ITS Architecture, and their roles and responsibilities in providing ITS services in the region.
- **Section 5: ITS Systems Inventory.** This section lists the systems that exist or are planned, and provide ITS services in the region.
- **Section 6: ITS Services.** This section lists the surface transportation needs for the region that may be addressed by ITS and the ITS Services used to address those needs.
- **Section 7: Interfaces and Information Exchanges.** The section lists the interfaces and information exchanges that are needed to provide ITS Services in the region.
- **Section 8: The Application of the FAMPO Regional ITS Architecture.** This section describes how the functional requirements, standards and agreements identified in the Regional ITS Architecture can be applied to ITS Projects.
- **Section 9: Maintenance of the Regional ITS Architecture.** This section provides a discussion on how to update the Regional ITS Architecture.

2 Regional ITS Architecture Development Process

The FAMPO Regional ITS Architecture was developed using the following process.

2.1 Scope of the Architecture

The first step of the Regional ITS Architecture process is define the scope, or the boundaries, of the Architecture. Scope covers three distinct factors:

- **Geographic Scope.** The geographic area selected should consider the institutional boundaries of ITS in the region. Is it the boundaries of the Metropolitan Planning Organization (MPO), or some larger region, such as a transportation plan study area?
- **Timeframe.** The architecture is a vision for the development of ITS in the region. How far into the future will be considered? One consideration is the timeframe used by the region when developing its transportation plans. Typically, 10-20 years is standard.
- **Service Scope.** Will the architecture consider all aspects of ITS, or will it leave some (such as Commercial Vehicle Operations) to be described at a statewide level?

The **geographic** scope of the architecture is the Fayetteville Area Metropolitan Planning Organization (FAMPO) region. The region includes the City of Fayetteville, Fort Bragg, the remainder of Cumberland County, Hoke County, and Harnett County. This Regional ITS Architecture interfaces with the following statewide or regional ITS architectures:

- North Carolina Statewide Services ITS Architecture
- Triangle Region ITS Architecture

The **timeframe** considered is 25 years (2035 horizon), which is consistent with the FAMPO Long-Range Transportation Plan (LRTP) timeline. This means that the architecture addresses existing ITS systems as well as those planned for development over the next 25 years, although the focus of the FAMPO Regional ITS Architecture will be on those ITS systems or elements that will be deployed over the next 5 years. Still, the FAMPO Regional ITS Architecture represents a snapshot of the currently anticipated ITS and other projects based on information gathered from stakeholders, research from agency websites,

and published agency documents. As such, the architecture will require regular updates to ensure that it maintains accurate representation throughout the region, and accurate interfaces with each of the Regional ITS Architectures within the State of North Carolina. This is addressed in more detail in Section 9, Maintenance of the Regional ITS Architecture.

Regarding the **service** scope, the FAMPO Regional ITS Architecture covers those ITS services that are regional in nature (e.g., Transit Services, Traffic Management) as well as those services that are managed from and by statewide agencies such as the North Carolina Department of Transportation (NCDOT). Those ITS projects that are statewide in nature (e.g., Commercial Vehicle Operations) would be addressed in the North Carolina Statewide Services ITS Architecture.

2.2 Process to Create the Regional ITS Architecture

Development of the FAMPO Regional ITS Architecture relied heavily on stakeholder input to ensure that it reflected current regional needs and plans. The following five-step process was used to develop the FAMPO Regional ITS Architecture:

- Create an initial draft inventory of architecture elements and a draft set of customized ITS Services to be provided;
- Conduct stakeholder interviews;
- Create a complete draft ITS architecture for review;
- Conduct stakeholder review of the draft ITS architecture; and
- Finalize the ITS architecture based on review comments.

2.2.1 Create Initial Inventory and Services

The initial draft set of ITS elements, services and interconnections was created based upon review of existing documentation regarding FAMPO region projects and systems. This work was performed as part of the Gap Assessment task performed in Task 3 of this project. The FAMPO Regional ITS Architecture elements identified through this review were mapped to NITSA Version 7.0 entities (subsystems and terminators). This created an initial inventory mapped to the National ITS Architecture. The existing and planned ITS projects were used to establish an initial list of services that the elements of the architecture would provide. The elements and their mapping to NITSA entities were entered into the software tool, Turbo Architecture.

The next step of the Gap Assessment task was to identify the service packages from the current version of NITSA (v7.0) that could address each of the 13 objectives that were identified in the *Task 2: Vision, Goals, Objectives and Performance Report*. For each existing or future service expected in the region, the service package diagram for that service from NITSA was edited so that each NITSA subsystem or terminator was associated with the local stakeholder element name. In some cases, multiple instances of the service package were developed, where the service has more than one instance in the region. This set of customized service packages using the draft elements was created in preparation for stakeholder outreach.

2.2.2 Stakeholder Interviews

A series of stakeholder interviews were performed by the project team from January to March, 2012. The stakeholders that were interviewed represents many aspects of surface transportation in the FAMPO region. In addition, further questions and clarification of several stakeholders were made by the project team during a workshop that was held on March 27, 2012.

A key overall objective of the project is that the Regional ITS Architecture should be a consensus architecture, that is, each of the participants understands and agrees to the ITS elements and specific

information exchanges between the ITS elements identified in the architecture that they participated in defining. (This is not to say that the resulting ITS Architecture has credible funding identified that would lead to full deployment. The ITS architecture only identifies ITS elements and interfaces that the stakeholders agree to. Existing funding processes will continue to be used to decide how to allocate limited resources to which ITS elements and interfaces for deployment.)

2.2.3 Create a Draft Architecture for Review

Following the workshop, an initial draft architecture was created. Using the NITSA Service Packages to define ITS services, a set of customized service packages were developed based on the stakeholder interviews. The Turbo Architecture database was completed to create several aspects of the draft ITS architecture. This involved the following activities:

- Updating the ITS inventory;
- Developing customized Service Packages; and
- Creating a Turbo Architecture database that represents the sum of all of the customized Service Packages.

The initial draft architecture was reviewed with the stakeholders during a Stakeholder Workshop held on April 27, 2012. The initial draft of the stakeholders, elements, ITS services and service package diagrams, and current and future ITS projects were reviewed with the stakeholders during this Workshop. As each aspect of the Regional ITS Architecture was reviewed by the project team, the stakeholders were given an opportunity to provide feedback. Not only did this provide valuable feedback on the initial draft of the Regional ITS Architecture, but also served as a forum for stakeholders to come to agreements on how the architecture should eventually be deployed, or how existing system could be fully utilized by all stakeholders.

2.2.4 Conduct Stakeholder Review of the Draft ITS Architecture

After the Stakeholder Workshop, the project team updated the ITS inventory and the customized service packages. Functional requirements and operational concepts were added to the Turbo Architecture database. .

Stakeholders were notified by email that a review period has commenced, and feedback was solicited. Stakeholders were encouraged to review the Regional ITS Architecture, and were encouraged to provide feedback.

The project team then reviewed the draft Regional ITS Architecture with stakeholders during another workshop on June 19, 2012. Additional comments about the Regional ITS Architecture and ITS projects were collected from the stakeholders during this workshop.

2.2.5 Finalize the Architecture Based on Review Comments.

Following the comments and workshop, the Draft ITS Architecture was revised based on comments from the workshop. Additional architecture aspects such as project sequencing, and agreements were developed and additional stakeholder review comments were solicited. The information was compiled into this final report.

2.3 Requirements of the Final FHWA Rule and FTA Policy on Architecture

The FHWA Final Rule (23CFR 940) and FTA Policy on Intelligent Transportation System Architecture and Standards, which took effect on April 8, 2001 defines a set of requirements that regional ITS architectures should meet. Table 1 shows how the requirements of the rule are met by the outputs developed for the FAMPO Regional ITS Architecture.

Table 1. FHWA Final Rule Requirements

Regional ITS Architecture Requirements	Where Requirements Documented
Description of region	Geographic definition, as well as timeframe and scope of services are given in Section 2.1 of this document.
Identification of participating agencies and other stakeholders	Listing of stakeholders and their definitions is given in Appendix C of this document. An inventory of the elements operated by the stakeholders is contained in Appendix E of this document. The same information is also available in the Turbo Architecture database.
An operational concept that identifies the roles and responsibilities of participating agencies and stakeholders	The operational concept is defined in Section 4.3 of this document.
A list of any agreements (existing or new) required for operations	A discussion of existing and needed new agreements is given in Section 8.4 of this document.
System functional requirements	The functional requirements of the ITS systems are described in an overview in Section 8.2 of this document, and are found on the in the Turbo Architecture database
Interface requirements and information exchanges with planned and existing systems and subsystems	The Interfaces and information flows are described in an overview in Section Error! Reference source not found. of he document, and are described in detail in the Turbo Architecture database.
Identification of ITS standards supporting regional and national interoperability	The identification of standards for ITS in the FAMPO region is discussed in Section 8.3 of this document.
The sequence of projects required for implementation	Projects for the FAMPO region are covered in Section 8.1, and listed in Appendix G of this document.
Develop and implement procedures and responsibilities for maintaining the architecture as needs evolve within the region.	The Maintenance Plan is contained in Section 9.

3 ITS Architecture Concepts

The FAMPO Regional ITS Architecture is a regional ITS architecture, which has been defined by FHWA Rule 940 as a “regional framework for ensuring institutional agreement and technical integration for implementation of ITS projects”. Regional ITS architectures are developed in order to provide a guide for the integration of transportation systems. The FAMPO Regional ITS Architecture is based upon the NITSA Version 7.0. A complete description of the NITSA architecture can be found at <http://www.iteris.com/itsarch>.

What are some of the main parts of an ITS architecture? They are made of the following:

- Organizations
- Systems operated
- Services provided
- Functions performed
- Information exchanged

The organizations that operate systems in the region covered by the architecture are referred to as stakeholders. These are public agencies, private organizations or the traveling public with a vested interest, or a "stake" in one or more transportation elements within a regional ITS architecture.

The systems operated by the stakeholders are referred to as elements. In the FAMPO Regional ITS Architecture, the elements represent actual systems, such as the City of Fayetteville Traffic Operations Center. An element may also represent field devices, for example the element City of Fayetteville Traffic Signals. A more thorough discussion of the architecture elements is contained in Section **Error! eference source not found..** The Regional ITS Architecture uses a set of common concepts or terms drawn from NITSA to describe the parts of the architecture. Since these NITSA terms show up repeatedly in later discussion they will be defined here.

The NITSA uses two terms to describe the systems that make up an architecture. They are:

- **Subsystems**, which represent the primary systems described by the architectures. For example the TMC element mentioned above represents a regional ITS architecture example of the Traffic Management Subsystem defined in the National ITS Architectures. Version 7.0 of the NITSA has 22 subsystems defined.
- **Terminators**, which represent systems that are on the boundary of the architecture. In general only interfaces to the terminators are described in the national architectures. An example of a terminator from the National ITS Architecture is the Weather Service. Version 7.0 of the NITSA has 76 terminators defined.

As a part of developing a regional ITS architecture, each element of the region is mapped to the subsystems and/or terminators that most closely define the functions of the element. This mapping allows the regional version to use the details associated with the subsystems and terminators in the NITSA. As an example, the element in the Regional ITS Architecture called National Weather Service is mapped to the National ITS Architecture terminator Weather Service.

The information exchanged between elements (in the Regional ITS Architecture) or between subsystems and terminators in the NITSA is described by information flows or architecture flows. There are hundreds of these flows defined in the National ITS Architecture, and it is this information that is used to create the interface definitions in the Regional ITS Architecture. For example in Figure 1, the top two boxes show an interface between two subsystems, with its information flows defining the exchange of information. A corresponding interface in the FAMPO Regional ITS Architecture is shown in the bottom two boxes.

By mapping the Regional ITS Architecture elements (e.g., City of Fayetteville Traffic Operations Center) to National ITS Architecture subsystems (or terminators) (e.g. Traffic Management Subsystem), the interfaces defined in the National ITS Architecture can be used as the basis for defining the interfaces in the Regional ITS Architecture.

The next key concept used by the architectures is that of Service Packages. These represent slices of an architecture that provide a transportation service. In NITSA, these Service Packages are combinations of subsystems and information flows that are used to provide the service. An example of a NITSA Service Package is shown in Figure 2. This shows the subsystems and information flows (some of which go to terminators) that perform the monitoring and control of roadway devices from a traffic management system used to control a street network. In the development of Regional ITS Architecture, a set of customized Service Packages were created that define the elements and interfaces used to provide the service in Regional ITS Architecture.

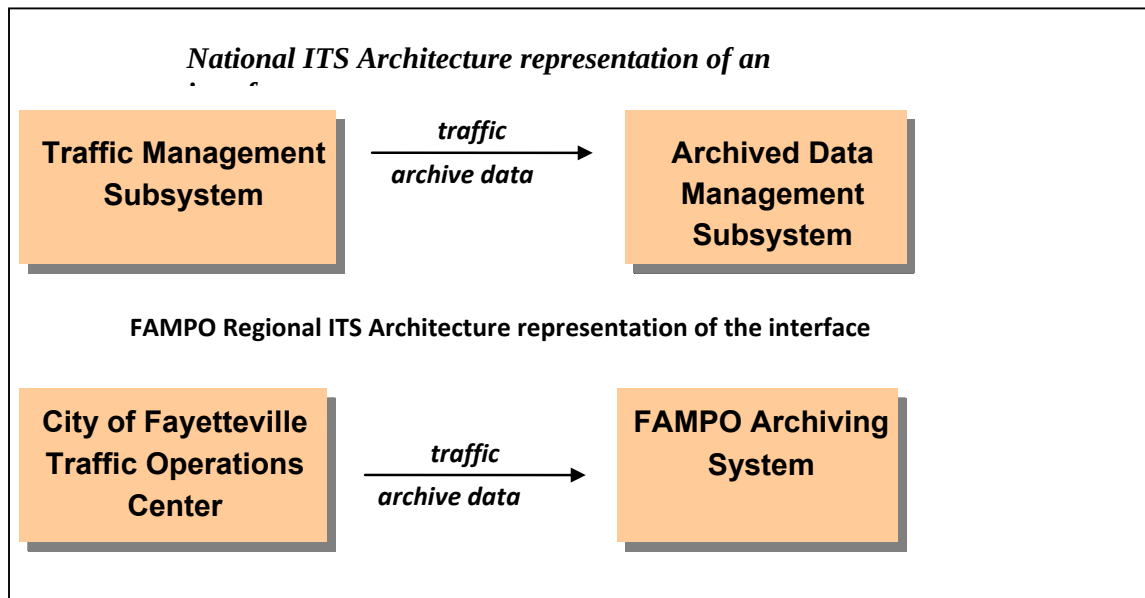


Figure 1. Information Flows

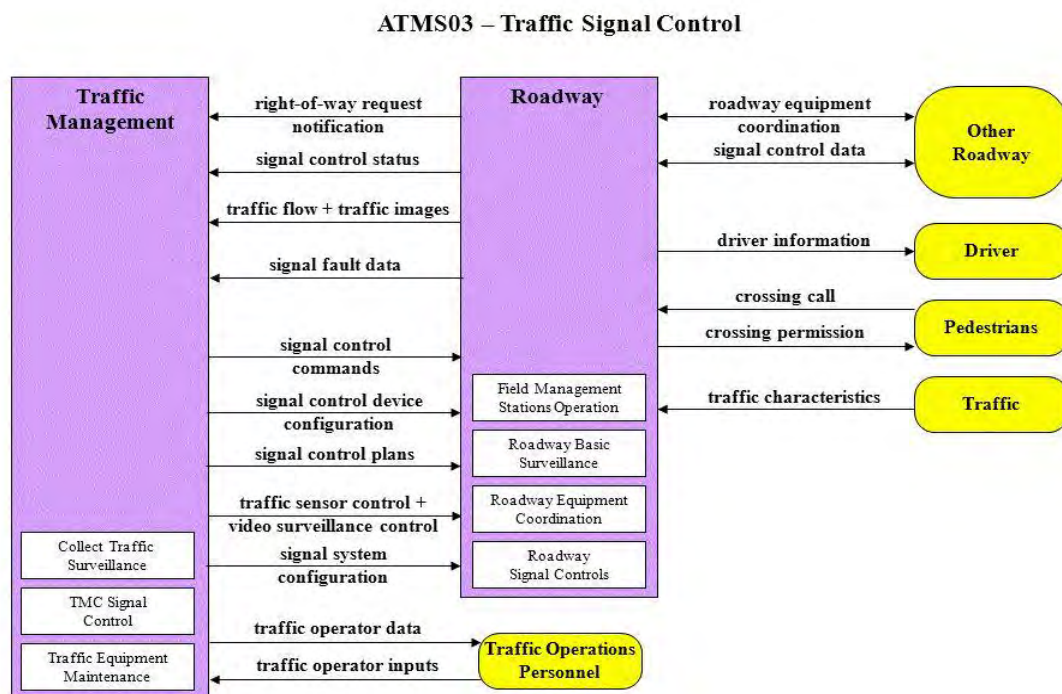


Figure 2. Example of National ITS Architecture Service Package

Figure 3 shows one of the customized service packages, in this case for the City of Fayetteville Traffic Operations Center. This diagram shows how City of Fayetteville Traffic Operations Center might implement the Surface Street Control Service.

Notice that the customized service package includes only some of the interfaces that were defined in the NITSA Service Package. It does not include interfaces to an Information Service Provider, personnel or a map update provider element. Elements mapping to these are not planned for the near future in the FAMPO region and thus are not included in the Regional ITS Architecture.

One final concept to mention relates to the functions performed by the elements in the architecture. The NITSA has the concept of an equipment package, which defines a piece of functionality within a subsystem. In Figure 2, Collect Traffic Surveillance is a function (or equipment package) that is performed by the Traffic Management Subsystem in performing the Surface Street Control Service. In the Regional ITS Architecture functions have been identified for the key elements using a mapping of equipment packages to each element. For example, the City of Fayetteville Traffic Operations Center (shown in **Figure 3**) will implement the Collect Traffic Surveillance equipment package (shown in Figure 2 as functionality in the Traffic Management Subsystem). Further information regarding how functions are defined for each element is found in Section 8.2 on Functional Requirements.

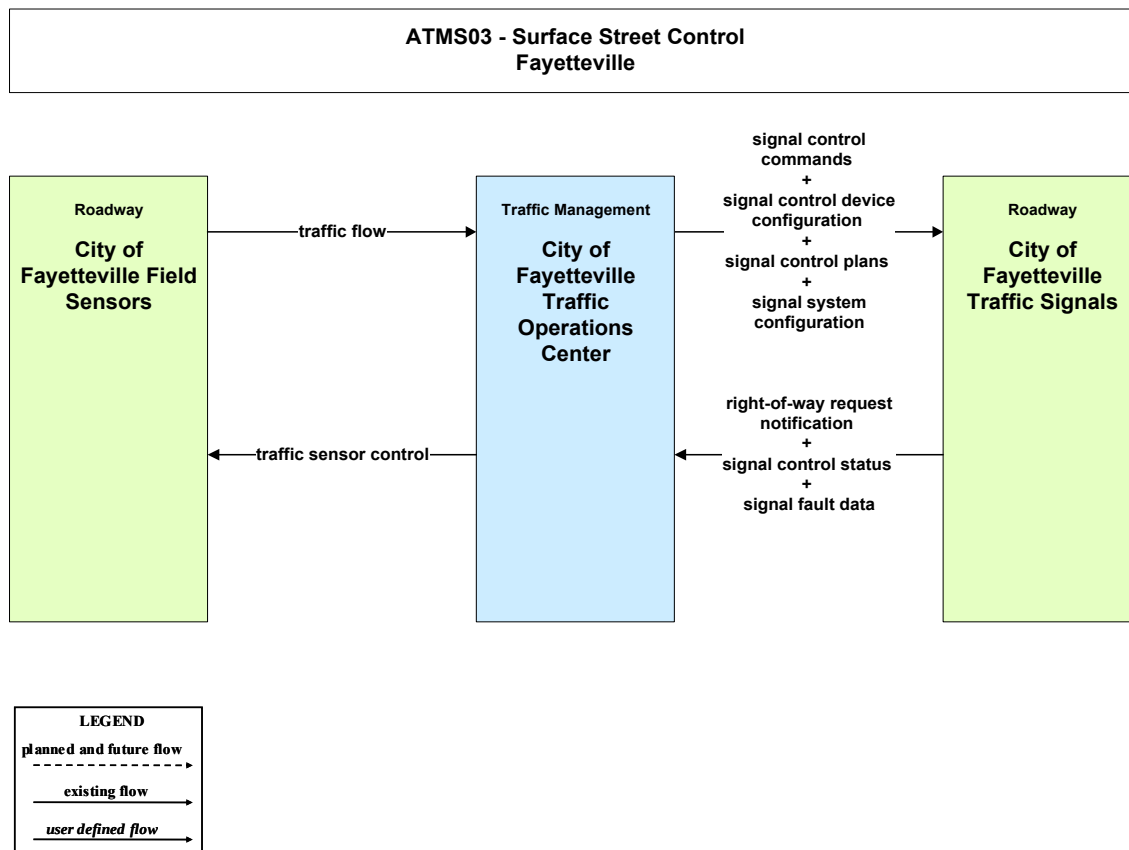


Figure 3. Example of a Customized Service Package

4 Identification of Stakeholders

4.1 Champion

In order to successfully develop a Regional ITS Architecture, it is necessary to have a champion who can lead the effort from the region's viewpoint. This champion should have the following skills/capabilities:

- A vision for interconnectivity, partnership, and regional integration;

- Knowledge of the local and regional ITS systems and projects;
- Understanding what a regional ITS architecture is, and how to use it most effectively in the planning process;
- A consensus builder or facilitator; and
- Executive level access to resources in order to gain the support of various regional or statewide agencies.

The champion for development of the FAMPO Regional ITS Architecture is the Fayetteville Area Metropolitan Planning Organization (FAMPO).

4.2 Stakeholders

Stakeholder coordination and involvement is one of the key elements of the development of a regional ITS architecture. Because ITS often transcends traditional transportation infrastructure, it is important to consider a range of stakeholders beyond the traditional traffic, transit, and maintenance areas. In addition, it is important to consider stakeholders at a regional level or stakeholders in adjoining regions.

The FAMPO Regional ITS Architecture includes a wide range of stakeholders. Many of these stakeholders were present at the stakeholder meetings described in the previous section. Appendix C provides a listing of the full range of stakeholders assigned to elements in the FAMPO Regional ITS Architecture. The table provides a name and description of the agency, department, or organization represented by the stakeholder.

The stakeholders listed in Appendix C represent a mix of specific agencies or organizations and generic names used to represent a variety of stakeholders. An example of specific agencies or organizations would be the North Carolina Division of Emergency Management.

Generic stakeholders were included to represent groups of agencies and organizations. While it may be ideal to list every stakeholder in the region, it is unrealistic - listing all potential stakeholder makes the Regional ITS Architecture unwieldy and difficult to maintain. For example, without using generic stakeholders, if a small city or town grows and begins to provide ITS services, the city or town would need to be added to the Regional ITS Architecture. However, if a generic stakeholder name was used, such as Local Traffic Management Departments, a new stakeholder would not have to be added to the Regional ITS Architecture. The definition of Local Traffic Management Department is, "This stakeholder group generically represents all regional (county and municipal) departments not specifically called out in the ITS architecture that provide traffic and engineering management services within its jurisdiction."

4.3 Operational Concept

An Operational Concept documents each stakeholder's current and future roles and responsibilities in the operation of the regional ITS systems. The operational concept documents these roles and responsibilities across a range of transportation services. The services covered are:

- **Surface Street Management.** The development of systems to monitor and operate arterials and provide coordinated intersection timing over a corridor, an area, or multiple jurisdictions.
- **Highway Management.** The development of systems to monitor highway traffic flow and roadway conditions. Includes systems to provide information to travelers on the roadway.
- **Incident Management.** The development of systems to provide rapid and effective response to incidents. Includes systems to detect and verify incidents, along with coordinated agency response to the incidents.

- **Transit Management.** The development of systems to more efficiently manage fleets of transit vehicles or transit rail. Includes systems to provide transit traveler information both pre-trip and during the trip.
- **Traveler Information.** The development of systems to provide static and real time transportation information to travelers.
- **Emergency Management.** The development of systems to provide emergency call taking, public safety dispatch, and emergency operations center operations.
- **Maintenance Management.** The development of systems to manage the maintenance of roadways in the region, including winter snow and ice clearance. Includes the managing of construction operations.
- **Archive Data Management.** The development of systems to collect transportation data for use in non-operational purposes (e.g. planning and research).
- **Electronic Payment.** The development of electronic fare payment systems for use by transit and other agencies (e.g. parking).

Appendix D identifies the roles and responsibilities of key stakeholders for the specified range of transportation services.

5 ITS Systems Inventory

Each stakeholder agency, company, or group owns, operates, maintains or plans ITS systems in the region. The Regional ITS Architecture inventory is a list of “elements” that represent all existing and planned ITS systems in a region as well as non-ITS systems that provide information to or get information from the ITS systems. The focus of the inventory is on those systems that support, or may support, interfaces that cross stakeholder boundaries (e.g., inter-agency interfaces, public/private interfaces).

The vast majority of the inventory represents ITS systems in the region, but the inventory does contain some elements that represent systems in adjoining regions. An example of an element in an adjoining region would be the NCDOT STOC, which represents the statewide traffic management center in Raleigh. It would interface with a traffic element in region.

Each element in the inventory is described by a name, the associated stakeholder, a description, general status (e.g. existing or planned), and the associated subsystems or terminators from NITSA.

5.1 Systems by Stakeholder

Appendix E sorts the inventory by stakeholder so that each stakeholder can easily identify all the relevant elements that are defined in the architecture. For each element in the inventory, the table provides an element description and an indication of whether the element exists or is planned.

The majority of elements in the inventory represent a specific existing or planned system. Some examples of specific systems are the City of Fayetteville Traffic Operations Center and NCDOT Statewide Traffic Operations Center (STOC).

Some of the elements represent sets of devices rather than a single specific system or device. An example of this type of element is the element NCDOT DMS. This element represents all of the DMSs that are operated by NCDOT. The element describes the type of field device, not the specific number of devices.

A third type of element in the inventory is a generic element that represents all of the systems of a certain type in the region. An example of this type of element is Local County Emergency Communications Center, which represents the public safety dispatch functions at the municipal and county level. These generic elements have been created for two primary reasons.

First, they represent elements with similar types of interfaces. From a standardization standpoint, describing how one of the major elements in the region (e.g., the City of Fayetteville Traffic Operations Center) interfaces with various public safety dispatch functions would be the same. A generic element provides an implication that the interfaces between that generic element and another ITS element will be consistent and/or similar, yielding integration cost savings in the end.

Second, describing many systems with a single element helps keep the architecture from growing too large – the Regional ITS Architecture may have so many ITS elements defined that the architecture becomes unwieldy and difficult to maintain.

5.2 Systems by Architecture Entity

Each element in the FAMPO Regional ITS Architecture inventory is mapped to one or more entities from the NITSA. In Version 7.0 of the NITSA, there are 98 entities defined. These 22 subsystems and 76 terminators describe a wide array of systems that provide ITS services or interface with systems that provide ITS services. The mapping of Regional ITS Architecture elements to NITSA entities has two primary benefits. First, it allows the full set of information flows contained in the National ITS Architecture to be used in the description of Regional ITS Architecture interfaces. Secondly, it allows the elements of the Regional ITS Architecture to be grouped by like entity.

Appendix F sorts inventory elements by entity. This table allows the users of the architecture to immediately identify all the elements that have functions relating to transit management, traffic management, or any other subsystem or terminator defined by NITSA.

The FAMPO Regional ITS Architecture inventory contains the following number of elements mapped to different types of entities (note that some elements are mapped to more than one entity since they perform functions that are covered by more than one entity in NITSA):

- Archived Data Management: 3
- Emergency Management: 23
- Information Service Providers: 10
- Maintenance and Construction Management: 11
- Roadway Subsystems: 21
- Traffic Management: 8
- Transit Management: 6

6 ITS Services

The ITS systems in the FAMPO Region currently provide a variety of transportation services and that list will grow as more systems are developed or upgraded. The current and planned services can be described by the set of Service Packages that are shown in Table 2. This set of services is a subset of the services contained in the National ITS Architecture, and represent all of the selected services based on information gathered at stakeholder meetings, needs assessments, and from the review of planning documents. Each of the Service Packages is currently implemented or planned for implementation on a very small scale throughout the region. For some services, there are one or more stakeholders who have

implemented a service while it is planned for the other stakeholders. In this case the service will be listed as “existing” to show that some implementation of the service is taking place in the region.

Table 2. Regional Service Packages

Service Package	Service Package Name	Status
AD1	ITS Data Mart	Planned
AD2	ITS Data Warehouse	Planned
APTS01	Transit Vehicle Tracking	Existing
APTS02	Transit-Fixed Route Operations	Existing
APTS03	Demand Response Transit Operations	Planned
APTS04	Transit Fare Collection Management	Planned
APTS05	Transit Security	Planned
APTS06	Transit Fleet Management	Planned
APTS07	Multi-modal Coordination	Planned
APTS08	Transit Traveler Information	Planned
APTS10	Transit Passenger Counting	Planned
ATIS01	Broadcast Traveler Information	Planned
ATIS02	Interactive Traveler Information	Planned
ATMS01	Network Surveillance	Existing
ATMS03	Traffic Signal Control	Existing
ATMS06	Traffic Information Dissemination	Existing
ATMS07	Regional Traffic Management	Planned
ATMS08	Traffic Incident Management System	Planned
ATMS10	Electronic Toll Collection	Planned
ATMS13	Standard Railroad Grade Crossing	Planned
ATMS15	Railroads Operations Coordination	Planned
ATMS16	Parking Facility Management	Planned
ATMS18	Reversible Lane Management	Planned
ATMS22	Variable Speed Limits	Planned
CVO10	HAZMAT Management	Planned
EM01	Emergency Call-Taking and Dispatch	Existing
EM02	Emergency Routing	Planned
EM04	Roadway Service Patrols	Planned
EM05	Transportation Infrastructure Protection	Planned
EM06	Wide-Area Alert	Planned
EM07	Early Warning System	Planned
EM08	Disaster Response and Recovery	Planned
EM09	Evacuation and Reentry Management	Planned
EM10	Disaster Traveler Management	Planned
MC01	Maintenance and Construction Vehicle and Equipment Tracking	Planned
MC02	Maintenance and Construction Vehicle Maintenance	Planned

Service Package	Service Package Name	Status
MC07	Roadway Maintenance and Construction	Planned
MC08	Work Zone Management	Planned
MC10	Maintenance and Construction Activity Coordination	Planned

Incident Management, identified as ATMS08 in the above table, is one of the key services that are planned throughout the FAMPO region and the entire United States. Although it is technically called Traffic Incident Management System, and identified numerically in the NITSA as ATMS08, a broader view of this service includes several Service Packages, including:

- ATMS03 –Traffic Signal Control
- ATMS04 – Traffic Metering
- ATMS06 – Traffic Information Dissemination
- ATMS07 – Regional Traffic Management
- ATMS08 – Traffic Incident Management System
- EM01 – Emergency Call-Taking and Dispatch
- EM02 – Emergency Routing

As indicated by Table 2 above, all of these services are identified as existing or planned for the FAMPO Regional ITS Architecture.

7 Interfaces and Information Exchanges

The ITS Services desired for the FAMPO region and the ITS elements to provide those services were identified in the previous step. This step determines what ITS elements have to be interconnected and what information must be shared between those ITS elements to provide those ITS Services. The interface definitions also should build on the operational concepts defined in an earlier step.

7.1 Customized Service Packages

The service packages of the NITSA were customized to reflect the unique systems and connections of the region. Each customized service package is shown graphically, with the service package name, the entity from NITSA, and the specific FAMPO elements associated with the entity. In addition the service packages show the information flows that move between elements.

Figure 4 is an example of an ATMS service package for Traffic Signal Control that has been customized for the FAMPO Region. This service package shows two subsystems, Traffic Management and Roadway, and the associated elements. Information flows (called “architecture flows” in NITSA) between the subsystems indicate what information is being shared. Service packages are grouped by stakeholder and by functional areas (e.g. Traffic Management, Maintenance and Construction, and Public Transportation) and each set of customized service packages can be viewed by clicking on the PDF icon under each area heading

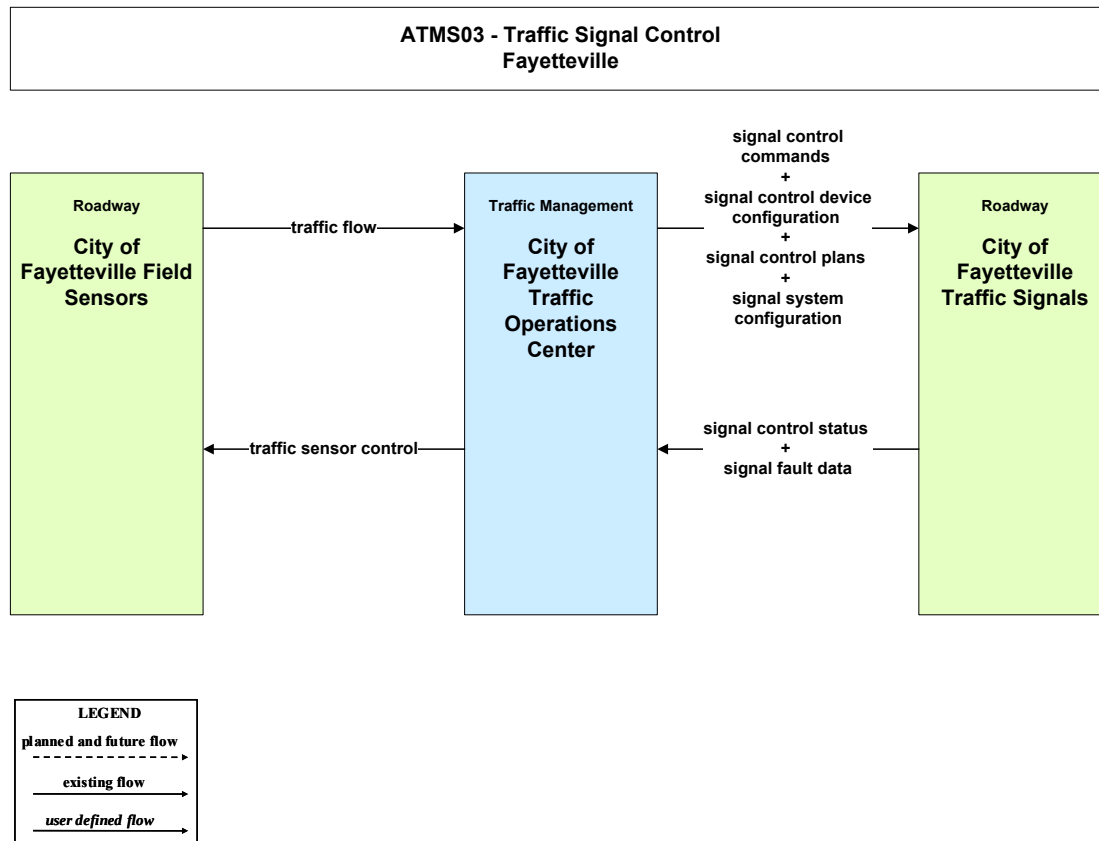


Figure 4. Example Customized Service Package

7.2 Regional Architecture Information Flows

While it is important to identify the various systems and stakeholders as part of a regional ITS architecture, a primary purpose of the architecture is to identify the connectivity between transportation systems in the region. The customized Service Packages represent services that can be deployed as an integrated capability, and the customized Service Package diagrams show the information flows between the subsystems and terminators that are most important to the deployment of the Service Packages. How these systems interface with each other is an integral part of the overall architecture.

There are 132 different elements identified as part of the FAMPO Regional ITS Architecture. These elements include municipal, county, and state traffic operations centers, transit centers, transit vehicles, public safety dispatch centers, media outlets, and others—essentially all of the existing and planned physical components that contribute to the region’s intelligent transportation system. Interfaces have been defined for each element in the architecture. For example, the City of Fayetteville Traffic Operations Center has planned interfaces with 24 other elements in the region ranging from field equipment to transit centers. Some of the interfaces are far less complex. For example the City of Fayetteville Maintenance Garage has interfaces with only two other elements in the architecture. In total the architecture defines 669 interfaces from one element to another.

Architecture flows between the elements define specific information that is exchanged by the elements. Each architecture flow has a direction, name and definition. Most of the architecture flows match ones from NITSA (the mapping of elements to NITSA entities allowed the developers to match the

architecture flows to the appropriate interfaces). In some cases user defined flows have been created for interfaces or connectivities that are not expressed in NITSA (Note these flows have a “_ud” at the end of the name to indicate they are user defined.). These architecture flows define the interface requirements between the various elements in the regional architecture. Considering a source element-architecture flow-destination element triplet, the FAMPO ITS Architecture defines 1908 of these triplets.

An example of the architecture flows between two elements is shown in **Figure 5**. In this interface the flows that go between the FAST Operations Center and the FAST Website are shown. Planned flows that do not yet exist are shown with a dotted line, while existing flows that are currently implemented are shown by a solid line.

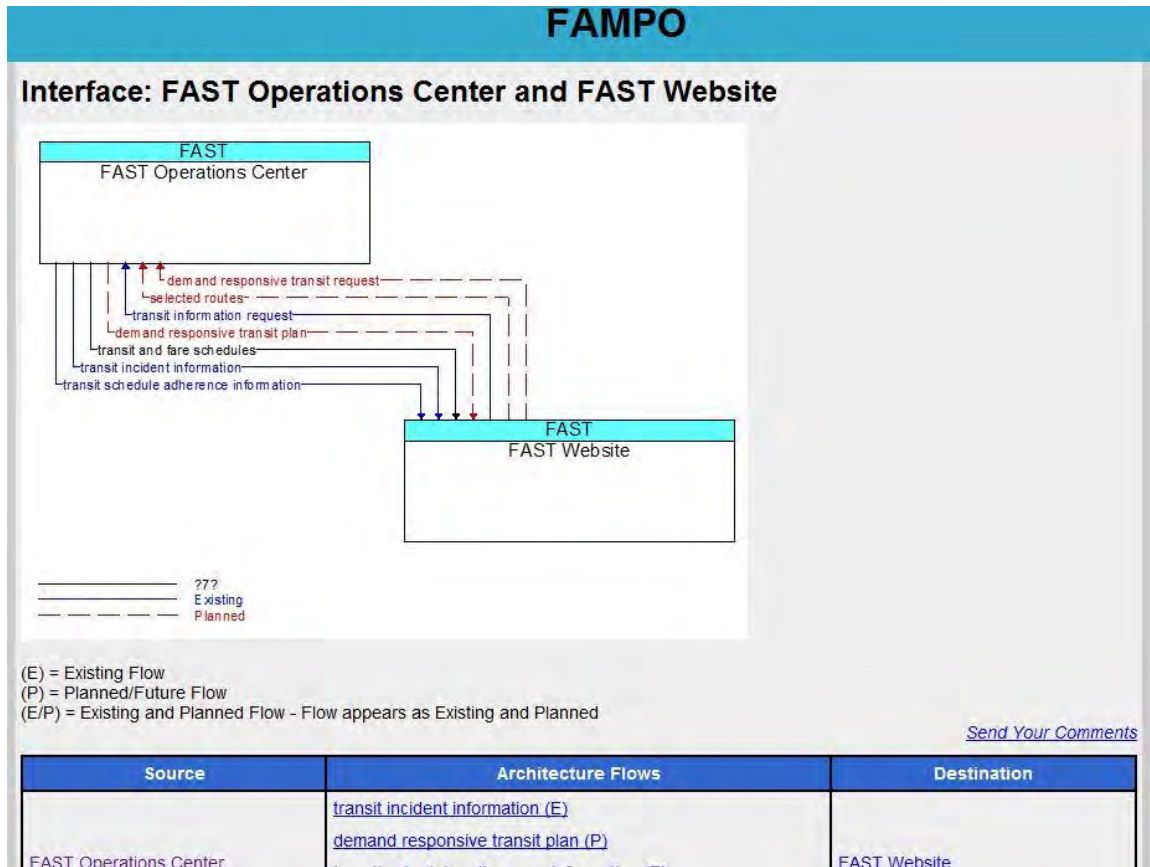


Figure 5. Example of Architecture Flows Between Elements

8 The Application of the FAMPO Regional ITS Architecture

The previous sections of the document defined the components of the Regional ITS Architecture. However, the most important part of developing an ITS architecture is establishing an approach to using it. An ITS architecture provides guidance for planning ITS projects within a region. Planning processes are used to identify projects whose implementation will respond to regional needs. Within a strategic deployment plan development, the regional ITS architecture serves as a bridge between regional goals and objectives and the ITS projects identified. By defining a regional ITS architecture with services that address the goals and objectives, ITS projects can be defined through the planning and deployment processes. Projects are the realization of a regional ITS architecture.

8.1 Projects

The incorporation of a regional ITS architecture in an agency's project development planning process will ultimately yield projects that are linked to the ITS architecture. Through the deployment of projects produced from the planning process, the services supported in the ITS architecture will be implemented and made a reality in the transportation system. Project implementation completes the evolution from refining transportation needs into services, functional descriptions in the ITS architecture, project identification in the planning process, and project definition and deployment. The overarching goal of the ITS architecture development process is that this evolution takes place with the maximum amount of integration knowledge possible, so as to efficiently and economically implement the ITS systems required to serve the transportation community and users.

Key to this process or evolution is to understand what dependencies or relationships exist between systems and projects so that an order can be identified for deployment. Given the importance of integrating ITS, the dependencies of one system on another or one project on another, it is critical to view the entire transportation system at a high functional level. The ITS architecture provides this view point and makes possible the understanding of the relationships between the ITS systems in the region.

Projects were identified based on the stakeholder defined goals and objectives and through stakeholder feedback specific to projects. These projects were evaluated as of the SDP development so they can be programmed and integrated within the regional planning process. The initial set of projects upon which the architecture is defined are shown in Appendix G.

8.2 Functional Requirements

Functional requirements are a description of the functions or activities that are currently performed by the ITS elements or that are planned to be performed in the future. For the FAMPO Regional ITS Architecture, these functions have been developed by using the functional assignments underlying the NITSA and the mapping from transportation services to the elements.

In NITSA, a Service Package is defined by subsystems, equipment packages, and architecture flows, which operate together to perform a particular transportation service (see Section 3 above). Equipment packages represent pieces of a subsystem that perform a single function. (NOTE: there are no equipment packages defined for the Terminators of the NITSA since they represent systems on the boundary of the architecture and, therefore, do not have functional descriptions within the architecture.) For example, the Traffic Signal Control (ATMS03) Service Package is composed of the three Traffic Management Subsystem equipment packages: Collect Traffic Surveillance, TMC Signal Control and Traffic Equipment Maintenance; and four Roadway Subsystem equipment packages: Roadway Basic Surveillance Roadway Signal Control and Roadway Equipment Coordination, and Field Management Stations Operation. The definitions of these seven equipment packages, copied from version 7.0 of NITSA, are:

- **Collect Traffic Surveillance.** This equipment package remotely monitors and controls traffic sensors and surveillance (e.g., CCTV) equipment, and collects, processes and stores the collected traffic data. Current traffic information and other real-time transportation information is also collected from other centers. The collected information is provided to traffic operations personnel and made available to other centers.
- **TMC Signal Control.** This equipment package provides the capability for traffic managers to monitor and manage the traffic flow at signalized intersections. This capability includes analyzing and reducing the collected data from traffic surveillance equipment and developing and implementing control plans for signalized intersections. Control plans may be developed

and implemented that coordinate signals at many intersections under the domain of a single traffic management subsystem and are responsive to traffic conditions and adapt to support incidents, preemption and priority requests, pedestrian crossing calls, etc.

- **Traffic Equipment Maintenance.** This equipment package monitors the operational status of field equipment and detects failures. It presents field equipment status to Traffic Operations Personnel and reports failures to the Maintenance and Construction Management Subsystem. The equipment package tracks the repair or replacement of the failed equipment. The entire range of ITS field equipment may be monitored by this equipment package including sensors (traffic, infrastructure, environmental, security, speed, etc.) and devices (highway advisory radio, dynamic message signs, automated roadway treatment systems, barrier and safeguard systems, cameras, traffic signals and override equipment, ramp meters, beacons, security surveillance equipment, etc.).
- **Roadway Basic Surveillance.** This equipment package monitors traffic conditions using fixed equipment such as loop detectors and CCTV cameras.
- **Roadway Equipment Coordination.** This equipment package supports direct communications between field equipment. It includes field elements that control and send data to other field elements. This includes coordination between remote sensors and field devices (e.g., Dynamic Message Signs) and coordination between the field devices themselves (e.g., direct coordination between traffic controllers that are controlling adjacent intersections.).
- **Roadway Signal Controls.** This equipment package includes the field elements that monitor and control signalized intersections. It includes the traffic signal controllers, signal heads, detectors, and other ancillary equipment that supports traffic signal control. It also includes field masters, and equipment that supports communications with a central monitoring and/or control system, as applicable. The communications link supports upload and download of signal timings and other parameters and reporting of current intersection status. This equipment package represents the field equipment used in all levels of traffic signal control from basic actuated systems that operate on fixed timing plans through adaptive systems. It also supports all signalized intersection configurations, including those that accommodate pedestrians.
- **Field Management Stations Operation.** This equipment package provides the central control and monitoring equipment, communication links, and the signal control equipment that support traffic control at signalized intersections. A range of traffic signal control systems are represented by this service package ranging from fixed-schedule control systems to fully traffic responsive systems that dynamically adjust control plans and strategies based on current traffic conditions and priority requests. This equipment package is generally an intra-jurisdictional package. Systems that achieve coordination across jurisdictions by using a common time base or other strategies that do not require real time coordination would also be represented by this package. Coordination of traffic signal systems using real-time communications is covered in the ATMS07-Regional Traffic Management service package. This equipment package is consistent with typical traffic signal control systems.

The approach used in the FAMPO Regional ITS Architecture was to begin with the mapping of equipment packages to elements, based on the mapping of elements to Service Packages within the architecture, as an initial definition of the functions being performed by each element. Then this mapping was customized in the Turbo Architecture tool to provide a more accurate picture of the functions performed by each element. The Turbo Architecture tool also contains a detailed mapping of functional requirements to each equipment package. This mapping to functional requirements has been

selected so that detailed functional requirements for each element are available for use in project definition.

8.3 ITS Standards

The following subsections provide a short discussion of ITS standards and their relation to the Regional ITS Architecture.

8.3.1 Discussion of Key Standards for the Region

ITS standards establish a common way in which devices connect and communicate with one another. This allows transportation agencies to implement systems that cost-effectively exchange pertinent data and accommodate equipment replacement, system upgrades, and system expansion. Standards benefit the traveling public by providing products that will function consistently and reliably throughout the region. ITS standards contribute to a safer and more efficient transportation system, facilitate regional interoperability, and promote an innovative and competitive market for transportation products and services.

The NITSA is the reference framework that spans all ITS standards activities and provides a means of detecting gaps, overlaps, and inconsistencies between the standards. The NITSA provides a starting point for standards development activities by identifying the applicable architecture flows and data flows to be standardized in the NITSA and the way in which the information is exchanged across those interfaces. Figure 6 shows the interfaces in the National ITS Architecture that are addressed by one or more family of ITS Standards.

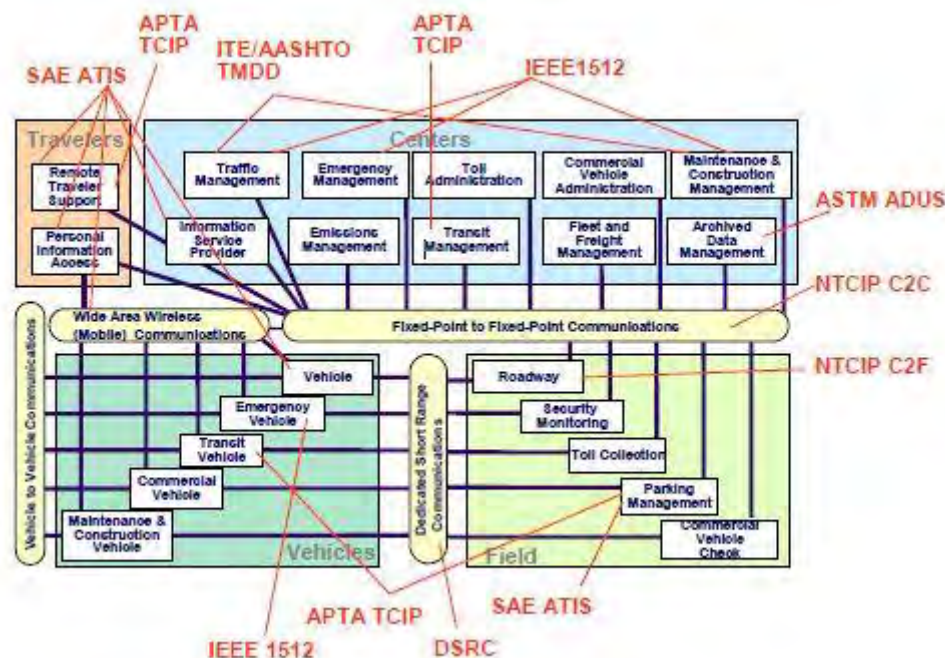


Figure 6. Relationship between the National ITS Architecture and ITS Standards

The use of ITS standards is very important to project development in the FAMPO region. Table 3 identifies the ITS standards that are potentially applicable within the region, as determined by the FAMPO Regional ITS Architecture. This table was created by taking the standards information available in the Turbo Architecture database, which identifies standards applicable to each architecture flow, and

taking the total set of standards that result from all the architecture flows selected in the FAMPO Regional ITS Architecture.

The table lists the abbreviation of Standards Development Organization (SDO) in the first column, the name of the standard in the second column and the standard identification number in the third column. Regular updates of SDO activities will help ensure that the latest standards are utilized. The SDOs involved in the development of ITS standards that are listed in Table 3 include:

- American Association of State Highway and Transportation Officials (AASHTO)
- American National Standards Institute (ANSI)
- American Public Transportation Association (APTA)
- American Society for Testing and Materials (ASTM)
- Institute of Electrical and Electronics Engineers (IEEE)
- Institute of Transportation Engineers (ITE)
- National Equipment Manufacturers Association (NEMA)
- Society of American Automotive Engineers (SAE)

Table 3. Applicable ITS Standards

SDO	Document ID	Standard Title
AASHTO/ITE	ITE TMDD	Traffic Management Data Dictionary (TMDD) and Message Sets for External Traffic Management Center Communications (MS/ETMCC)
AASHTO/ITE/NEMA	NTCIP 1201	Global Object Definitions
AASHTO/ITE/NEMA	NTCIP 1202	Object Definitions for Actuated Traffic Signal Controller (ASC) Units
AASHTO/ITE/NEMA	NTCIP 1203	Object Definitions for Dynamic Message Signs (DMS)
AASHTO/ITE/NEMA	NTCIP 1204	Object Definitions for Environmental Sensor Stations (ESS)
AASHTO/ITE/NEMA	NTCIP 1205	Object Definitions for Closed Circuit Television (CCTV) Camera Control
AASHTO/ITE/NEMA	NTCIP 1206	Object Definitions for Data Collection and Monitoring (DCM) Devices
AASHTO/ITE/NEMA	NTCIP 1207	Object Definitions for Ramp Meter Control (RMC) Units
AASHTO/ITE/NEMA	NTCIP 1208	Object Definitions for Closed Circuit Television (CCTV) Switching
AASHTO/ITE/NEMA	NTCIP 1209	Data Element Definitions for Transportation Sensor Systems (TSS)
AASHTO/ITE/NEMA	NTCIP 1210	Field Management Stations (FMS) - Part 1: Object Definitions for Signal System Masters
AASHTO/ITE/NEMA	NTCIP 1211	Object Definitions for Signal Control and Prioritization (SCP)
AASHTO/ITE/NEMA	NTCIP 1214	Object Definitions for Conflict Monitor Units (CMU)
AASHTO/ITE/NEMA	NTCIP C2C	NTCIP Center-to-Center Standards Group
AASHTO/ITE/NEMA	NTCIP C2F	NTCIP Center-to-Field Standards Group
APTA	APTA TCIP-S-001 3.0.3	Standard for Transit Communications Interface Profiles
ASTM	ASTM E2468-05	Standard Practice for Metadata to Support Archived Data Management Systems

SDO	Document ID	Standard Title
ASTM	ASTM E2665-08	Standard Specifications for Archiving ITS-Generated Traffic Monitoring Data
ASTM	ASTM E2158-01	Standard Specification for Dedicated Short Range Communication (DSRC) Physical Layer using Microwave in the 902-928 MHz Band
ASTM/IEEE/SAE	DSRC 5GHz	Dedicated Short Range Communication at 5.9 GHz Standards Group
IEEE	IEEE 1455-1999	Standard for Message Sets for Vehicle/Roadside Communications
IEEE	IEEE 1570-2002	Standard for the Interface Between the Rail Subsystem and the Highway Subsystem at a Highway Rail Intersection
IEEE	IEEE IM	Incident Management Standards Group
IEEE	IEEE P1609.11	Standard for Wireless Access in Vehicular Environments (WAVE) - Over-the-Air Data Exchange Protocol for Intelligent Transportation Systems (ITS)
SAE	ATIS General Use	Advanced Traveler Information Systems (ATIS) General Use Standards Group

8.3.2 Mapping of ITS Architecture Flows to ITS Standards

The previous section provides a general discussion of ITS standards and identifies what standards may be applicable in the region based on the FAMPO Regional ITS Architecture. NITSA contains a far more detailed standards view that maps applicable standards to the individual information flows that go from one element to another. Thus, when writing specifications to deploy the elements and the interfaces that are in depicted in the architecture, it can be a source of information on what ITS Standards may be applicable to those interfaces. This detailed information about ITS Standards is contained at the NITSA website (<http://www.iteris.com/itsarch/>) and can be accessed through the links to the architecture flows (Click on Physical Architecture -> Architecture Flows). Architecture flows which are supported by an ITS Standard, will have a Standards icon next to it. Clicking an architecture flow leads to a web page with a set of links that describe the information flow, including a description of the applicable ITS Standards at the bottom of the page. **Figure 7** is a screenshot of the ITS Standards information available for NTCIP 1203: Object Definitions for Dynamic Message Signs (DMS).

The National ITS Architecture 7.0

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NTCIP 1203: Object Definitions for Dynamic Message Signs (DMS) (Standard* Activity)

Source	Architecture Flow	Destination
Maintenance and Construction Management	roadway information system data	Roadway
Roadway	roadway information system status	Maintenance and Construction Management
Roadway	roadway information system status	Traffic Management
Traffic Management	roadway information system data	Roadway

RITA U.S. Department of Transportation Research and Innovative Technology Administration

Last Updated 3/28/2012

United States Department of Transportation

Figure 7. Example ITS Standards Information

A list of the ITS Standards that may be applicable for the FAMPO Regional ITS Architecture can be found by opening the Turbo Architecture database and clicking on the Standards tab. A screenshot of the list of these ITS Standards is shown in **Figure 8**.

Turbo Architecture - C:\Consysten\Project\FAMPO\FAMPO.tbo - FAMPO Regional ITS Architecture

File Edit Tools Output Help

Start Planning Stateholders Inventory Services Ops Concept Requirements Interfaces Standards Agreements

Current Architecture Standards: View Group Sort Filter Limit Info Present

FAMPO Regional ITS Architecture Standards (26 Entries)

Group	Group/Doc ID	Title	SDO	User Defined	In Arch	Include
ATIS General Use	ATIS General Use	Advanced Traveler Information Systems (ATIS) General Use Standards Group	SAE	☒	☒	☒
ATIS Low Bandwidth	ATIS Low Bandwidth	Advanced Traveler Information Systems (ATIS) Bandwidth Limited Standards Group	SAE	☒	☒	☒
DSRC 5GHz	DSRC 5GHz	Dedicated Short Range Communication at 5.9 GHz Standards Group	ASTM/IEEE/SAE	☒	☒	☒
DSRC 915MHz	DSRC 915MHz	Dedicated Short Range Communication at 915 MHz Standards Group	ASTM	☒	☒	☒
IEEE IM	IEEE IM	Incident Management Standards Group	IEEE	☒	☒	☒
NTCIP CDC	NTCIP CDC	NTCIP Center-to-Center Standards Group	AASHTO/ENEMA	☒	☒	☒
NTCIP C2F	NTCIP C2F	NTCIP Center-to-Field Standards Group	AASHTO/ENEMA	☒	☒	☒
APIA TCP-S-001 3.0.4	APIA TCP-S-001 3.0.4	Standard for Transit Communications Interface Profiles	APIA	☒	☒	☒
ASTM E2486-05	ASTM E2486-05	Standard Practice for Metadata to Support Archived Data Management Systems	ASTM	☒	☒	☒
ASTM E2685-08	ASTM E2685-08	Standard Specifications for Archiving ITS-Generated Traffic Monitoring Data	ASTM	☒	☒	☒
IEEE 1455-1999	IEEE 1455-1999	Standard for Message Sets for Vehicle/Roadside Communications	IEEE	☒	☒	☒
IEEE 1570-2002	IEEE 1570-2002	Standard for the Interface Between the Rail Subsystem and the Highway Subsystem at a Highway Rail Intersection	IEEE	☒	☒	☒
IEEE P1809.11	IEEE P1809.11	Standard for Wireless Access in Vehicular Environments (WAVE) - Over-the-Air Data Exchange Protocol for Intelligent Transportation Systems (ITS)	IEEE	☒	☒	☒
ITE TMD0	ITE TMD0	Traffic Management Data Dictionary (TMD0) and Message Sets for External Traffic Management Center Communications (MS/ETMCC)	AASHTO/ITE	☒	☒	☒
NTCIP 1201	NTCIP 1201	Global Object Definitions	AASHTO/ENEMA	☒	☒	☒
NTCIP 1202	NTCIP 1202	Object Definitions for Actuated Traffic Signal Controller (ASC) Units	AASHTO/ENEMA	☒	☒	☒
NTCIP 1203	NTCIP 1203	Object Definitions for Dynamic Message Signs (DMS)	AASHTO/ENEMA	☒	☒	☒
NTCIP 1204	NTCIP 1204	Object Definitions for Environmental Sensor Stations (ESS)	AASHTO/ENEMA	☒	☒	☒
NTCIP 1205	NTCIP 1205	Object Definitions for Closed Circuit Television (CCTV) Camera Control	AASHTO/ENEMA	☒	☒	☒
NTCIP 1206	NTCIP 1206	Object Definitions for Data Collection and Monitoring (DCM) Devices	AASHTO/ENEMA	☒	☒	☒
NTCIP 1207	NTCIP 1207	Object Definitions for Ramp Meter Control (RMC) Units	AASHTO/ENEMA	☒	☒	☒
NTCIP 1208	NTCIP 1208	Object Definitions for Closed Circuit Television (CCTV) Switching	AASHTO/ENEMA	☒	☒	☒
NTCIP 1209	NTCIP 1209	Data Element Definitions for Transportation Sensor Systems (TSS)	AASHTO/ENEMA	☒	☒	☒
NTCIP 1210	NTCIP 1210	Field Management Stations (FMS) - Part 1: Object Definitions for Signal System Masters	AASHTO/ENEMA	☒	☒	☒
NTCIP 1211	NTCIP 1211	Object Definitions for Signal Control and Prioritization (SCP)	AASHTO/ENEMA	☒	☒	☒
NTCIP 1214	NTCIP 1214	Object Definitions for Conflict Monitor Units (CMU)	AASHTO/ENEMA	☒	☒	☒

New Copy Modify Show Apply Cancel

Figure 8. Example Applicable Standards Mapping

8.3.3 Using ITS Standards in Projects

This section discusses how the list of ITS standards can be used in the development of an ITS project. A project extracted from the ITS architecture can be defined in terms of the transportation services it will provide, the ITS elements that are included in the project, and the interfaces between those ITS elements. For a Regional ITS Architecture, this may involve parts of one or more customized Service Package diagrams. Based on the diagrams, the relevant information exchanges between ITS systems relative to the project can be derived. From the ITS architecture, analyzing these architecture flows will yield a list of ITS standards that may be applicable to the project. Note that ITS projects that are federally funded are required to use applicable ITS standards and interoperability tests that have been officially adopted by U.S. DOT. However, as of the date of this document, no ITS standard or interoperability test has been officially adopted.

Although a regional ITS architecture provides a list of possible national standards that may be applicable, project managers must determine which standards to use for individual projects and how to specify those standards. The interfaces between systems and the ITS standards identified in the ITS architecture should be evaluated by the project specification writers. By evaluating interfaces rather than individual information flows, the amount of work required is reduced considerably.

Next, an analysis should be performed to determine what aspects of the standards on the list support the user and functional requirements that have been defined for the ITS project. Rarely will an agency need all the functions and messages that an ITS standard supports. Therefore, the project specifications should detail the required data objects (center-to-field) or messages (center-to-center) for a project.

Conversely, there is also a possibility that an ITS standard does not support all the user and functional requirements that have been defined. Many of the ITS standards are still in development and only a handful of ITS standards can be considered mature at this time, meaning the standard has been deployed and tested by numerous agencies, and has industry wide support. Although the standards-development organizations attempt to support the most common user requirements and needs, they cannot always do so or they may satisfy those requirements and needs in a different manner. In this case, agency-specific objects or messages may be needed, and these requirements should be included in the specifications.

Based on the analysis, the stakeholders should agree what standards, if any, should be adopted for each interface. It may also be necessary to consider any regional standards that have been adopted for use in the region or state. The procuring agency would then finalize the relevant details for implementing the standard, taking into account specific technology and communications choices, to achieve interoperability.

8.4 Agreements

The identification of institutional agreements required is crucial to the development of a consensus architecture. The following pages identify the agreements associated with a Regional ITS Architecture.

8.4.1 Types of Agreements

There are several types of arrangements associated with the interfaces included with the projects discussed previously. Data exchanges between systems require agreements on the transmission protocol and data formats to ensure compatibility. Coordinating field device operations owned by different agencies requires defined procedures for submitting message requests and rules governing when such requests can be honored. Such coordination can be done with informal arrangements such as a Memorandum of Understanding (MOU). Sharing control of field devices operated by different agencies involves more liability issues, which requires more formal agreements. Coordinated incident

response may also require formal agreements, but also requires group training of personnel from various agencies. While all interfaces involve agreements for data compatibility, agreements for procedure and operation as well as training can also be critical elements to optimizing the benefits of the architecture.

Table 4 identifies types of potential agreements that could be used by agencies in the region.

Table 4. Types of Agreements

Type of Agreement	Description
Handshake Agreement	• Early agreement between one or more partners • Not recommended for long term operations.
Memorandum of Understanding	• Initial agreement used to provide minimal detail and usually demonstrating a general consensus. • Used to expand a more detailed agreement like an Interagency Agreement which may be broad in scope but contains all of the standard contract clauses required by a specific agency. • May serve as a means to modify a much broader Master Funding Agreement, allowing the master agreement to cover various ITS projects throughout the region and the MOUs to specify the scope and differences between the projects.
Interagency Agreement	• Between public agencies (e.g., transit authorities, cities, counties, etc.) for operations, services or funding • Documents responsibility, functions and liability, at a minimum.
Intergovernmental Agreement	• Between governmental agencies (e.g., Agreements between universities and State DOT, MPOs and State DOT, etc.)
Operational Agreement	• Between any agency involved in funding, operating, maintaining or using the right-of-way of another public or private agency. • Identifies respective responsibilities for all activities associated with shared systems being operated and/or maintained.
Funding Agreement	• Documents the funding arrangements for ITS projects (and other projects) • Includes at a minimum standard funding clauses, detailed scope, services to be performed, detailed project budgets, etc.
Master Agreements	• Standard contract and/or legal verbiage for a specific agency and serving as a master agreement by which all business is done. These agreements can be found in the legal department of many public agencies. • Allows states, cities, transit agencies, and other public agencies that do business with the same agencies over and over (e.g., cities and counties) to have one Master Agreement that uses smaller agreements (e.g., MOUs, Scope-of-Work and Budget Modifications, Funding Agreements, Project Agreements, etc.) to modify or expand the boundaries of the larger agreement to include more specific language.

8.4.2 Existing and Planned Agreements

The identification of institutional agreements, along with whether these agreements exist or need to be formulated, is a key output of a regional ITS architecture, and should be updated periodically as part of the overall maintenance plan.

Several agreements were identified during development of the FAMPO Regional ITS Architecture. The following table provides a brief description of these agreements. The full agreements are contained in Appendix H.

Table 5. Existing agreements in the FAMPO Region

Name of Agreement	Description
MOU for the Fayetteville Area System of Transit Fixed Route AVL Project	Agreement between FAST and NCDOT regarding the funding and implementation of a fixed-route AVL system.
MOU for Work Zone Safety Patrol between NC Department of Public Safety and NCDOT	Agreement between NCDOT and the NC Department of Public Safety, State Highway Patrol Section creating a Work Zone Safety Patrol created by the NC State Highway Patrol
MOU for Removal of Vehicles from the Roadway between NCDOT and State Highway Patrol	Agreement between NCDOT Highway Division and the NC Department of Crime Patrol and Public Safety, Division of State Highway Patrol covering the removal of vehicles from highways.
MOU for ITS Integrated Surveillance and Data Management Infrastructure Services between NCDOT and Traffic.com, Inc.	Agreement between NCDOT and Traffic.com covering data management.

8.4.3 Potential Agreements

In addition to these existing agreements, the FAMPO Regional ITS Architecture will be used to determine a set of agreements that may need to be put into place in order to implement the interconnections described by the architecture. For each customized Service Package developed in the architecture, potential institutional agreements can be identified. Agreements are identified on the basis of information being shared across institutional boundaries. Instances that involve the sharing of information wholly within one institution do not require an agreement.

Figure 9 illustrates incident management using the City of Fayetteville Traffic Operations Center with emergency management agencies. As shown on the right side of the diagram, the City of Fayetteville Traffic Operations Center is sharing information public safety agencies, and given the nature and sensitivity of law enforcement data, institutional agreements may be necessary to accomplish this interface. On the right, the City of Fayetteville Central Dispatch shares information with the City of Fayetteville Traffic Operations Center, and no institutional agreements are necessary because the sharing of information is between elements under the same institutional entity, in this case the City of Fayetteville. However, both the Cumberland County Communications Center and the Fort Bragg Integrated Incident Management Center are different institutional entities, and this might be a case where institutional agreements could facilitate the sharing of information between the City of Fayetteville and Cumberland County or Fort Bragg.

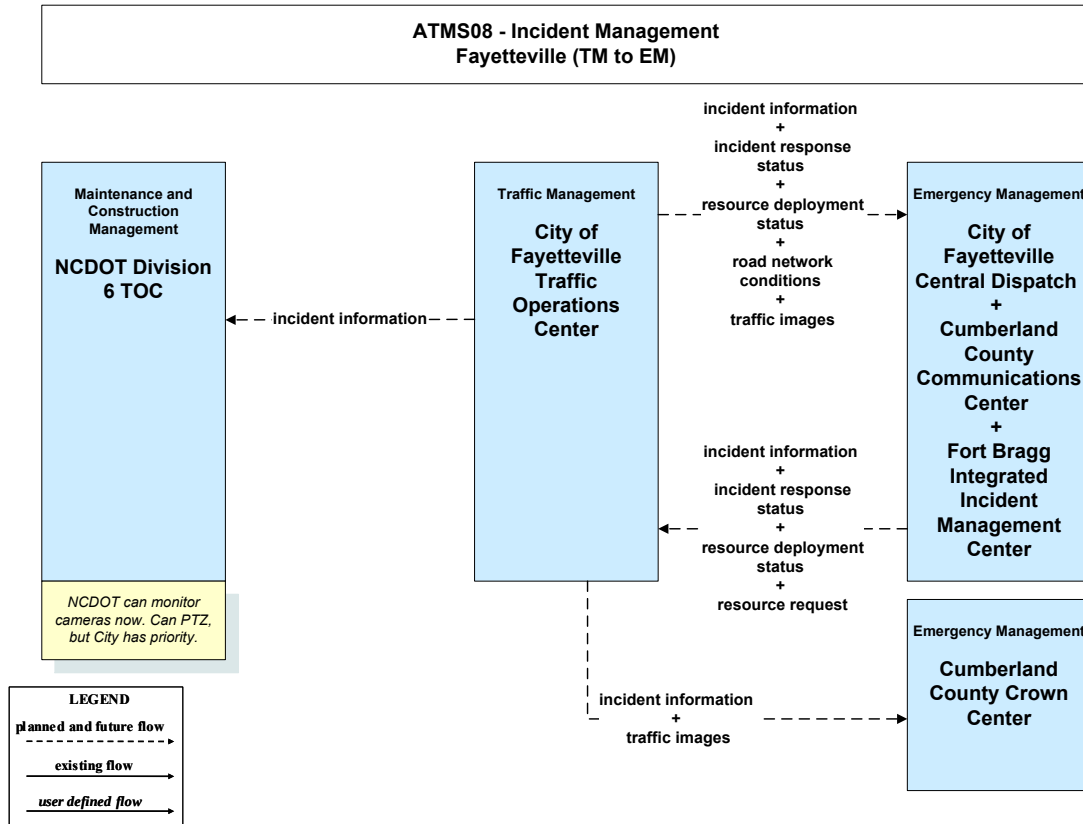


Figure 9. Example Customized Service Package - ATMS08

Each Service Package identified in the Fayetteville Regional ITS Architecture and selected as a high priority Service Package will be analyzed using the same methodology as described above.

8.4.4 Recommendations

The identification of needed agreements is a key to the successful completion of ITS projects. One suggestion for the future is that as part of the systems engineering analysis done for each ITS project, the needed agreements be detailed, along with the nature of the information sharing that causes the need for the agreement.

9 Maintenance of the Regional ITS Architecture

The ITS Architecture developed for the FAMPO region addresses the Region's vision for ITS implementation at the time the plan was developed. As the Region grows, needs will change, and, as technology progresses, new ITS opportunities will arise. Shifts in regional needs and focus as well as changes in NITSA will necessitate that the FAMPO Regional ITS Architecture be updated to remain a useful resource for the Region.

The FAMPO Regional Architecture Steering Committee will be responsible for maintaining the Regional ITS Architecture. The maintenance of the architecture has been defined into three distinct levels including administrative, interim, and full updates.

9.1 Procedure for Submitting ITS Architecture Changes Between Scheduled Updates

Documentation for needed updates of the FAMPO Regional ITS Architecture will need to be submitted to the maintainer of the Regional ITS Architecture, which is the NCDOT ITS Development Group. Between interim and full plan updates, administrative updates will be required to accommodate ITS projects deployed in the Region. For situations where a change to the FAMPO Regional ITS Architecture is required, an ITS Architecture Maintenance Change Request Forms has been developed as part of the Triangle Effort and is included as Appendix J. This form should be completed and submitted to NCDOT whenever a change is proposed.

The Maintenance Change Request Forms identifies three levels of modifications. They include:

- Level 1 – Basic changes that do not affect the structure of the architecture. *Examples include: Changes to stakeholder or element name, element status, or data flow status.*
- Level 2 – Structural changes that impact only one agency. *Examples include: Addition of new Service Package or modifications to an existing Service Package that affects only one agency.*
- Level 3 – Structural changes that have the potential to impact multiple agencies. *Examples include: Addition of a new service package or modifications to an existing service package that involves multiple agencies or incorporation of a new stakeholder into the architecture.*

In the process of documenting the change, the stakeholder proposing the change and FAMPO should contact all agencies that will be impacted to obtain feedback. A defined architecture review committee, will review and accept the proposed changes when they are submitted and incorporate the changes into the Service Package diagrams and Turbo Architecture database. Most interim changes will not impact the Regional ITS Architecture document. If an interim change does impact the document, the NCDOT will decide whether or not the change is significant enough to require an immediate update, or if the change can simply be documented for incorporation during the next complete update.

9.2 Maintenance of Baseline Documents

The NCDOT will be responsible for maintaining the official baseline documents for the FAMPO Regional ITS Architecture. For the FAMPO Regional ITS Architecture, the following are the components of the architecture baseline.

- FAMPO Regional ITS Architecture Document (This Document)
- Set of Customized Service Packages (Visio File)
- Turbo Architecture Database

The original FAMPO Regional ITS Architecture document, in Microsoft Word format, will be held by the NCDOT (along with FAMPO). Both agencies will receive Master Copies of all original documents, files and databases associated with this project.

The customized Service Packages, Turbo Architecture database and other baseline components also will be held and maintained by the FAMPO. Each document will use a versioning scheme that identifies the baseline and revision number. For example, since this architecture is an update of the initial release of the FAMPO Regional ITS Architecture, the documents at the conclusion of this effort will be version 2.00. Minor revisions will be 2.01, 2.02, etc. The next full update to the document will be version 3.00.

Table 5 summarizes the components of the Regional ITS Architecture and identifies the current version at the completion and release of this document. This table should be updated any time an interim update to the architecture document is performed.

Table 5. Summary of Baseline Architecture Components

Architecture Component	Format	Version at Completion of Update
Architecture Document	Microsoft Word (.doc)	1.0
Customized Service Package Diagrams	Microsoft Visio (.vsd)	1.0
Turbo Architecture Database	Turbo Database (.tbo)	1.0

When completing the change form, the requesting agency should identify the baseline document versions that they are intending to modify to reduce the potential for confusion.

Appendix A – Acronyms

Acronym	Definition
AASHTO	American Association of State Highway and Transportation Officials
ADA	Americans with Disabilities Act
ADMS	Archived Data Management Subsystem
ADUS	Archived Data User Service
ANS	American National Standards Institute
APTA	American Public Transportation Association
APTS	Advanced Public Transportation System
ASTM	American Society for Testing and Materials
ATIS	Advanced Traveler Information System
AVCS	Advanced Traffic Management System
AVI	Advanced Vehicle Control System
AVL	Automated Vehicle Identification
C2C	Center to Center
C2F	Center to Field
CCTV	Closed Circuit TV
CFR	Code of Federal Regulations
CV	Commercial Vehicle
CVAS	Commercial Vehicle Administration Subsystem
CVCS	Commercial Vehicle Check Subsystem
CVO	Commercial Vehicle Operations
CVS	Commercial Vehicle Subsystem
DHS	Department of Homeland Security
DMS	Dynamic Message Sign
DMV	Department of Motor Vehicles
DOT	Department of Transportation
DPS	Department of Public Safety
DRE	Disaster Response and Evacuation
DSRC	Dedicated Short Range Communications
EM	Emergency Management Subsystem
EMC	Emergency Management Center
EMMS	Emissions Management Subsystem
EMS	Emergency Medical Services
EOC	Emergency Operations Center
ETA	Expected Time of Arrival
EVS	Emergency Vehicle Subsystem
FHWA	Federal Highway Administration
FMCSA	Federal Motor Carrier Safety Administration
FMS	Fleet and Freight Management Subsystem
FTA	Federal Transit Administration
FTP	File Transfer Protocol
GIS	Geographic Information System
GPS	Global Positioning System
HAR	Highway Advisory Radio
HAZMAT	HAZardous MAterial(s)
HMMS	Highway Maintenance Management System
HOT	High Occupancy Toll
HOV	High Occupancy Vehicle
HRI	Highway Rail Intersection
HSAS	Homeland Security Advisory System
HTML	Hypertext Markup Language

Acronym	Definition
HTTP	Hypertext Transfer Protocol
IEEE	Institute of Electrical and Electronics Engineers, Inc.
IFTA	International Fuel Tax Agreement
IRP	International Registration Plan
ISC	International Standards Organization
ISO	Information Service Provider
ISP	Institute of Transportation Engineers
ITE	Intelligent Transportation Systems
ITS	Hypertext Transfer Protocol
MCMS	Maintenance and Construction Subsystem
MCC	Maintenance and Construction Operations
MCVS	Maintenance and Construction Vehicle Subsystem
MDT	Mobile Data Terminal
MPH	Miles per Hour
MPC	Metropolitan Planning Organization
MS/ETMCC	Maintenance and Construction Subsystem
MTD	Motor Transportation Division
NEMA	National Electrical Manufacturers Association
NIPC	National Infrastructure Protection Center
NTCIP	National Transportation Communications for ITS Protocol
OS/OW	Oversize/ Overweight
PDA	Personal Digital Assistant
PIAS	Personal Information Access Subsystem
PIN	Personal Identification Number
PIO	Public Information Office
PMS	Parking Management Subsystem
PRISM	Performance and Registration Information Systems Management
PSAP	Public Safety Answering Point
RCB	Radio Communications Bureau
RPO	Regional Planning Organization
RS	Roadway Subsystem
RTD	Regional Transit District
RTS	Remote Traveler Support Subsystem
SAE	Society of Automotive Engineers
SAFER	Safety and Fitness Electronic Records
SDC	Standards Development Organization
SMS	Security Monitoring Subsystem
STIP	State Transportation Improvement Program
STOC	State Transportation Operations Center
TAS	Toll Administration Subsystem
TCP	Transit Communications Interface Profiles
TCS	Transport Control Protocol
TDM	Travel Demand Management
TEA-21	Transportation Efficiency Act for the 21st Century
TMC	Traffic Management Center
TMDD	Traffic Management Data Dictionary
TMS	Traffic Management Subsystem
TOC	Traffic Operations Center
TRMC	Transit Management Center
TRMS	Transit Management Subsystem
TRVS	Transit Vehicle Subsystem
USDOT	United States Department of Transportation

Acronym	Definition
VS	Vehicle Subsystem
WAA	Wide Area Alert
WAN	Wide Area Network
WIM	Weigh-in Motion
WWW	World Wide Web

Appendix B – Glossary

Term	Definition
Architecture	A framework within which a system can be built. Requirements dictate what functionality the architecture must satisfy. An architecture functionally defines what the pieces of the system are and the information that is exchanged between them. An architecture is functionally oriented and not technology-specific which allows the architecture to remain effective over time. It defines "what must be done", not "how it will be done".
Architecture Flow	Information that is exchanged between subsystems and terminators in the physical architecture view of the National ITS Architecture. Architecture flows are the primary tool that is used to define the Regional ITS Architecture interfaces. These architecture flows and their communication requirements define the interfaces which form the basis for much of the ongoing standards work in the national ITS program. The terms "information flow" and "architecture flow" are used interchangeably.
Element	This is the basic building block of Regional ITS Architectures and Project ITS Architectures. It is the name used by stakeholders to describe a system or piece of a system.
Equipment Package	Equipment packages are the building blocks of the physical architecture subsystems. Equipment Packages group similar processes of a particular subsystem together into an "implementable" package. The grouping also takes into account the user services and the need to accommodate various levels of functionality.
Information Flow	Information that is exchanged between subsystems and terminators in the physical architecture view of the National ITS Architecture. These information flows are normally identical to the architecture flows in the National ITS Architecture. The terms "information flow" and "architecture flow" are used interchangeably.
Intelligent Transportation System	The system defined as the electronics, communications or information processing used singly or integrated to improve the efficiency or safety of surface transportation.
ITS Architecture	Defines an architecture of interrelated systems that work together to deliver transportation services. An ITS architecture defines how systems functionally operate and the interconnection of information exchanges that must take place between these systems to accomplish transportation services.
ITS Project	Any project that in whole or in part funds the acquisition of technologies or systems of technologies that provide or significantly contribute to the provision of one or more ITS user services.
Logical Architecture	The logical architecture view of the National ITS Architecture defines what has to be done to support the ITS user services. It defines the processes that perform ITS functions and the information or data flows that are shared between these processes.
National ITS Architecture	A common, established framework for developing integrated transportation systems. The National ITS Architecture is comprised of the logical architecture and the physical architecture, which satisfy a defined set of user service requirements. The National ITS Architecture is maintained by the United States Department of Transportation (USDOT).
Physical Architecture	The physical architecture is the part of the National ITS Architecture that provides agencies with a physical representation (though not a detailed design) of the important ITS interfaces and major system components. It provides a high-level structure around the processes and data flows defined in the logical architecture. The principal elements in the physical architecture are the subsystems and architecture flows that connect these subsystems and terminators into an overall structure. The physical architecture takes the processes identified in the logical architecture and assigns them to subsystems. In addition, the data flows (also from the logical architecture) are grouped together into architecture flows. These architecture flows and their communication requirements define the interfaces required between subsystems, which form the basis for much of the ongoing standards work in the ITS program.

Term	Definition
Project ITS Architecture	A framework that identifies the institutional agreement and technical integration necessary to interface a major ITS project with other ITS projects and systems.
Region	The geographical area that identifies the boundaries of the Regional ITS Architecture and is defined by and based on the needs of the participating agencies and other stakeholders. In metropolitan areas, a region should be no less than the boundaries of the metropolitan planning area.
Regional ITS Architecture	A specific, tailored framework for ensuring institutional agreement and technical integration for the implementation of ITS projects or groups of projects in a particular region. It functionally defines what pieces of the system are linked to others and what information is exchanged between them.
Service Package	The market packages provide an accessible, service-oriented perspective to the National ITS Architecture. They are tailored to fit, separately or in combination, real world transportation problems and needs. Market packages collect together one or more equipment packages that must work together to deliver a given transportation service and the architecture flows that connect them and other important external systems. In other words, they identify the pieces of the physical architecture that are required to implement a particular transportation service.
Stakeholders	A widely used term that notates a public agency, private organization or the traveling public with a vested interest, or a "stake" in one or more transportation elements within a Regional ITS Architecture.
Standards	Documented technical specifications sponsored by a Standards Development Organization (SDO) to be used consistently as rules, guidelines, or definitions of characteristics for the interchange of data. A broad array of ITS standards is currently under development that will specifically define the interfaces identified in the National ITS Architecture.
Subsystem	The principle structural element of the physical architecture view of the National ITS Architecture. Subsystems are individual pieces of the Intelligent Transportation System defined by the National ITS Architecture. Subsystems are grouped into four classes: Centers, Field, Vehicles, and Travelers. Example subsystems are the Traffic Management Subsystem, the Vehicle Subsystem, and the Roadway Subsystem. These correspond to the physical world: respectively traffic operations centers, automobiles, and roadside signal controllers. Due to this close correspondence between the physical world and the subsystems, the subsystem interfaces are prime candidates for standardization.
System	A collection of hardware, software, data, processes, and people that work together to achieve a common goal. Note the scope of a "system" depends on one's viewpoint. To a sign manufacturer, a dynamic message sign is a "system". To a state DOT, the same sign is only a component of a larger Freeway Management "System". In a Regional ITS Architecture, a Freeway Management System is a part of the overall surface transportation "system" for the region.
System Inventory	The collection of all ITS-related elements in a Regional ITS Architecture.
Terminator	Terminators define the boundary of an architecture. The National ITS Architecture terminators represent the people, systems, and general environment that interface to ITS. The interfaces between terminators and the subsystems and processes within the National ITS Architecture are defined, but no functional requirements are allocated to terminators. The logical architecture and physical architecture views of the National ITS Architecture both have exactly the same set of terminators. The only difference is that logical architecture processes communicate with terminators using data flows, while physical architecture subsystems use architecture flows.
Turbo Architecture	An automated software tool used to input and manage system inventory, market packages, architecture flows and interconnects with regard to a Regional ITS Architecture and/or multiple Project ITS Architectures.
User Services	User services document what ITS should do from the user's perspective. A broad range of

Term	Definition
	users are considered, including the traveling public as well as many different types of system operators. User services, including the corresponding user service requirements, form the basis for the National ITS Architecture development effort. The initial user services were jointly defined by USDOT and ITS America with significant stakeholder input and documented in the National Program Plan. The concept of user services allows system or project definition to begin by establishing the high level services that will be provided to address identified problems and needs. New or updated user services have been and will continue to be satisfied by the National ITS Architecture over time.

Appendix C – Stakeholders

Stakeholder Name	Stakeholder Description
Amtrak	Nationwide passenger rail organization with service throughout the United States.
Archived Data Users	Users of archived data. May include USDOT, traffic management agencies, transit agencies, and transportation planners.
CHEMTREC	CHEMTREC (CHEMical TRANsportation Emergency Center) was established by the chemical industry as a public service hotline for fire fighters, law enforcement, and other emergency responders to obtain information and assistance for emergency incidents involving chemicals and hazardous materials.
City of Fayetteville	Represents the various government departments and agencies of the City of Fayetteville
Cumberland County	Represents the various government departments and agencies of Cumberland County.
FAMPO	Fayetteville Area Metropolitan Planning Organization
FAST	Fayetteville Area System of Transit, the public transportation provider for Fayetteville and Cumberland County
Federal Highway Administration	The Federal Highway Administration (FHWA). Control federal funding for transportation projects, though it does not own any ITS systems in the Fayetteville region.
Financial Institutions	Represents the financial institutions that the regional transportation agencies will use as part of electronic fare payment systems to reconcile payments.
Fort Bragg	Represents the various divisions of Fort Bragg.
Harnett County	Represents the various government departments and agencies of Harnett County.
Hoke County	Represents the various government departments and agencies of Hoke County.
Local City/Town	Represents local cities and town not specifically named in the architecture
Local Maintenance and Construction Providers	This stakeholder group represents all regional (county and municipal) departments that provide roadway and utility maintenance and construction services.
Local News Media	Includes both print and broadcast news media.

Stakeholder Name	Stakeholder Description
Local Public Safety Providers	This stakeholder group generically represents all regional (county and municipal) public safety providers not specifically called out in the ITS architecture. Public safety providers provide law enforcement, fire, rescue, and emergency medical services.
Local Traffic Management Departments	This stakeholder group generically represents all regional (county and municipal) departments not specifically called out in the ITS architecture that provide traffic and engineering management services within its jurisdiction.
Local Transit Operators	Represents other local transit providers not explicitly called out in the Regional ITS Architecture. This includes transit agencies providing shuttle or express buses into the region, providers of local fixed-route shuttle buses (including campus shuttles), paratransit services, and human services transportation providers of cross county medical trips. Includes Spring Lake Transit and Harnett County Transit System.
National Weather Service	General weather forecasts to the public.
NC Department of Crime Control and Public Safety	The North Carolina Department of Crime Control and Public Safety aims to reduce crime, enhance public safety and assist victims throughout North Carolina.
NC Department of Health and Human Services	The North Carolina Department of Health and Human Services offers programs and services to the state's most vulnerable citizens, both individuals and families.
NCDOT	The North Carolina Department of Transportation (NCDOT) provides high-quality transportation for travelers throughout North Carolina, including highways, rail, aviation, ferries, bicycle and pedestrian facilities, and public transit.
NCDOT DMV	The Division of Motor Vehicles (DMV) is a division of the North Carolina Department of Transportation (NCDOT). The DMV provides vehicle licensing, titling, and registration information, and vehicle inspection programs for the citizens of North Carolina.
North Carolina	Represents the other state departments and agencies for the State of North Carolina not specifically called out in the ITS architecture.
North Carolina Division of Emergency Management	A division of the North Carolina Department of Crime Control and Public Safety, the Division of Emergency Management is the central point of coordination within the state for response and recovery to disasters.

Stakeholder Name	Stakeholder Description
North Carolina Turnpike Authority	The North Carolina Turnpike Authority (NCTA) is authorized to study, plan, develop and undertake preliminary design work for toll roads in the state. At the conclusion of these activities, the NCTA is authorized to design, establish, purchase, construct, operate, and maintain the toll roads. Could be part of NCDOT - Toll.
Private Commercial Vehicles and Fleet Operators	Owner/operators of private commercial vehicles and fleets.
Private Rail Operators	Represents private companies that operate freight rail within the State of North Carolina. Includes CSX.
Private Road Weather Information Service Providers	Private vendor systems that collect and disseminate road weather information from mobile and fixed data sources and weather information services.
Private Tow Wreckers	Represents private towing companies operating in the region.
Private Traveler Information Providers	Local, regional, and national information service providers, such as SmartRoutes or Metro Traffic, that provide both subscription service and general broadcast travel information to the public. Includes internet sites, service bureaus, etc.
Public Travelers	The general public and users of the transportation system.
Regional Event Promoters	These stakeholders support the information exchange/coordination with various special event activities including university sporting events. It also includes groups that promote events such as a Chambers of Commerce, Visitors Bureaus or universities.
Regional Medical Centers	Represents the hospitals, medical centers and trauma centers in the region.
School Districts	Represents the various independent school districts in the region.
US Department of Veterans Affairs	United States Department of Veterans Affairs. Operates the Veterans One Call Center
USDOT	includes Federal Highway Administration (FHWA) and Federal Transit Agency (FTA). Provides funding for transportation projects in the region.

Appendix D - Roles and Responsibilities

RR Area Name	Stakeholder	RR Description
Archived Data Systems for FAMPO Regional ITS Architecture	City of Fayetteville	Collect and archive traffic information from traffic signal system sensors, including traffic volumes, speeds and occupancy.
	FAMPO	Collect and archive traffic information from traffic signal system sensors, including traffic volumes, speeds and occupancy.
	FAST	Collect and archive transit information, such as transit fare information, passenger information, transit services, transit vehicle maintenance data, etc.
	NCDOT	Collect and archive traffic information from traffic signal system sensors, including traffic volumes, speeds and occupancy.
	NCDOT DMV	Collect and archive crash and incident information in the state crash records database.
Commercial Vehicle Operations for FAMPO Regional ITS Architecture	Cumberland County	Coordinate incident response for HAZMAT spills with county and local fire/EMS.
		Receive spill notification for HAZMAT spills from private commercial fleets.
Electronic Toll Collection for FAMPO Regional ITS Architecture	North Carolina Turnpike Authority	Coordinate with the department of motor vehicles and county courts to collect tolls from violators.
		Operate a customer service center to process toll transactions and handle violations processing.
		Operate toll collection equipment on toll roads
		Provide customer account information using a web-site.
		Provide smart card fare capabilities and coordinate with other regional agencies.

RR Area Name	Stakeholder	RR Description
Emergency Management for FAMPO Regional ITS Architecture	City of Fayetteville	Coordinate emergency plans and responses with county EOCs. Includes adjusting signal timing patterns and managing municipal roads in response to and under the direction of the county EOC.
		Coordinate emergency response with county EOCs, the state police, and other public safety agencies.
		Coordinate regional emergency plans, incident responses, evacuation and re-entry plans, and disaster management plans with the county EOC.
		Coordinate with regional medical centers regarding the status of the care facility.
		Dispatch public safety vehicles to incidents in the region.
		Receive Amber Alerts from the NC Center for Missing Persons.
		Receive early warning information and threat information from the county EOC.
		Receive wide area alert information from the county EOC.
		Share incident report information with other public safety providers.
		Suggest routes to public safety vehicles in response to emergencies and track public safety vehicles to the incidents.
	Cumberland County	Receive early warning information and threat information from the county EOC.
		Receive other wide area alert information from the county EOC.
		Respond to potential threats to the transportation infrastructure.
		Coordinate emergency plans and responses with county EOCs. Includes adjusting signal timing patterns and managing municipal roads in response to and under the direction of the county EOC.

RR Area Name	Stakeholder	RR Description
		Coordinate emergency plans, emergency transit schedules, and the status of emergency transit systems with county EOCs.
		Coordinate emergency response with county EOCs, the highway patrol, and other public safety agencies.
		Coordinate regional emergency plans, incident responses, evacuation and re-entry plans, and disaster management plans with the county EOC.
		Dispatch public safety vehicles to incidents in the region.
		Receive Amber Alerts from the NC Center for Missing Persons.
		Share incident report information with other public safety providers.
		Monitor the transportation infrastructure (e.g., traffic operations centers, overpasses, bridges) for potential threats using sensors and surveillance equipment and inform the appropriate emergency management agencies.
		Coordinate incident and threat information as part of an early warning system with regional emergency management agencies; maintenance and construction agencies; transit agencies; and ISPs.
		Coordinate wide area alert notifications with regional traffic management agencies; regional emergency management agencies; regional maintenance and construction agencies; and the regional transit agencies.
		Coordinate wide area alert notifications with regional traffic management agencies; regional emergency management agencies; regional maintenance and construction agencies; and the regional transit agencies.
		Monitor and detect potential, looming, and actual disasters including natural disasters and man-made disasters.
		Operate the county EOC.

RR Area Name	Stakeholder	RR Description
	FAST	Provide evacuation and incident information to regional ISPs and the media for travelers in the region.
		Coordinate emergency plans, emergency transit schedules, and the status of emergency transit systems with county EOCs.
		Coordinate regional emergency plans, incident responses, evacuation and re-entry plans, and disaster management plans with the county EOC.
		Provide emergency transit services for evacuations, fires, and disasters, including re-entry services.
		Receive early warning information and threat information from the county EOC.
		Receive wide area alert information from the county EOC.
	Fort Bragg	Coordinate emergency plans and responses with county EOCs. Includes adjusting signal timing patterns and managing municipal roads in response to and under the direction of the county EOC.
		Coordinate emergency plans, emergency transit schedules, and the status of emergency transit systems with county EOCs.
		Coordinate emergency response with county EOCs and other public safety agencies.
		Coordinate regional emergency plans, incident responses, evacuation and re-entry plans, and disaster management plans with the county EOC.
		Dispatch public safety vehicles to incidents within Fort Bragg
		Receive Amber Alerts from the NC Center for Missing Persons.
		Receive early warning information and threat information from the county EOC.
		Receive wide area alert information from the county EOC.

RR Area Name	Stakeholder	RR Description
		Share incident report information with other public safety providers.
	Harnett County	Coordinate emergency plans and maintenance resources with local maintenance and construction agencies.
		Receive other wide area alert information from the county EOC.
		Coordinate emergency plans and responses with county EOCs. Includes adjusting signal timing patterns and managing municipal roads in response to and under the direction of the county EOC.
		Coordinate emergency plans, emergency transit schedules, and the status of emergency transit systems with county EOCs.
		Coordinate emergency response with county EOCs, the highway patrol, and other public safety agencies.
		Coordinate regional emergency plans, incident responses, evacuation and re-entry plans, and disaster management plans with the county EOC.
		Coordinate with regional medical centers regarding the status of the care facility.
		Dispatch public safety vehicles to incidents in the region.
		Receive Amber Alerts from the NC Center for Missing Persons.
		Share incident report information with other public safety providers.
		Suggest routes to public safety vehicles in response to emergencies and track public safety vehicles to the incidents.
		Coordinate wide area alert notifications with regional traffic management agencies; regional emergency management agencies; regional maintenance and construction agencies; and the regional transit agencies.

RR Area Name	Stakeholder	RR Description
		Develop and coordinate county/regional emergency plans; evacuation and re-entry plans; and disaster management plans with regional emergency and transportation management agencies.
		Monitor and detect potential, looming, and actual disasters including natural disasters and man-made disasters.
		Monitor the transportation infrastructure (e.g., traffic operations centers, overpasses, bridges) for potential threats using sensors and surveillance equipment and inform the appropriate emergency management agencies.
		Operate the county EOC.
		Respond to potential threats to the transportation infrastructure.
		Receive other wide area alert information from the county EOC.
	Hoke County	Coordinate emergency plans and maintenance resources with local maintenance and construction agencies.
		Coordinate evacuation and re-entry plans with the county EOC.
		Coordinate incident and threat information as part of an early warning system with regional emergency management agencies; maintenance and construction agencies; transit agencies; and ISPs.
		Coordinate wide area alert notifications with regional traffic management agencies; regional emergency management agencies; regional maintenance and construction agencies; and the regional transit agencies.
		Develop and coordinate county/regional emergency plans; evacuation and re-entry plans; and disaster management plans with regional emergency and transportation management agencies.

RR Area Name	Stakeholder	RR Description
		Monitor and detect potential, looming, and actual disasters including natural disasters and man-made disasters.
		Operate the county EOC.
		Receive early warning information and threat information from the county EOC.
		Receive other wide area alert information from the county EOC.
		Respond to potential threats to the transportation infrastructure.
		Coordinate emergency plans and responses with county EOCs. Includes adjusting signal timing patterns and managing municipal roads in response to and under the direction of the county EOC.
		Coordinate emergency plans, emergency transit schedules, and the status of emergency transit systems with county EOCs.
		Coordinate emergency response with county EOCs, the highway patrol, and other public safety agencies.
		Coordinate regional emergency plans, incident responses, evacuation and re-entry plans, and disaster management plans with the county EOC.
		Dispatch public safety vehicles to incidents in the region.
		Receive Amber Alerts from the NC Center for Missing Persons.
		Share incident report information with other public safety providers.
	NC Department of Crime Control and Public Safety	Dispatch public safety vehicles to incidents in the region.
		Coordinate regional emergency plans, incident responses, evacuation and re-entry plans, and disaster management plans with the county EOC.

RR Area Name	Stakeholder	RR Description
		Coordinate emergency response with county EOCs, the highway patrol, and other public safety agencies.
		Coordinate emergency plans and responses with county EOCs. Includes adjusting signal timing patterns and managing municipal roads in response to and under the direction of the county EOC.
		Coordinate emergency plans, emergency transit schedules, and the status of emergency transit systems with county EOCs.
		Receive Amber Alerts from the NC Center for Missing Persons.
		Share incident report information with other public safety providers.
		Coordinate maintenance resources in response to incidents with the county and local public works department; and the NCDOT county maintenance units.
	NCDOT	Coordinate emergency plans and responses with county EOCs. Includes adjusting signal timing patterns and managing municipal roads in response to and under the direction of the county EOC.
		Receive early warning information and threat information from the county EOC.
		Receive wide area alert information from the county EOC.
		Coordinate evacuation and re-entry plans with the State EOC and county EOC.
		Dispatch roadway service patrol vehicles that monitor roads that aid motorists, offering rapid response to minor incidents (flat tire, accidents, out of gas) to minimize disruption to the traffic stream.

RR Area Name	Stakeholder	RR Description
		Monitor its transportation infrastructure (e.g., bridges, tunnels and operations centers) for potential threats using sensors and surveillance equipment and inform the appropriate emergency management agencies.
	North Carolina Division of Emergency Management	Coordinate emergency plans and maintenance resources with local maintenance and construction agencies.
		Coordinate emergency plans, emergency transit schedules, and the status of emergency transit systems with local transit agencies.
		Coordinate incident and threat information as part of an early warning system with regional emergency management agencies; maintenance and construction agencies; transit agencies; and ISPs.
		Coordinate wide area alert notifications with regional traffic management agencies; regional emergency management agencies; regional maintenance and construction agencies; and the regional transit agencies.
		Develop and coordinate statewide emergency plans; evacuation and re-entry plans; and disaster management plans with regional emergency and transportation management agencies.
		Monitor and detect potential, looming, and actual disasters including natural disasters and man-made disasters.
		Operate the State EOC.
		Provide evacuation and incident information to regional ISPs and the media for travelers in the region.
Freeway Management for FAMPO Regional ITS Architecture	NCDOT	Collect road weather information from field sensors.
		Collect traffic data from highway system sensors.
		Collect traffic probe information (e.g., highway travel times) from information service providers.

RR Area Name	Stakeholder	RR Description
		Monitor and control highway traffic with traffic sensors, ramp meters and lane control signals.
		Monitor and control reversible lanes on highways and state-owned arterials with lane control signals.
		Monitor and control traffic information devices of other traffic management agencies, such as dynamic message signs, during certain agreed upon conditions, such as specific hours or during specific emergencies.
		Monitor highway surveillance cameras.
		Operate high occupancy toll (HOT) lanes..
		Operate traffic information devices, such as dynamic message signs and highway advisory radios.
		Perform network surveillance for incident detection and verification, and send traffic/incident information and traffic images to local and county public safety agencies and EOCs.
		Provide traffic information in a coordinated effort to the STOC, SmartLink and other traffic management agencies.
		Provide traffic information reports to other traffic management agencies.
		Provide traffic information to travelers via the NCDOT website, 511 system, information service providers, and the media.
		Provide traffic information to travelers via traffic information devices on state-owned roadways (e.g., DMS and HAR equipment), SmartLink and local ISPs and web sites.
		Provide traffic information, such as road network conditions, information to transit agencies.
		Provide traffic information, such as road network conditions, to information service providers.

RR Area Name	Stakeholder	RR Description
		Provide traffic information, such as road network conditions, to maintenance and construction agencies.
		Provide traffic information, such as road network conditions, to public safety agencies.
Incident Management for FAMPO Regional ITS Architecture	City of Fayetteville	Coordinate incident response for incidents on or adjacent to roadways with public safety agencies, and EOCs in surrounding counties and municipalities, including response for scheduled events.
		Coordinate incident response with county and municipal public safety agencies; traffic management agencies; and the NCDOT, as appropriate.
		Coordinate maintenance resources for incidents with other municipal and county maintenance and construction systems as well as NCDOT county maintenance units.
		Coordinate operations with traffic management agencies during scheduled events.
		Dispatch public safety vehicles to incidents in the municipal limits.
		Perform incident detection and verification for all streets within its jurisdiction, and provide this information to traffic management and other public safety agencies.
		Perform incident detection and verification for all streets within its jurisdiction, and provide this information to traffic management and other public safety agencies.
		Provide incident information to other traffic management and public safety agencies.
		Provide maintenance resources in response to incidents on arterials.
		Receive emergency calls from counties and municipalities in the jurisdiction of individual communication centers.

RR Area Name	Stakeholder	RR Description
		Receive maintenance resource requests for incident response from county fire/EMS/sheriff, local police/fire/EMS, the state highway patrol, and 911 emergency communications centers.
		Receive maintenance resource requests for incident response from the traffic operations center.
	Cumberland County	Coordinate incident response for incidents on or adjacent to roadways with public safety agencies, and EOCs in surrounding counties and municipalities, including response for scheduled events.
		Coordinate incident response with county and municipal public safety agencies; traffic management agencies; and the NCDOT, as appropriate.
		Dispatch public safety vehicles to incidents in the municipal/county limits.
		Receive emergency calls from counties and municipalities in the jurisdiction of individual communication centers.
		Receive maintenance resource requests for incident response from county fire/EMS/sheriff, local police/fire/EMS, the state highway patrol, and 911 emergency communications centers.
	Fort Bragg	Coordinate incident response for incidents on or adjacent to roadways with public safety agencies, and EOCs in surrounding counties and municipalities, including response for scheduled events.
		Coordinate incident response with county and municipal public safety agencies; traffic management agencies; and the NCDOT, as appropriate.
		Perform incident detection and verification for all streets within its jurisdiction, and provide this information to traffic management and other public safety agencies.
		Provide incident information to other traffic management and public safety agencies.

RR Area Name	Stakeholder	RR Description
		Provide maintenance resources in response to incidents on arterials.
		Receive emergency calls from within the jurisdiction of individual communication centers.
		Receive maintenance resource requests for incident response from the traffic operations center.
	Harnett County	Coordinate incident response for incidents on or adjacent to roadways with public safety agencies, and EOCs in surrounding counties and municipalities, including response for scheduled events.
		Coordinate incident response with county and municipal public safety agencies; traffic management agencies; and the NCDOT, as appropriate.
		Dispatch public safety vehicles to incidents in the municipal/county limits.
		Receive emergency calls from counties and municipalities in the jurisdiction of individual communication centers.
		Receive maintenance resource requests for incident response from county fire/EMS/sheriff, local police/fire/EMS, the state highway patrol, and 911 emergency communications centers.
	Hoke County	Coordinate incident response for incidents on or adjacent to roadways with public safety agencies, and EOCs in surrounding counties and municipalities, including response for scheduled events.
		Coordinate incident response with county and municipal public safety agencies; traffic management agencies; and the NCDOT, as appropriate.
		Dispatch public safety vehicles to incidents in the municipal/county limits.
		Receive emergency calls from counties and municipalities in the jurisdiction of individual communication centers.

RR Area Name	Stakeholder	RR Description
		Receive maintenance resource requests for incident response from county fire/EMS/sheriff, local police/fire/EMS, the state highway patrol, and 911 emergency communications centers.
	Local Maintenance and Construction Providers	Coordinate incident response for incidents on or adjacent to roadways with public safety agencies, and EOCs in surrounding counties and municipalities, including response for scheduled events.
		Coordinate incident response with county and municipal public safety agencies; traffic management agencies; and the NCDOT, as appropriate.
		Coordinate maintenance resources for incidents with other municipal and county maintenance and construction systems as well as NCDOT county maintenance units.
		Provide maintenance resources in response to incidents on arterials.
		Receive maintenance resource requests for incident response from the traffic operations center.
	Local Traffic Management Departments	Coordinate incident response for incidents on or adjacent to roadways with public safety agencies, and EOCs in surrounding counties and municipalities, including response for scheduled events.
		Coordinate operations with traffic management agencies during scheduled events.
		Perform incident detection and verification for all streets within its jurisdiction, and provide this information to traffic management and other public safety agencies.
		Provide incident information to other traffic management and public safety agencies.
	NC Department of Crime Control and Public Safety	Coordinate incident response for incidents on or adjacent to roadways with public safety agencies, and EOCs in surrounding counties and municipalities, including response for scheduled events.

RR Area Name	Stakeholder	RR Description
		Coordinate maintenance resources for incidents with other municipal and county maintenance and construction systems as well as NCDOT county maintenance units.
		Dispatch highway patrol vehicles to incidents within jurisdiction.
		Receive emergency calls from cell phones for incidents in the region.
		Receive maintenance resource requests for incident response from county fire/EMS/sheriff, local police/fire/EMS, the state highway patrol, and 911 emergency communications centers.
	NCDOT	Coordinate incident response for incidents on or adjacent to roadways with public safety agencies, and EOCs in surrounding counties and municipalities, including response for scheduled events.
		Coordinate maintenance resources for incidents with other municipal and county maintenance and construction systems as well as NCDOT county maintenance units.
		Coordinate operations with traffic management agencies during scheduled events.
		Input incident information into TIMS
		Perform incident detection and verification for all streets within its jurisdiction, and provide this information to traffic management and other public safety agencies.
		Provide incident information to other traffic management and public safety agencies.
		Provide maintenance resources in response to incidents on arterials.
		Receive maintenance resource requests for incident response from the traffic operations center.

RR Area Name	Stakeholder	RR Description
Maintenance and Construction for FAMPO Regional ITS Architecture	City of Fayetteville	Coordinate a maintenance or construction request from the local TOC.
		Coordinate with other municipal and county maintenance and construction systems, as well as the NCDOT county maintenance units.
		Distribute roadway construction, maintenance information and work zone information into TIMS for distribution to other traffic management agencies and transit agencies.
		Manage work zones for all local maintenance and construction activities, and monitor work zone safety with local field devices and vehicles.
		Perform maintenance for ITS field equipment owned by the agency.
		Provide maintenance and construction information to NCDOT county maintenance units; regional maintenance and construction operations; and the traveling public through portable DMS devices.
	Local Maintenance and Construction Providers	Coordinate a maintenance or construction request from the local TOC.
		Coordinate with other municipal and county maintenance and construction systems, as well as the NCDOT county maintenance units.
		Distribute roadway construction, maintenance information and work zone information into TIMS for distribution to other traffic management agencies and transit agencies.
		Maintenance vehicles provide automated maintenance status information to the local maintenance dispatch and equipment repair facility.
		Manage work zones for all local maintenance and construction activities, and monitor work zone safety with local field devices and vehicles.

RR Area Name	Stakeholder	RR Description
		Perform maintenance for ITS field equipment owned by the agency.
		Provide maintenance and construction information to NCDOT county maintenance units; regional maintenance and construction operations; and the traveling public through portable DMS devices.
		Receive automatic vehicle location (AVL) information from maintenance and construction vehicles.
	NCDOT	Collect environmental information from NCDOT field equipment, and from public and private weather service providers.
		Coordinate maintenance or construction requests from the NCDOT State Roadway Maintenance or the TRTMC.
		Coordinate with municipal and county maintenance and construction systems, as well as the NCDOT county maintenance units.
		Distribute roadway construction, maintenance information and work zone information into TIMS for distribution to other traffic management agencies and transit agencies.
		Maintenance vehicles provide automated maintenance status information to the state maintenance dispatch and equipment repair facility.
		Manage work zones for all NCDOT maintenance and construction activities, and monitor work zone safety with NCDOT field devices and vehicles.
		Perform maintenance for ITS field equipment owned by the NCDOT.
		Provide environmental data to public and private weather service providers.

RR Area Name	Stakeholder	RR Description
		Provide maintenance and construction information to NCDOT county maintenance units; regional maintenance and construction operations; and the traveling public through portable DMS devices.
		Receive automatic vehicle location (AVL) information from NCDOT maintenance vehicles.
Parking Management for FAMPO Regional ITS Architecture	City of Fayetteville	Operate, monitor and manage parking facilities. Collect current parking status information and share with local TOC and information service providers.
		Establish relationships with financial institutions for smart card payments.
		Provide regional smart card and transponder tag capabilities at facilities.
Surface Street Management for FAMPO Regional ITS Architecture	City of Fayetteville	Adjust signal timing patterns in response to incidents.
		Collect traffic data from the traffic signal system sensors.
		Coordinate traffic signals at rail-intersection grade crossings.
		Coordinate with transit agencies to improve transportation service coordination, such as providing transit transfer information.
		Monitor arterial surveillance cameras.
		Operate traffic information devices, such as dynamic message signs and highway advisory radios.
		Operate traffic signal systems on local arterials and streets owned and operated by the municipality.
		Perform network surveillance for incident detection and verification, and send traffic/incident information and traffic images to local and county public safety agencies and EOCs.
		Provide maintenance information to travelers via SmartLink, TIMS and private traveler information systems.

RR Area Name	Stakeholder	RR Description
		Provide signal preemption for emergency vehicles.
		Provide signal priority for transit vehicles.
		Provide traffic and road network information to local transit agencies.
		Provide traffic information reports to other traffic management agencies.
		Provide traffic information to travelers via traffic information devices on roadways (e.g., DMS and HAR equipment), and through local ISPs and web sites.
		Provide traffic information, such as road network conditions, to maintenance and construction agencies.
		Provide traffic information, such as road network conditions, to public safety agencies.
		Provide traffic information, such as road network conditions, to SmartLink, private traveler information systems and the media.
	Fort Bragg	Adjust signal timing patterns in response to incidents.
		Collect traffic data from the traffic signal system sensors.
		Monitor and control traffic information devices of other traffic management agencies, such as traffic signal controllers, during certain agreed upon conditions, such as specific hours or during specific emergencies.
		Monitor arterial surveillance cameras.
		Operate traffic information devices, such as dynamic message signs and highway advisory radios.
		Operate traffic signal systems on local arterials and streets owned and operated by the municipality.

RR Area Name	Stakeholder	RR Description
		Perform network surveillance for incident detection and verification, and send traffic/incident information and traffic images to local and county public safety agencies and EOCs.
		Provide traffic information reports to other traffic management agencies.
		Provide traffic information to travelers via traffic information devices on roadways (e.g., DMS and HAR equipment), and through local ISPs and web sites.
		Provide traffic information, such as road network conditions, to maintenance and construction agencies.
	Local Traffic Management Departments	Adjust signal timing patterns in response to incidents.
		Collect traffic data from the traffic signal system sensors.
		Monitor and control traffic information devices of other traffic management agencies, such as traffic signal controllers, during certain agreed upon conditions, such as specific hours or during specific emergencies.
		Monitor arterial surveillance cameras.
		Operate traffic information devices, such as dynamic message signs and highway advisory radios.
		Operate traffic signal systems on local arterials and streets owned and operated by the municipality.
		Perform network surveillance for incident detection and verification, and send traffic/incident information and traffic images to local and county public safety agencies and EOCs.
		Provide signal preemption for emergency vehicles.
		Provide traffic and road network information to local transit agencies.
		Provide traffic information reports to other traffic management agencies.

RR Area Name	Stakeholder	RR Description
		Provide traffic information to travelers via traffic information devices on roadways (e.g., DMS and HAR equipment), and through local ISPs and web sites.
		Provide traffic information, such as road network conditions, to maintenance and construction agencies.
		Provide traffic information, such as road network conditions, to public safety agencies.
		Provide traffic information, such as road network conditions, to SmartLink, private traveler information systems and the media.
	NCDOT	Adjust signal timing patterns in response to incidents.
		Collect traffic data from the traffic signal system sensors.
		Coordinate traffic signals at rail-intersection grade crossings.
		Interconnect with traffic signals operated by adjacent jurisdictions.
		Operate traffic signal systems for municipalities.
Transit Services for FAMPO Regional ITS Architecture	FAST	Communicate the collected passenger data entering and exiting a transit vehicle back to the transit management center.
		Coordinate transit schedules with other local transit agencies, particularly for transit connections at transit transfer points.
		Coordinate transit security incidents with local police and the county sheriff.
		Coordinate with multimodal transportation agencies, including airports, commuter rails, and heavy rail.
		Count the number of passengers entering and exiting a transit vehicle using sensors mounted on the vehicle.

RR Area Name	Stakeholder	RR Description
		Monitor transit facilities for safety and security purposes using video surveillance and through transit user activated alarms.
		Provide automated dispatch and scheduling for the demand-responsive or paratransit system.
		Provide automated dispatch and scheduling for the fixed-route system. Provide operator instructions and receive schedule performance information from transit vehicles while in service.
		Provide automated transit maintenance scheduling through automated vehicle condition.
		Provide customer service interfaces with demand-responsive users -- IVR, text, web.
		Provide operator instructions and receive schedule performance information from transit vehicles while in service.
		Provide transit passenger electronic fare payment capabilities on all transit vehicles.
		Provide transit schedule and fare information to the FASTwebsite, and NC 511.
		Provide transit security on all transit vehicles through silent alarms and on-board video surveillance.
		Provide transit traveler information on the agency's traveler information systems.
		Provide transit traveler information to private sector traveler information services and on all transit vehicles.
		Smart card fare coordination with other regional transit agencies.
		Track and evaluate schedule performance on all fixed-route transit vehicles.

RR Area Name	Stakeholder	RR Description
		Track the location of transit vehicles.
Traveler Information for FAMPO Regional ITS Architecture	City of Fayetteville	
	FAST	Collect transit fare and schedules and provide that information to the traveling public.
	NCDOT	Collect and provide real-time travel times on dynamic message signs.
		Collect maintenance and construction information and provide it to the media and traveling public.
		Collect traffic and incident information and weather information and provide it to the media and private travelers.
		Collect transit fare and schedules from transit agencies and provide that information to the traveling public.
		Provide interactive traveler information, including trip planning services, through the Web site and regional kiosks at rest areas, visitor centers, and service plazas.

Appendix E - Inventory By Stakeholder

Stakeholder	Element Name	Element Description	Element Status
Amtrak	Amtrak National Operations Center	Amtrak's Consolidated National Operations Center (CNOC) - The high-tech, facility from which Amtrak's national operations are controlled.	Existing
	Amtrak Passenger Train Terminals	Represents Amtrak passenger train terminals located in the region.	Existing
Archived Data Users	Archived Data Users	Users of archived data.	Existing
CHEMTREC	CHEMTREC	CHEMTREC (CHEMical TRANsportation Emergency Center) was established by the chemical industry as a public service hotline for fire fighters, law enforcement, and other emergency responders to obtain information and assistance for emergency incidents involving chemicals and hazardous materials.	Existing
City of Fayetteville	City of Fayetteville CCTV Cameras	Represents Closed Circuit Television (CCTV) cameras operated and maintained by the City of Fayetteville for security purposes and traffic observation. These CCTV cameras are used to observe traffic conditions, detect incidents, and to identify security related issues.	Existing
	City of Fayetteville Central Dispatch	Represents the public service answer point (PSAP) for the City of Fayetteville.	Existing
	City of Fayetteville DMS	Represents dynamic (or also variable) message signs (DMS) operated and maintained by the City of Fayetteville to provide travelers information about special events, traffic congestion, accidents, incidents, roadwork zones, or speed limits on a specific arterial segment. Includes portable DMSs for work zone information.	Planned

Stakeholder	Element Name	Element Description	Element Status
	City of Fayetteville EAS	The Fayetteville Emergency Alert System (EAS) was established to provide the residents of Fayetteville with advance warning and critical information during times of emergencies. The EAS is currently a Reverse 911 system.	Planned
	City of Fayetteville Engineering and Infrastructure Department	Represents the divisions of the City of Fayetteville Engineering and Infrastructure Department that deal with roadway maintenance and construction projects, including the Street Maintenance Division and the Construction Management Division. This element also represents all facilities that dispatch maintenance and construction vehicles which are responsible for managing and maintaining all local roadways.	Existing
	City of Fayetteville Field Sensors	Represents the traffic detectors and sensors operated and maintained by the City of Fayetteville to collect traffic information such as volumes, occupancies, and speeds.	Existing
	City of Fayetteville Fire/EMS Vehicles	Represents the ITS-devices (i.e., mobile data terminals) onboard the fire department and EMS vehicles operated by the City of Fayetteville's Fire Department.	Existing
	City of Fayetteville Maintenance and Construction Vehicles	Generically represents all ITS equipment (e.g., mobile data terminals) on board The City of Fayetteville's maintenance and construction vehicles. These vehicles are used to manage and maintain all state roadways.	Existing
	City of Fayetteville Maintenance Garage	Represents maintenance garages where ITS equipment and vehicles are maintained and repaired.	Existing
	City of Fayetteville Parking Management System	Parking management system for the City of Fayetteville to enable monitoring of parking availability in the downtown area.	Planned
	City of Fayetteville Police Vehicles	Represents the ITS-devices (i.e., mobile data terminals) onboard the law enforcement vehicles for the City of Fayetteville	Existing

Stakeholder	Element Name	Element Description	Element Status
	City of Fayetteville Traffic Operations Center	The City of Fayetteville's Traffic Operations Center (TOC) monitors and operates the City of Fayetteville's ITS field equipment, including traffic signals.	Existing
	City of Fayetteville Traffic Signals	Represents the traffic signals, owned and operated by the City of Fayetteville.	Existing
	City of Fayetteville Website	Website for the City of Fayetteville	Existing
	Fayetteville, NC Regional Airport	The Fayetteville Regional Airport serves a 12-county area in the Sandhills of southern North Carolina, along the I-95 corridor.	Existing
Cumberland County	Cumberland County Communications Center	Represents the public service answer point (PSAP) for Cumberland County and is operated by the Cumberland County EMS. Also provides dispatch services and support services to several user agencies in and around Cumberland County.	Existing
	Cumberland County Crown Center	Entertainment facility serving the citizens of Cumberland County.	Existing
	Cumberland County EAS	The Cumberland County Emergency Alert System (EAS) was established to provide the residents of Cumberland County with advance warning and critical information during times of emergencies. The EAS is currently a Reverse 911 system.	Existing
	Cumberland County EMS Vehicles	Represents the ITS-devices (i.e., mobile data terminals) onboard the EMS vehicles operated within Cumberland County	Existing
	Cumberland County EOC	The Cumberland County Emergency Operations Center coordinates countywide emergency and disaster planning, education, warning, response and recovery to minimize the adverse impact on area residents and property.	Existing

Stakeholder	Element Name	Element Description	Element Status
	Cumberland County Fire Vehicles	Represents the ITS-devices (i.e., mobile data terminals) onboard the fire department vehicles operated in Cumberland County.	Existing
	Cumberland County Sheriffs Vehicles	Represents the ITS-devices (i.e., mobile data terminals) onboard the fire vehicles operated by the Cumberland Coun	Existing
FAMPO	FAMPO Archiving System	This system gathers and archives traffic data, crash data, and inventory data for NCDOT.	Planned
	Regional Transit Information Portal	Regional portal to integrate transit information from such sources as Amtrak, FAST, and local transit providers	Planned
FAST	FAST Demand Response Vehicles	Represents the demand vehicles, including the systems within the transit vehicle, operated by Fayetteville Area System of Transit (FAST). The systems represented may include the computer-aided dispatch and automatic vehicle location (CAD/AVL) systems, traveler information systems, and security systems.	Existing
FAST	FAST Fixed Route Vehicles	Represents the fixed route transit vehicles, including the systems within the transit vehicle, operated by the Fayetteville Area System of Transit (FAST). The systems represented may include the computer-aided dispatch and automatic vehicle location (CAD/AVL) systems, traveler information systems, and security systems.	Existing
	FAST Operations Center	Represents the Fayetteville Area System of Transit (FAST) transit operations center.	Existing
	FAST Transfer Center	Regional hub for public transportation and other transportation services. Also, represents the ITS systems inside this transit transfer facility, including transit traveler information systems.	Planned
	FAST Website	Website for the Fayetteville Area System of Transit	Existing
	Regional Smart Card Vending Machines	Vending machines that dispense regional smart cards	Planned

Stakeholder	Element Name	Element Description	Element Status
	FAST Facility Security Cameras	Represents cameras at FAST Transit Facilities for the purposes of security. Monitored by the FAST Operations Center	Existing
Financial Institutions	Financial Institutions	Represents the financial institutions the regional transportation agencies will use as part of electronic fare payment systems.	Existing
Fort Bragg	Fort Bragg Access Control Points	Represents field equipment at access control points to Fort Bragg	Existing
	Fort Bragg DragonNet	DragonNet is Fort Bragg's intranet and Information Service Provider	Planned
	Fort Bragg Emergency Response Vehicle	Represents the ITS-devices (i.e., mobile data terminals) onboard the emergency response vehicles operated by Fort Bragg.	Existing
	Fort Bragg EOC	The Fort Bragg Emergency Operations Center (EOC) coordinates emergency and disaster planning, education, warning, response and recovery to minimize the adverse impact on Fort Bragg,	Existing
	Fort Bragg Field Equipment	Represents the ITS field equipment owned and operated by Fort Bragg. Such ITS field equipment may include traffic signals, traffic sensors, dynamic message signs, or CCTV cameras. It does not include field equipment at access control points	Existing
	Fort Bragg CCTV Cameras	Represents Closed Circuit Television (CCTV) cameras operated and maintained by the Fort Bragg for traffic observation. These CCTV cameras are used to observe traffic conditions, detect incidents, and to identify security related issues.	Existing
	Fort Bragg Integrated Incident Management Center	Public safety answering point (PSAP), traffic management center and emergency dispatch center for Fort Bragg.	Existing

Stakeholder	Element Name	Element Description	Element Status
	Fort Bragg Operations and Maintenance Division - DPW		Planned
	Fort Bragg Shuttle Express Dispatch Center	Fort Bragg Shuttle Express is a free service that transports members of the military and their families around Fort Bragg	Existing
	Fort Bragg Shuttle Express Vehicles	Represents the transit vehicles, including the systems within the transit vehicle, operated by Fort Bragg Shuttle Express. The systems represented may include the computer-aided dispatch and automatic vehicle location (CAD/AVL) systems, traveler information systems, and security systems.	Existing
	Fort Bragg Traffic Operations Center	Fort Bragg's Traffic Operations Center (TOC) monitors and operates Fort Bragg's ITS field equipment, including traffic signals.	Planned
	Fort Bragg Traffic Signals	Represents the traffic signals, owned and operated by the Fort Bragg.	Existing
Harnett County	Harnett County Central Dispatch	Represents the public service answer point (PSAP) for Harnett County.	Existing
	Harnett County EOC	The Harnett County Emergency Operations Center coordinates countywide emergency and disaster planning, education, warning, response and recovery to minimize the adverse impact on area residents and property.	Existing
Hoke County	Hoke County Communications Center	Represents the public service answer point (PSAP) for Hoke County. Also provides dispatch services and support services to several user agencies in and around Hoke County.	Existing
	Hoke County EOC	The Hoke County Emergency Operations Center coordinates countywide emergency and disaster planning, education, warning, response and recovery to minimize the adverse impact on area residents and property.	Existing

Stakeholder	Element Name	Element Description	Element Status
Local City/Town	Local City/Town Website	Website for a local city or town	Planned
Local Maintenance and Construction Providers	City of Fayetteville Storage Yard	Represents City of Fayetteville storage yards and facilities, where maintenance equipment and materials are stored.	Existing
	Local Maintenance Garage	Represents maintenance garages where ITS equipment and vehicles are maintained and repaired.	Planned
	Local Public Works Department	Generically represents all public works departments/divisions of any county or municipality in the region that deal with roadway maintenance and construction projects. This element also represents all facilities that dispatch maintenance and construction vehicles which are responsible for managing and maintaining all local roadways.	Existing
	Local Public Works Vehicles	Generically represents all ITS equipment (e.g., mobile data terminals) on board maintenance and construction vehicles. These vehicles are used to manage and maintain all local roadways.	Existing
	Local Storage Yards		Planned
	Other Local Public Works Departments	Generically represents other adjacent local public works departments that perform roadway maintenance and construction operations.	Existing
Local News Media	Local Media	Represents the information systems that provide traffic reports, travel conditions, and other transportation-related news services to the traveling public through radio, TV, internet, and other media.	Existing
Local Public Safety Providers	Local County Emergency Communications Center	Represents the local county emergency management communications center not specifically called out in the ITS architecture. Generally, the county emergency communications is also the county public safety answering points (PSAP).	Existing

Stakeholder	Element Name	Element Description	Element Status
	Local County EOC	Generically represents Emergency Operations Center (EOCs), who coordinates countywide emergency and disaster planning, education, warning, response and recovery to minimize the adverse impact on area residents and property.	Existing
	Local Fire/EMS Vehicles	Represents the ITS-devices (i.e., mobile data terminals) onboard local fire/EMS vehicles operated by local counties and municipalities.	Existing
	Local Police/Sheriffs Vehicles	Represents the ITS-devices (i.e., mobile data terminals) onboard the law enforcement vehicles for local counties and municipalities.	Existing
	Local PSAP	Generically represents the local public safety answering points (PSAP) not specifically called out in the ITS architecture.	Existing
Local Traffic Management Departments	Local ITS Field Equipment	Represents the ITS field equipment owned and operated by local counties and municipalities. Such ITS field equipment may include traffic signals, traffic sensors, dynamic message signs, or CCTV cameras.	Planned
	Local Traffic Operations Centers	Represents the individual county or municipal traffic operations centers that operate traffic management/ITS equipment. These "centers" collect traffic information and manages the roadway equipment accordingly, as well as coordinates traffic signal control. The traffic operations center may be a single computer.	Planned
	Local Traffic Signals	Represents the traffic signals, owned and operated by the local counties and municipalities. Includes the ITS equipment installed on these signals that allows for signal preemption of emergency vehicles or signal priority of transit vehicles.	Existing

Stakeholder	Element Name	Element Description	Element Status
Local Transit Operators	Local Transit Buses	Represents the transit vehicles, including the systems within the transit vehicle, operated by local transit agencies, counties, or municipalities. The systems represented may include the computer-aided dispatch and automatic vehicle location (CAD/AVL) systems, traveler information systems, and security systems.	Planned
	Local Transit Dispatch Centers	Represents local transit dispatch centers, owned and operated by local transit agencies, counties, or municipalities, not specifically called out in the architecture.	Planned
	Local Transit Pass	Represents local transit fare passes or cards used by the various transit operators in the region.	Existing
	Private Transit Systems	This element represents private transit systems.	Planned
National Weather Service	National Weather Service	This element provides weather, hydrologic, and climate information and warnings of hazardous weather including thunderstorms, flooding, hurricanes, tornadoes, winter weather, tsunamis, and climate events.	Existing
NC Department of Crime Control and Public Safety	NC Center for Missing Persons	The N.C. Center for Missing Persons serves as the clearinghouse for information regarding missing children and adults and is charged with issuing AMBER Alerts and Silver Alerts. The Center is part of the Division of Alcohol Law Enforcement, which is a division of the North Carolina Department of Crime Control and Public Safety.	Existing
	NCSHP Dispatch Center	Represents the local dispatch center for the North Carolina State Highway Patrol (NCSHP) Vehicles. The NCSHP is a division of the North Carolina Department of Crime Control and Public Safety. The NCSHP's primary mission is to reduce collisions and make the highways of North Carolina as safe as possible.	Existing
	NCSHP Vehicles	Represents the ITS-devices (i.e., mobile data terminals) onboard the North Carolina State Highway Patrol vehicles.	Existing

Stakeholder	Element Name	Element Description	Element Status
NC Department of Health and Human Services	Social Services Agencies	Represents the social services agencies that provide full or partial reimbursements or vouchers for citizens requiring assistance, such as the elderly, disabled, veterans, and low-income families.	Existing
NCDOT	NCDOT 511 System	NCDOT's 511 system provides travel updates over a toll-free travel information line.	Existing
	NCDOT CCTV Cameras	Represents Closed Circuit Television (CCTV) cameras operated and maintained by NCDOT in Region 6 and used for security purposes and traffic observation. These CCTV cameras are used to observe traffic conditions, detecting incidents, or identifying security related issues.	Existing
	NCDOT Count Stations	Represents fixed traffic count stations.	Existing
	NCDOT County Maintenance Unit	Represents the individual county maintenance yard responding to their area.	Existing
	NCDOT Division 6 TOC	The North Carolina Department of Transportation Region 6 Traffic Operations Center (TOC) monitors and operates the ITS field equipment along Cumberland, Bladen, Harnett, Robeson, and Columbus area freeways.	Existing
	NCDOT DMS	Represents dynamic (or also variable) message signs (DMS) operated and maintained by NCDOT in Region 6 to provide travelers information about special events, traffic congestion, accidents, incidents, roadwork zones, or speed limits on a specific highway segment. Includes portable DMSs for work zone information.	Existing
	NCDOT Maintenance and Construction Vehicles	Generically represents all ITS equipment (e.g., mobile data terminals) on board NCDOT's maintenance and construction vehicles. These vehicles are used to manage and maintain all state roadways.	Existing
	NCDOT Maintenance Yards	Represents NCDOT storage yards and facilities, where maintenance equipment and materials are stored.	Existing

Stakeholder	Element Name	Element Description	Element Status
	NCDOT Reversible Lane Controls	Represents the ITS field equipment used by NCDOT to monitor and control reversible lanes. This may include gate controls, lane signals, and traffic sensors used to monitor the direction of travel of vehicles.	Planned
	NCDOT Safety Patrol Service	The Safety Patrol Service will monitor roads that aid motorists, and offer rapid response to minor incidents (flat tire, accidents, out of gas) to minimize disruption to the traffic stream. If problems are detected, the roadway service patrol vehicles will provide assistance to the motorist (e.g., push a vehicle to the shoulder or median).	Planned
	NCDOT SmartLink/TIMS	NCDOT's Traveler Information Management System (TIMS), provides real-time travel information in major metropolitan areas through live traffic cameras and speed sensors. TIMS also provides road construction, accidents, weather conditions or other incidents that may affect travel time by region, route or county.	Existing
	NCDOT State Data Warehouse	This system gathers and archives traffic data, crash data, and inventory data for NCDOT.	Existing
	NCDOT State Roadway Maintenance	Represents NCDOT's division roadway maintenance and construction operations.	Existing
	NCDOT STOC	North Carolina Department of Transportation Statewide Traffic Operations Center (STOC). Operating 24/7, the STOC monitors and operates those ITS field devices on state roadways and freeways not monitored by the RTMCs.	Existing
	NCDOT TEAAS	NCDOT's Traffic Engineering Accident Analysis System (TEAAS). Used by NC's traffic engineers to analyze accidents that occur on the state's roads.	Existing
	NCDOT Traffic Signals	Represents the traffic signals in Region 6 owned or operated by NCDOT. Includes the ITS equipment installed on these signals that allows for signal preemption of emergency vehicles or signal priority of transit vehicles.	Existing

Stakeholder	Element Name	Element Description	Element Status
	NCDOT Variable Speed Limit Signs	Variable Speed Limit Signs used to change and regulate speed limits.	Planned
	Other NCDOT Maintenance Divisions	Represents other adjacent NCDOT maintenance divisions that perform roadway maintenance and construction operations.	Existing
	NCDOT Rail Division Train Terminals	Represents NCDOT Rail passenger train terminals located in the region.	Existing
	Other NCDOT RTMCs	Represents other adjacent NCDOT Regional Traffic Management Centers.	Existing
NCDOT DMV	NCDOT DMV CRASH	This database contains information on all reported crashes in North Carolina since January 1990. May also be known as the Crash Reporting System (CRS).	Existing
	NCDOT DMV Database	Vehicle registration systems of the NCDOT Division of Motor Vehicles. These systems provides commercial driver's license and vehicle registration in the State of North Carolina.	Existing
North Carolina	North Carolina State Bureau of Investigation	Investigative unit of the North Carolina State Highway Patrol. Responsible for issuing Amber and Silver Alerts	Planned
North Carolina Division of Emergency Management	NC EAS	The North Carolina Emergency Alert System (EAS) was established to provide the citizens of North Carolina advance warning and critical information during times of emergencies.	Existing
	NC SEOC	The North Carolina State Operations Center (SEOC) for North Carolina's Division of Emergency Management. Includes a 24-hour communications center. This EOC is the primary location from which State operations will be conducted under the direction and control of the State Emergency Response Team (SERT) leader, usually the Director of the Division of Emergency Management.	Existing

Stakeholder	Element Name	Element Description	Element Status
	North Carolina National Guard Joint Force Headquarters and State Emergency Operations Center	The North Carolina National Guard Joint Force Headquarters and State Emergency Operations Center for North Carolina's Division of Emergency Management and North Carolina's National Guard. Includes a 24-hour communications center. This EOC is the primary location from which State operations will be conducted under the direction and control of the State Emergency Response Team (SERT) leader, usually the Director of the Division of Emergency Management.	Existing
North Carolina Turnpike Authority	NCTA CSC Web Site	Web site and information portal (including account information) for NCTA customers.	Planned
	NCTA Customer Service Center	Customer Service Centers (CSCs) for NCTA's electronic toll system, providing administrative back office and customer support functions for the electronic toll system.	Planned
	NCTA Toll Collection System	Represents the electronic toll collection roadway equipment. e.g., tag readers, toll booth equipment, lane curtains, license plate readers, etc., operated by NCTA on its toll roads.	Planned
	NCTA Toll Tag	The NCTA vehicle transponder used for electronic payment of toll roads. In the future, may be used for other applications, i.e.. Airport Parking.	Planned
Private Commercial Vehicles and Fleet Operators	Private Fleet Vehicle Dispatch Systems	Charter bus fleets, major truck fleet operators, taxi services, limo services, etc. that operate in North Carolina. Note that the dispatch may actually be outside the state.	Existing
Private Rail Operators	Rail Operations Centers	The dispatch centers for railroads that operate in the State of North Carolina.	Existing
	Rail Wayside Equipment	The rail operated equipment at highway rail intersections.	Existing
Private Tow Wreckers	Private Tow Wreckers Dispatch	Dispatch function for privately owned tow or wrecker service. Based on a rotation list.	Existing

Stakeholder	Element Name	Element Description	Element Status
	Private Tow Wreckers Vehicles	Represents the ITS equipment, such as mobile data terminals, in tow or wrecker vehicles.	Existing
Private Traveler Information Providers	Private Traveler Information Systems	This element represents the private traveler information providers serving the region, including websites or mobile features.	Existing
Public Travelers	Commercial Vehicles	Commercial vehicles include ITS equipment that supports safe and efficient commercial vehicle operations. This equipment monitors vehicle operation, provides the driver and motor carrier real-time information, and supports mainline electronic screening.	Existing
	Driver	Drivers	Existing
	User Personal Computing Devices	User Personal Computing Devices refers to equipment an individual owns and can personalize with their choices for information about transportation networks. An Internet-connected PC is an example.	Existing
	Vehicle	Represents the ITS systems onboard a private vehicle, including a GPS system.	Existing
Regional Event Promoters	Regional Event Promoters	This element refers to promoters and sponsors of special events, including collegiate sporting events. They coordinate with traffic and emergency providers.	Planned
	Regional Medical Centers	Medical centers (e.g. hospitals and trauma centers) throughout the region.	Existing
School Districts	School District Buses	Generically represents the ITS equipment (e.g., mobile data terminals) on school buses operated by the independent school districts. The ITS equipment represented may include the computer-aided dispatch and automatic vehicle location (CAD/AVL) systems, traveler information systems, and security systems.	Planned
	School Districts Dispatch Center	Generically represents the dispatch centers for the various independent school districts that provide transportation services for schools, and also provide transportation during emergencies.	Existing

Stakeholder	Element Name	Element Description	Element Status
US Department of Veterans Affairs	Veterans One Call Center	Single access point for Veterans Services	Existing

Appendix F - Inventory By Entity

Associated Entity	Element Name	Stakeholder	Element Status
Alerting and Advisory Systems	City of Fayetteville EAS	City of Fayetteville	Planned
Alerting and Advisory Systems	Cumberland County EAS	Cumberland County	Existing
Alerting and Advisory Systems	NC EAS	North Carolina Division of Emergency Management	Existing
Archived Data Management	FAMPO Archiving System	FAMPO	Planned
Archived Data Management	NCDOT DMV CRASH	NCDOT DMV	Existing
Archived Data Management	NCDOT State Data Warehouse	NCDOT	Existing
Archived Data User Systems	Archived Data Users	Archived Data Users	Existing
Archived Data User Systems	NCDOT TEAAS	NCDOT	Existing
Care Facility	Regional Medical Centers	Regional Medical Centers	Existing
Commercial Vehicle	Commercial Vehicles	Public Travelers	Existing
DMV	NCDOT DMV Database	NCDOT DMV	Existing
Driver	Driver	Public Travelers	Existing
Emergency Management	City of Fayetteville Central Dispatch	City of Fayetteville	Existing
Emergency Management	City of Fayetteville Traffic Operations Center	City of Fayetteville	Existing
Emergency Management	Cumberland County Communications Center	Cumberland County	Existing
Emergency Management	Cumberland County Crown Center	Cumberland County	Existing
Emergency Management	Cumberland County EOC	Cumberland County	Existing
Emergency Management	FAST Operations Center	FAST	Existing
Emergency Management	Fort Bragg EOC	Fort Bragg	Existing
Emergency Management	Fort Bragg Integrated Incident Management Center	Fort Bragg	Existing

Associated Entity	Element Name	Stakeholder	Element Status
Emergency Management	Fort Bragg Traffic Operations Center	Fort Bragg	Planned
Emergency Management	Harnett County Central Dispatch	Harnett County	Existing
Emergency Management	Harnett County EOC	Harnett County	Existing
Emergency Management	Hoke County Communications Center	Hoke County	Existing
Emergency Management	Hoke County EOC	Hoke County	Existing
Emergency Management	Local County Emergency Communications Center	Local Public Safety Providers	Existing
Emergency Management	Local County EOC	Local Public Safety Providers	Existing
Emergency Management	Local PSAP	Local Public Safety Providers	Existing
Emergency Management	NC Center for Missing Persons	NC Department of Crime Control and Public Safety	Existing
Emergency Management	NC SEOC	North Carolina Division of Emergency Management	Existing
Emergency Management	NCDOT Division 6 TOC	NCDOT	Existing
Emergency Management	NCSHP Dispatch Center	NC Department of Crime Control and Public Safety	Existing
Emergency Management	North Carolina National Guard Joint Force Headquarters and State Emergency Operations Center	North Carolina Division of Emergency Management	Existing
Emergency Management	North Carolina State Bureau of Investigation	North Carolina	Planned
Emergency Management	Private Tow Wreckers Dispatch	Private Tow Wreckers	Existing
Emergency Vehicle	City of Fayetteville Fire/EMS Vehicles	City of Fayetteville	Existing
Emergency Vehicle	City of Fayetteville Police Vehicles	City of Fayetteville	Existing
Emergency Vehicle	Cumberland County EMS Vehicles	Cumberland County	Existing
Emergency Vehicle	Cumberland County Fire Vehicles	Cumberland County	Existing
Emergency Vehicle	Cumberland County Sheriffs Vehicles	Cumberland County	Existing
Emergency Vehicle	Fort Bragg Emergency Response Vehicle	Fort Bragg	Existing
Emergency Vehicle	Local Fire/EMS Vehicles	Local Public Safety Providers	Existing

Associated Entity	Element Name	Stakeholder	Element Status
Emergency Vehicle	Local Police/Sheriffs Vehicles	Local Public Safety Providers	Existing
Emergency Vehicle	NCDOT Safety Patrol Service	NCDOT	Planned
Emergency Vehicle	NCSHP Vehicles	NC Department of Crime Control and Public Safety	Existing
Emergency Vehicle	Private Tow Wreckers Vehicles	Private Tow Wreckers	Existing
Equipment Repair Facility	City of Fayetteville Maintenance Garage	City of Fayetteville	Existing
Equipment Repair Facility	Local Maintenance Garage	Local Maintenance and Construction Providers	Planned
Event Promoters	Cumberland County Crown Center	Cumberland County	Existing
Event Promoters	Regional Event Promoters	Regional Event Promoters	Planned
Financial Institution	Financial Institutions	Financial Institutions	Existing
Fleet and Freight Management	CHEMTREC	CHEMTREC	Existing
Fleet and Freight Management	Private Fleet Vehicle Dispatch Systems	Private Commercial Vehicles and Fleet Operators	Existing
Information Service Provider	City of Fayetteville Website	City of Fayetteville	Existing
Information Service Provider	FAST Website	FAST	Existing
Information Service Provider	Fort Bragg DragonNet	Fort Bragg	Planned
Information Service Provider	Local City/Town Website	Local City/Town	Planned
Information Service Provider	NCDOT 511 System	NCDOT	Existing
Information Service Provider	NCDOT SmartLink/TIMS	NCDOT	Existing
Information Service Provider	NCTA CSC Web Site	North Carolina Turnpike Authority	Planned
Information Service Provider	Private Traveler Information Systems	Private Traveler Information Providers	Existing
Information Service Provider	Regional Transit Information Portal	FAMPO	Planned

Associated Entity	Element Name	Stakeholder	Element Status
Information Service Provider	Veterans One Call Center	US Department of Veterans Affairs	Existing
Maintenance and Construction Management	City of Fayetteville Engineering and Infrastructure Department	City of Fayetteville	Existing
Maintenance and Construction Management	City of Fayetteville Traffic Operations Center	City of Fayetteville	Existing
Maintenance and Construction Management	Fort Bragg Operations and Maintenance Division - DPW	Fort Bragg	Planned
Maintenance and Construction Management	Fort Bragg Traffic Operations Center	Fort Bragg	Planned
Maintenance and Construction Management	Local Public Works Department	Local Maintenance and Construction Providers	Existing
Maintenance and Construction Management	Local Traffic Operations Centers	Local Traffic Management Departments	Planned
Maintenance and Construction Management	NCDOT County Maintenance Unit	NCDOT	Existing
Maintenance and Construction Management	NCDOT Division 6 TOC	NCDOT	Existing
Maintenance and Construction Management	NCDOT SmartLink/TIMS	NCDOT	Existing
Maintenance and Construction Management	NCDOT State Roadway Maintenance	NCDOT	Existing
Maintenance and Construction Vehicle	City of Fayetteville Maintenance and Construction Vehicles	City of Fayetteville	Existing
Maintenance and Construction Vehicle	Local Public Works Vehicles	Local Maintenance and Construction Providers	Existing
Maintenance and Construction Vehicle	NCDOT Maintenance and Construction Vehicles	NCDOT	Existing
Media	Local Media	Local News Media	Existing
Multimodal Transportation Service Provider	Amtrak Passenger Train Terminals	Amtrak	Existing

Associated Entity	Element Name	Stakeholder	Element Status
Multimodal Transportation Service Provider	FAST Transfer Center	FAST	Planned
Multimodal Transportation Service Provider	Fayetteville, NC Regional Airport	City of Fayetteville	Existing
Multimodal Transportation Service Provider	NCDOT Rail Division Train Terminals	NCDOT	Existing
Other Emergency Management	NC SEOC	North Carolina Division of Emergency Management	Existing
Other Emergency Management	NCDOT STOC	NCDOT	Existing
Other Emergency Management	webEOC		Planned
Other MCM	Other Local Public Works Departments	Local Maintenance and Construction Providers	Existing
Other MCM	Other NCDOT Maintenance Divisions	NCDOT	Existing
Other Roadway	NCDOT DMS	NCDOT	Existing
Other Traffic Management	Other NCDOT RTMCs	NCDOT	Existing
Parking Management	City of Fayetteville Parking Management System	City of Fayetteville	Planned
Payment Administration	NCTA Customer Service Center	North Carolina Turnpike Authority	Planned
Personal Information Access	User Personal Computing Devices	Public Travelers	Existing
Rail Operations	Rail Operations Centers	Private Rail Operators	Existing
Remote Traveler Support	FAST Transfer Center	FAST	Planned
Remote Traveler Support	Regional Smart Card Vending Machines	FAST	Planned
Roadway	City of Fayetteville CCTV Cameras	City of Fayetteville	Existing
Roadway	City of Fayetteville DMS	City of Fayetteville	Planned
Roadway	City of Fayetteville Field Sensors	City of Fayetteville	Existing
Roadway	City of Fayetteville Traffic Signals	City of Fayetteville	Existing

Associated Entity	Element Name	Stakeholder	Element Status
Roadway	Fort Bragg Access Control Points	Fort Bragg	Existing
Roadway	Fort Bragg CCTV Cameras	Fort Bragg	Existing
Roadway	Fort Bragg Field Equipment	Fort Bragg	Existing
Roadway	Fort Bragg Traffic Signals	Fort Bragg	Existing
Roadway	Local ITS Field Equipment	Local Traffic Management Departments	Planned
Roadway	Local Traffic Signals	Local Traffic Management Departments	Existing
Roadway	NCDOT CCTV Cameras	NCDOT	Existing
Roadway	NCDOT Count Stations	NCDOT	Existing
Roadway	NCDOT DMS	NCDOT	Existing
Roadway	NCDOT Reversible Lane Controls	NCDOT	Planned
Roadway	NCDOT Traffic Signals	NCDOT	Existing
Roadway	NCDOT Variable Speed Limit Signs	NCDOT	Planned
Roadway Payment	NCTA Toll Collection System	North Carolina Turnpike Authority	Planned
Security Monitoring	FAST Facility Security Cameras	FAST	Existing
Security Monitoring	Fort Bragg Access Control Points	Fort Bragg	Existing
Security Monitoring	Fort Bragg Field Equipment	Fort Bragg	Existing
Social Services Agency	Social Services Agencies	NC Department of Health and Human Services	Existing
Storage Facility	City of Fayetteville Storage Yard	Local Maintenance and Construction Providers	Existing
Storage Facility	Local Storage Yards	Local Maintenance and Construction Providers	Planned
Storage Facility	NCDOT Maintenance Yards	NCDOT	Existing
Traffic Management	City of Fayetteville Traffic Operations Center	City of Fayetteville	Existing

Associated Entity	Element Name	Stakeholder	Element Status
Traffic Management	Fort Bragg Integrated Incident Management Center	Fort Bragg	Existing
Traffic Management	Fort Bragg Traffic Operations Center	Fort Bragg	Planned
Traffic Management	Local Traffic Operations Centers	Local Traffic Management Departments	Planned
Traffic Management	NCDOT Division 6 TOC	NCDOT	Existing
Traffic Management	NCDOT SmartLink/TIMS	NCDOT	Existing
Traffic Management	NCDOT STOC	NCDOT	Existing
Transit Management	Amtrak National Operations Center	Amtrak	Existing
Transit Management	FAST Operations Center	FAST	Existing
Transit Management	Fort Bragg Integrated Incident Management Center	Fort Bragg	Existing
Transit Management	Fort Bragg Shuttle Express Dispatch Center	Fort Bragg	Existing
Transit Management	Local Transit Dispatch Centers	Local Transit Operators	Planned
Transit Management	Private Transit Systems	Local Transit Operators	Planned
Transit Management	School Districts Dispatch Center	School Districts	Existing
Transit Vehicle	FAST Demand Response Vehicles	FAST	Existing
Transit Vehicle	FAST Fixed Route Vehicles	FAST	Existing
Transit Vehicle	Fort Bragg Shuttle Express Vehicles	Fort Bragg	Existing
Transit Vehicle	Local Transit Buses	Local Transit Operators	Planned
Transit Vehicle	School District Buses	School Districts	Planned
Traveler Card	Local Transit Pass	Local Transit Operators	Existing
Traveler Card	NCTA Toll Tag	North Carolina Turnpike Authority	Planned
Traveler Card	Regional Smart Card		Planned
Vehicle	Vehicle	Public Travelers	Existing
Wayside Equipment	Rail Wayside Equipment	Private Rail Operators	Existing

Associated Entity	Element Name	Stakeholder	Element Status
Weather Service	National Weather Service	National Weather Service	Existing

Appendix G - Regional Projects

Name	Description	Timeframe	Geographic Scope	Cost
FAM-ADFAMPO-001	Regional Data Warehouse. Includes data collection and management capabilities provided by the ITS Data Mart, and adds the functionality and interface definitions that allow collection of data from multiple agencies and data sources across modes and jurisdictional bound.	Medium Term	FAMPO Region	
FAM-ADMULTI-001	ITS Data Archive. Collects data and data catalogs from one or more data sources and stores data in repository. This focused archive typically includes data covering a single transportation mode and one jurisdiction that is collected from an operational data store and archived for future use. It provides the basic data quality, data privacy, and meta data management common to all ITS archives and provides general query and report access to archive data users.	Medium Term	One per agency	
FAM-APTSFAST-001	Multimodal transfer center. Includes traveler information system to provide estimated or actual time of arrival information systems for travelers.	Short Term	Fayetteville Transit	\$297,769
FAM-APTSFAST-002	Complete upgrade of AVL system. Includes interface for Google Transit.	Short Term	Fayetteville Transit	\$265,533
FAM-APTSFAST-003	Complete upgrade of APC System.	Short Term	Fayetteville Transit	

Name	Description	Timeframe	Geographic Scope	Cost
FAM-APTSFAST-004	Safety and Security	Short Term	Fayetteville Transit	
FAM-APTSFAST-005	Regional Transit Payment Card. Manages transit fare collection on-board transit vehicles and at transit stops using electronic means. It allows transit users to use a traveler card or other electronic payment device. Readers located either in the infrastructure or on-board the transit vehicle allow electronic fare payment. Data is processed, stored, and displayed on the transit vehicle and communicated as needed to the Transit Management Subsystem.	Long Term	Fayetteville Transit	
FAM-APTSFAST-006	Coordination with One Stop Call Center. Coordination with Veterans One Stop call center for paratransit system.	Medium Term	Fayetteville Transit	
FAM-APTSFAST-007	Coordination with PSAP. Provide capability for PSAP to view location of Transit vehicles to assist in emergency response	Medium Term	Fayetteville Transit	
FAM-APTSFAST-008	Automate the download of maintenance information from the FAST vehicles using the AVL system, and automate the generation of work orders.	Medium Term	Fayetteville Transit	
FAM-ATMSBRA-001	Update Fort Bragg Traffic Signal System. Update the traffic signal control system and traffic signal controllers on Fort Bragg.	Medium Term	Fort Bragg	

Name	Description	Timeframe	Geographic Scope	Cost
FAM-ATMSBRA-002	Fort Bragg Traveler Information System. Install DMS near Fort Bragg entrances about current queues.	Medium Term	Fort Bragg entry gates	
FAM-ATMSDunn-001	Dunn Citywide Traffic Signal System. Signals and Communications	Medium Term	Dunn	\$1,475,182
FAM-ATMSFayer-001CCTV	Life Cycle Replacement. (12) Fayetteville CCTVs	Short Term	Fayetteville	\$222,370
FAM-ATMSFayer-002CCTV	Life Cycle Replacement. (12) Fayetteville CCTVs	Short Term	Fayetteville	\$222,370
FAM-ATMSFayer-003SS	Life Cycle Replacement. Fayetteville Signal System Upgrade	Medium Term	Fayetteville	\$15,079,633
FAM-ATMSFaye-004	Deploy ITS on Santa Fe and Yadkin (3) Fayetteville CCTVs.	Short Term	Fayetteville	\$60,647
FAM-ATMSFaye-005	Deploy ITS on US 401 Ramsey Street (4) Fayetteville CCTVs	Short Term	Fayetteville	\$80,862
FAM-ATMSI295-001	Add Communications Infrastructure. Add optical fiber infrastructure. (16 miles)	Medium Term	I-295 NC/24/N87 (Bragg Boulevard) to I-95.	\$2,534,400
FAM-ATMSI295-002	Add ITS Devices. Add (8) CCTV cameras and (8) DMS on I-295 from NC 24-87 (Bragg Blvd) to north I-95.	Short Term	I-295 NC/24/N87 (Bragg Boulevard) to I-95.	\$1,910,087

Name	Description	Timeframe	Geographic Scope	Cost
FAM-ATMSI295-003	Add Communications Infrastructure. Add optical fiber infrastructure. (23 miles)	Medium Term	I-295 West of NC/24/N87 (Bragg Boulevard) to I-95 in Robeson County.	\$3,643,200
FAM-ATMSI295-006	Add ITS Devices. Add (8) CCTV cameras and (4) DMS on I-295 West of NC 24-87 (Bragg Boulevard) to south I-95 in Robeson Co. I-295 from NC/24/N87 (Bragg Boulevard) to South I-95.	Long Term	I-295	\$1,035,906
FAM-ATMSI74R-001CCTV	Life Cycle Replacement. Replace CCTVs on I-74 in Robeson Co. (8)	Medium Term	I-74 - US 74	\$141,509
FAM-ATMSI74R-002DMS	Life Cycle Replacement. Replace DMS on I-74 in Robeson Co. (7)	Medium Term	I-74 - US 74	\$1,092,727
FAM-ATMSI74R-003CCTV	Life Cycle Replacement. Replace CCTVs on I-74 in Columbus Co. (6)	Long Term	I-74 - US 74	\$20,216
FAM-ATMSI74R-004DMS	Life Cycle Replacement. Replace DMS on I-74 in Columbus Co. (10)	Long Term	I-74 - US 74	\$1,750,000
FAM-ATMSI95B-001	Deploy ITS on I-95 Business/US 301. Add (6) CCTV cameras I-95 Bus. from I-95 (Exit 56) to I-95 (Exit 40).	Short Term	US 401	\$558,384
FAM-ATMSI95-002	Add Communications Infrastructure. Add optical fiber infrastructure. (20 miles)	Medium Term	I-95 from Johnston Co. line (mm 78) to I-295 (mm 58)	\$3,168,000

Name	Description	Timeframe	Geographic Scope	Cost
FAM-ATMSI95-003	Add Communications Infrastructure. Add optical fiber infrastructure. (20 miles)	Medium Term	I-95 from I-295 (mm 58) to Robeson Co. line (mm 38)	\$3,168,000
FAM-ATMSI95-004	Add Communications Infrastructure. Add optical fiber infrastructure. (20 miles)	Medium Term	I-95 from Robeson Co. line (mm 38) to Lumberton (mm 20)	\$3,000,000
FAM-ATMSI95R-005CCTV	Life Cycle Replacement. Replace CCTVs on I-95 in Cumberland Co. (9)	Medium Term	I-95	\$181,940
FAM-ATMSI95R-006DMS	Life Cycle Replacement. Replace DMS on I-95 in Cumberland Co. (8)	Medium Term	I-95	\$1,966,909
FAM-ATMSI95R-007CCTV	Life Cycle Replacement. . Replace CCTVs on I-95 in Robeson Co. (6)	Medium Term	I-95	\$121,293
FAM-ATMSI95R-008DMS	Life Cycle Replacement. Replace DMS on I-95 in Robeson Co. (8)	Medium Term	I-95	\$1,748,364
FAM-ATMSI95R-009CCTV	Life Cycle Replacement. Replace CCTVs on I-95 in Harnett Co. (2)	Medium Term	I-95	\$60,647
FAM-ATMSI95R-010DMS	Life Cycle Replacement. Replace DMS on I-95 in Harnett Co. (2)	Medium Term	I-95	\$218,546
FAM-ATMSI95-011VSL	Variable Speed Limit System. Install variable speed limit (VSL) signs for inclement weather.	Medium Term	I-95	
FAM-ATMSLumb-001	Lumberton Citywide Traffic Signal System. Signals and Communications	Medium Term	Lumberton	\$2,950,363
FAM-ATMSNC24-001	Deploy ITS on NC 24 from I-295 Loop to I-95. Add (3) CCTV cameras and (2) DMS.	Medium Term	NC 24 from Outer Loop to I-95	\$517,953

Name	Description	Timeframe	Geographic Scope	Cost
FAM-ATMSNC24-002	Deploy ITS on NC 24 from I-95 to Sampson Co. line. Add (1) CCTV cameras and (1) DMS.	Long Term	NC 24 from I-95 to Sampson Co. line	\$238,761
FAM-ATMSNC24-87-001	Deploy ITS on NC 24-87. Add (4) CCTV cameras and (2) DMS.	Medium Term	NC 24-87 from I-295 to NC 27	\$517,953
FAM-ATMSNC87-001	Deploy ITS on NC 87. Add (6) CCTV cameras and (0) DMS.	Medium Term	NC 87 from Ramsey St. to I-95	\$121,293
FAM-ATMSNC87-002	Deploy ITS on NC 87. Add (3) CCTV cameras and (0) DMS.	Long Term	NC 87 from I-95 to Elizabethtown	\$60,647
FAM-ATMSNC87-003	Deploy ITS on NC 87 from Elizabethtown to US 74. Add (3) CCTV cameras and (0) DMS.	Long Term	NC 87 from Elizabethtown to US 74	\$60,647
FAM-ATMSUS401-001	Deploy ITS on US 401 Bypass. Add (4) CCTV cameras and (0) DMS.	Medium - Long Term	US 401 Bypass from Ramsey St. to Hoke Co. line	\$80,862
FAM-ATMSUS401R-002DMS	Life Cycle Replacement. Replace DMS on Skibo Rd. (2)	Short Term	US 401 Byp	\$437,091
FAM-EMI95-001	The Safety Patrol Service would monitor roads that aid motorists, and offer rapid response to minor incidents (flat tire, accidents, out of gas) to minimize disruption to the traffic stream. If problems are detected, the roadway service patrol vehicles will provide assistance to the motorist (e.g., push a vehicle to the shoulder or median).	Medium Term	NCDOT Division 6	\$262,255

Name	Description	Timeframe	Geographic Scope	Cost
FAM-EMCC-001	Connection from the PSAP to TOCs (NCDOT and City of Fayetteville) to provide video and DMS info to PSAP and for PSAP to provide incident info to TOCs.	Medium Term	Cumberland County	
FAM-EMCC-002	Additional Mobile Communications Terminals in Public Safety Vehicles (County Sheriff)	Short Term	Cumberland County	
STA-ATMSMULTI-001	An interface that allows users to customize information on trips, routes, time of day, day of week, and notification. System to alert users when an incident occurs on their pre-defined routes.		Statewide	
STA-ATMSMULTI-004	Basic event management integrated into Smartlink software. This is the replacement for the TIMS (Traffic Incident Management System).		Statewide	\$300,000
STA-ATMSMULTI-005	Add Center-to-Field (C2F) Communications to the NCDOT Smartlink Software. Add Dynamic Message Sign (DMS) contro, reversible lane sign control, Closed Circuit Television (CCTV) camera control, and video wall control capabilities to the NCDOT SmartLink system.	Short Term	Statewide	
STA-ATMSMULTI-006	Detour Database - Detour maps in a GIS format to be integrated into Smartlink to be placed on the web quickly and efficiently. Develop detour maps in a GIS format to be integrated into TIMS to be placed on the web quickly and efficiently.		Statewide	\$198,000

Name	Description	Timeframe	Geographic Scope	Cost
STA-ATMSMULTI-008	Integrate CAD feeds into the NCDOT SmartLink system, including the State Highway Patrol CAD/AVL.	Short Term	Statewide	
STA-ATMSMULTI-009	Smartlink will be an integrated software system that will be installed at NCDOT facilities statewide providing command and control capabilities to NCDOT operators at various locations throughout the state. All 14 NCDOT Divisions will have the capability to use Smartlink to see what the status of the transportation system is in real time at any of the Divisions connected through Center-to-Center, while Divisions and the three RTMCs and selected other facilities will have the ability to control ITS devices in the field to enhance mobility across their areas of influence.	Short Term	Statewide	
STA-ATMSMULTI-010	Add AMBER and SILVER alert messaging to the NCDOT SmartLink system.	Short Term	Statewide	
STA-ATMSMULTI-011	Add emergency management links and performance measures reporting to the NCDOT SmartLink system, as well as semi-automatic Incident Management Assistance Patrol (IMAP) dispatch and e-mail alerting for designated personnel.	Short Term	Statewide	

Name	Description	Timeframe	Geographic Scope	Cost
STA-ATMSMULTI-013	NCDOT Smartlink Interface with traffic sensors to obtain speed, volume, occupancy to support travel time calculation with automatic DMS messaging for travel times.	Short Term	Statewide	
STA-ATMSMULTI-014	Allow electronic files, such as documents and pictures, to be attached to incident records in the NCDOT SmartLink system.	Short Term	Statewide	
STA-ATMSMULTI-015	Add the capability to show other agencies (towing, EMS, law enforcement, etc.) response times in the NCDOT SmartLink incident timelines for the purposes of performance measure reporting		Statewide	
STA-ATMSMULTI-016	Add the capability for automatic incident detection based on traffic sensor data with dynamic response plan generation to NCDOT SmartLink software	Short Term	Statewide	
STA-ATMSMULTI-017	Add the capability for Highway Advisory Radio (HAR), Road Weather Information System (RWIS), automatic Safety Patrol Service	Short Term	Statewide	

Appendix H Agreements

FAST AVL
Updated 08/17/2008

MOU for the Fayetteville Area System of Transit Fixed Route AVL Project

Memorandum of Understanding (MOU)

The TECHNOLOGY Software project will be a cooperative effort of the following agencies and a collaborative effort with the selected software vendor:

Blue items are to be replaced

Lead Funding Agency	North Carolina Department of Transportation, Public Transportation Division
Roles and Responsibilities	Primary funder of TECHNOLOGY System: - Agrees to provide funding for 90% of the capital, training and software costs of the approved state grant applications – these costs do not include contract administration, multiple year maintenance, data communication or custom reports unless the benefits are statewide - Agrees to fund 85% of the annual maintenance fee as an eligible expense in the community transportation grant process after the one year warranty is complete; once the 'go live' is achieved, legacy system costs will not be eligible for reimbursement - Agrees to have representation on the Implementation Team and to participate in meetings to resolve any issues - Expects as a requirement of funding that each agency will follow the implied and actual intent of this agreement - Requires that failure to 'go live', fully implement the system and continuously use the system will result in repayment of 90% of the costs. Full implementation must be done within 90 days of 'go live'.
Contact	Miriam Perry, Director

Technical Assistance	North Carolina State University / Institute for Transportation Research and Education / Public Transportation Group
Roles and Responsibilities	Technical Assistance Provider of the Paratransit Scheduling and Dispatching System: - Agrees to provide assistance in implementation, business practice and organizational issues - Agrees to provide assistance in collecting "before and after" data and completing the analysis - Agrees to have representation on the Implementation Team - Agrees to participate in meetings / conversations to resolve any issues - Agrees to update definitions and other documents as appropriate
Contact	Debbie Collins, NC Transit Program Manager

**MEMORANDUM OF UNDERSTANDING
BETWEEN THE
DEPARTMENT OF PUBLIC SAFETY;
STATE HIGHWAY PATROL SECTION;
AND
DEPARTMENT OF TRANSPORTATION

WORK ZONE SAFETY PATROL**

This Memorandum of Understanding (MOU) is made this 1 day of July, 2012 between the **Department of Public Safety; State Highway Patrol Section** and the **Department of Transportation (DOT)**. This Memorandum of Understanding supersedes all previous executed work zone Memorandums of Understanding.

WHEREAS, work zones present an enhanced risk of injury to workers and to the motoring public; and

WHEREAS, the State Highway Patrol as a Section within the Department of Public Safety, is responsible for ensuring safe, efficient transportation on the streets and highways of this state; and

WHEREAS, the State Highway Patrol has prior experience in patrolling work zones in the state of North Carolina; and

WHEREAS, the Department of Transportation recognizes the need to have enhanced work zone safety patrols and law enforcement presence at many of its existing and future work zones; and

WHEREAS, the Department of Transportation desires to provide enhanced work zone safety patrols by the State Highway Patrol at a select number of work zones; and

WHEREAS, the Department of Transportation and the Department of Public Safety agree that enhanced work zone safety patrols help to reduce collision involving fatalities and personal injuries that occur in such work zones; and

NOW, therefore, in consideration of the premises and mutual benefits as set out above, the Department of Transportation and the Department of Public Safety hereby mutually agree as follows:

1. The State Highway Patrol shall utilize off-duty troopers to provide enhanced work zone safety patrols at such work zones as may be identified and prioritized by the Department of Transportation.
2. Annually, the Department of Transportation shall notify the State Highway Patrol by memorandum of the anticipated allocation and workload for the year (July 1st to June 30th). The State Highway Patrol shall respond to this memorandum with their ability to meet the demand.

INTERAGENCY MEMORANDUM OF UNDERSTANDING
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
NORTH CAROLINA DEPARTMENT OF CRIME CONTROL AND PUBLIC
SAFETY
DIVISION OF STATE HIGHWAY PATROL
REMOVAL OF VEHICLES FROM ROADWAY

This memorandum of understanding made this 15 day of June, 2011 by and between the North Carolina Department of Transportation (NCDOT) and the North Carolina State Highway Patrol (SHP) is to provide guidance for implementation of the Quick Clearance provision of N.C.G.S. 20-161(f) on the State Highway system.

WHEREAS, in an effort to minimize the potential personal injury and/or economic loss associated with disruptions to the regular flow of traffic, the North Carolina Legislature has enacted specific legislation authorizing the immediate removal (Quick Clearance) of vehicles and/or property which interfere with the regular flow of traffic or otherwise constitute a hazard on the State highway system; and

WHEREAS, the parties hereto recognize the potential hazards and economic loss that may occur from wrecked, abandoned, disabled, unattended, burned, or partially dismantled vehicles, cargo, or other personal property on the State highway system when such occurrence or condition interferes with the regular flow of traffic; and

WHEREAS, the North Carolina Legislature has vested in investigating law enforcement officers the authority to immediately remove or cause to be removed such vehicles or property only when such vehicle or property interferes with the regular flow of traffic or otherwise constitutes a hazard and when done in conjunction with the concurrence of the North Carolina Department of Transportation;

NOW THEREFORE, the North Carolina Department of Transportation and State Highway Patrol each agree to the following described guidelines and delineation of specific authority and obligations in order to implement the provisions of the Quick Clearance legislation:

1. General:

Whenever a state highway is closed or partially blocked by a wrecked, abandoned, disabled, unattended, burned, or partially dismantled vehicle, cargo, or other personal property, the priority shall be to clear the road and reopen the roadway as soon as possible. It is understood that damage to vehicles and / or cargo may occur as a result of clearing the road on an urgent basis. Notwithstanding, while reasonable attempts to avoid such damage should be taken, the highest priority is public safety. Additionally, while consideration for the vehicle and / or owner's preference for utilization of a wrecker service and related service providers and for the integrity of the power unit, trailer and cargo are not to be ignored in every circumstance, public safety and convenience of the motoring public shall be paramount. Consistent with this public safety and motoring public priority, the following procedure is hereby established:

Appendix I

FAMPO Regional ITS Architecture

Customized Service Package Diagrams

based on
National ITS Architecture Version 7.0

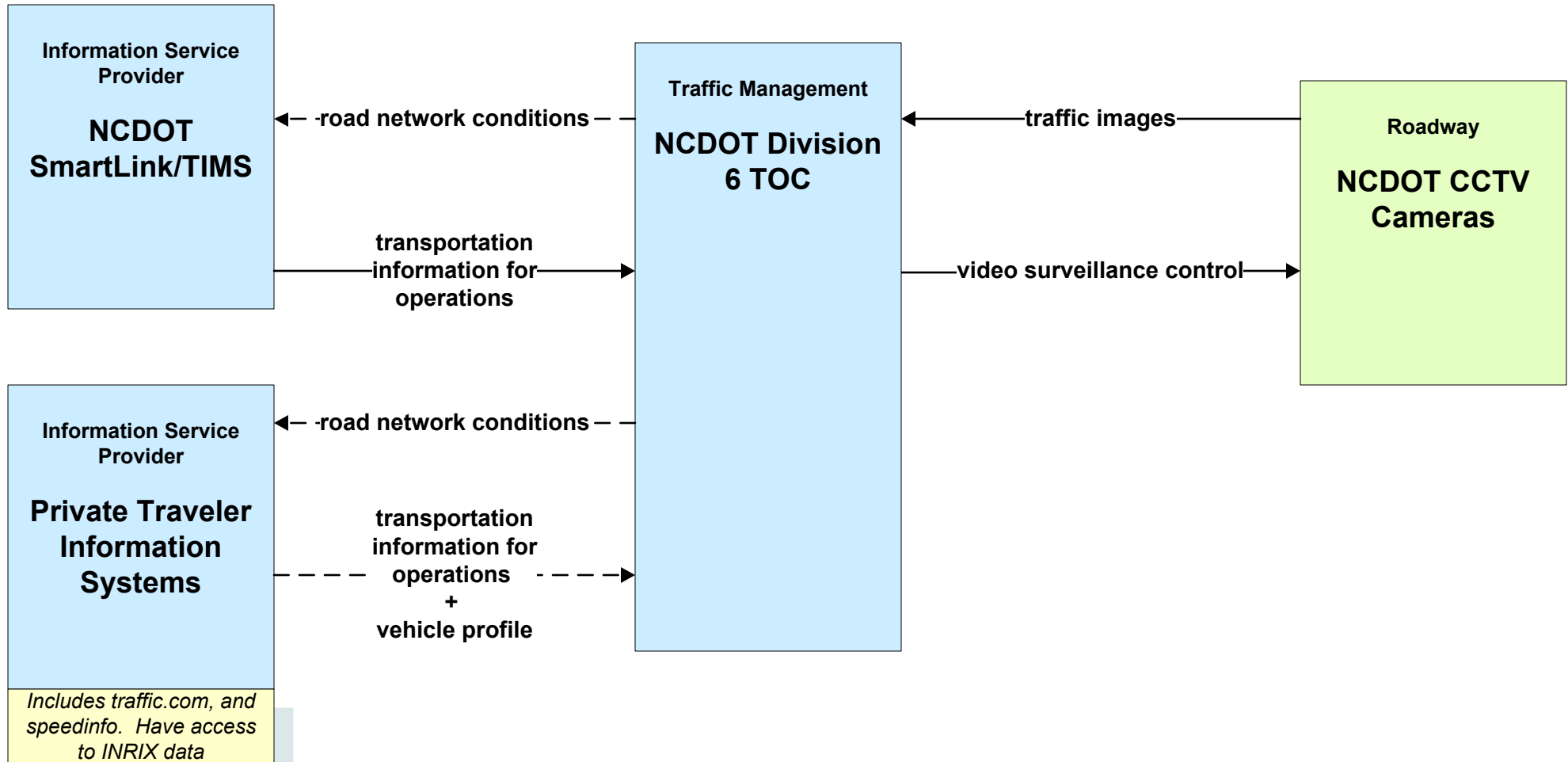
April 4, 2013

FAMPO Regional ITS Architecture

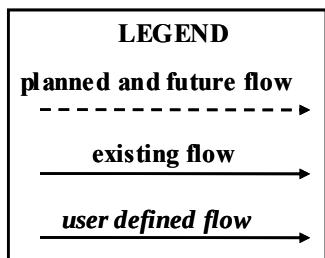
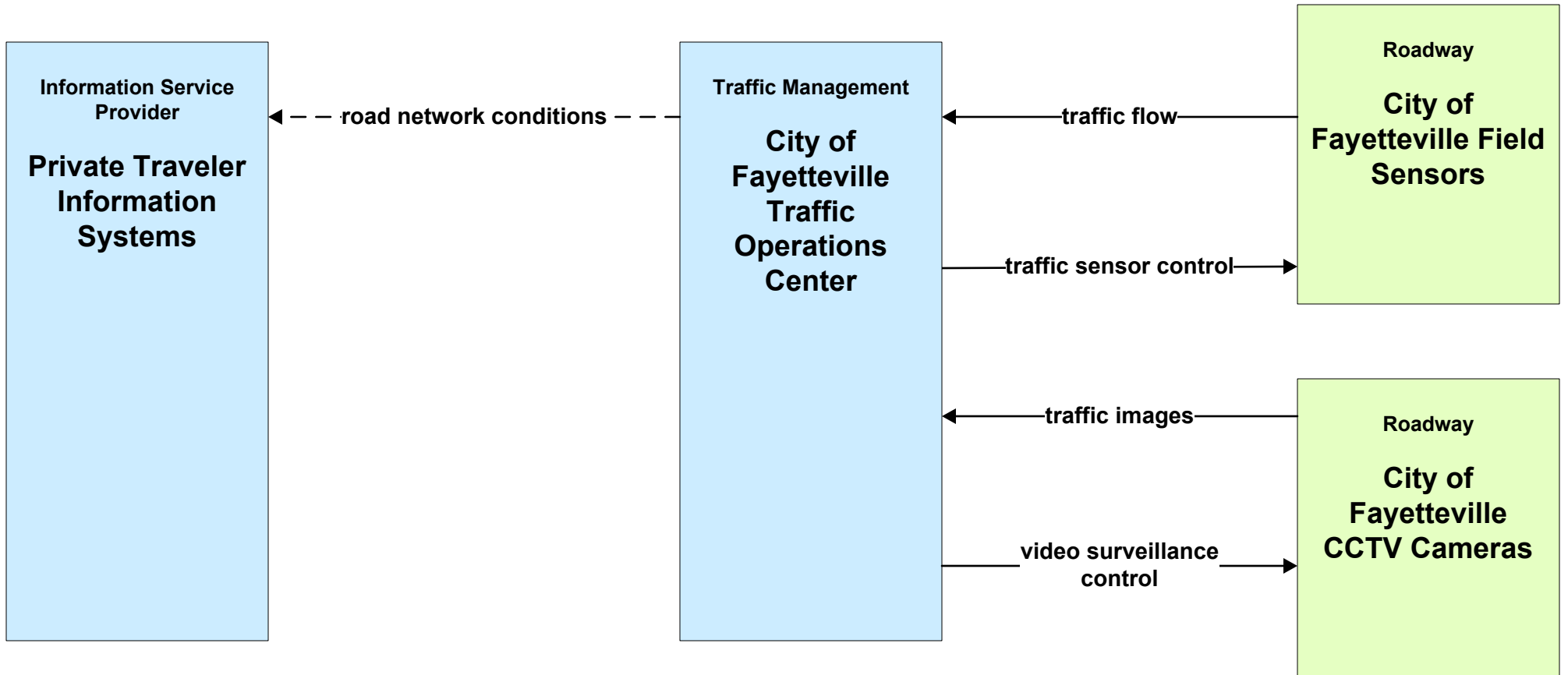
Customized Service Package Diagrams

**Advanced Traffic Management Systems
(ATMS)**

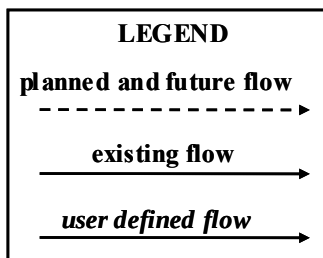
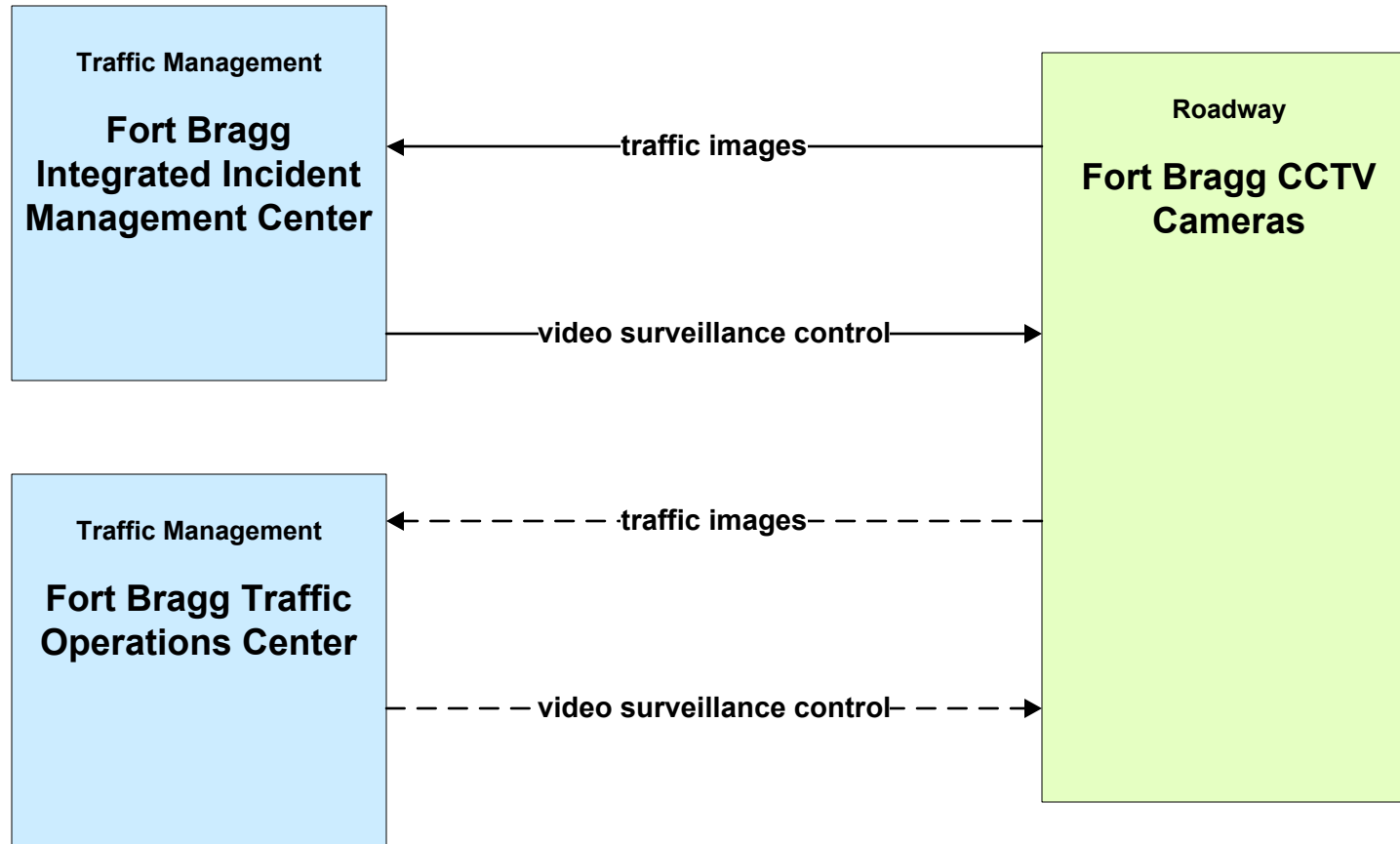
ATMS01 - Network Surveillance NCDOT



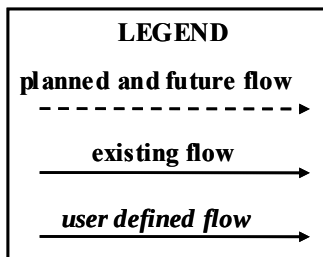
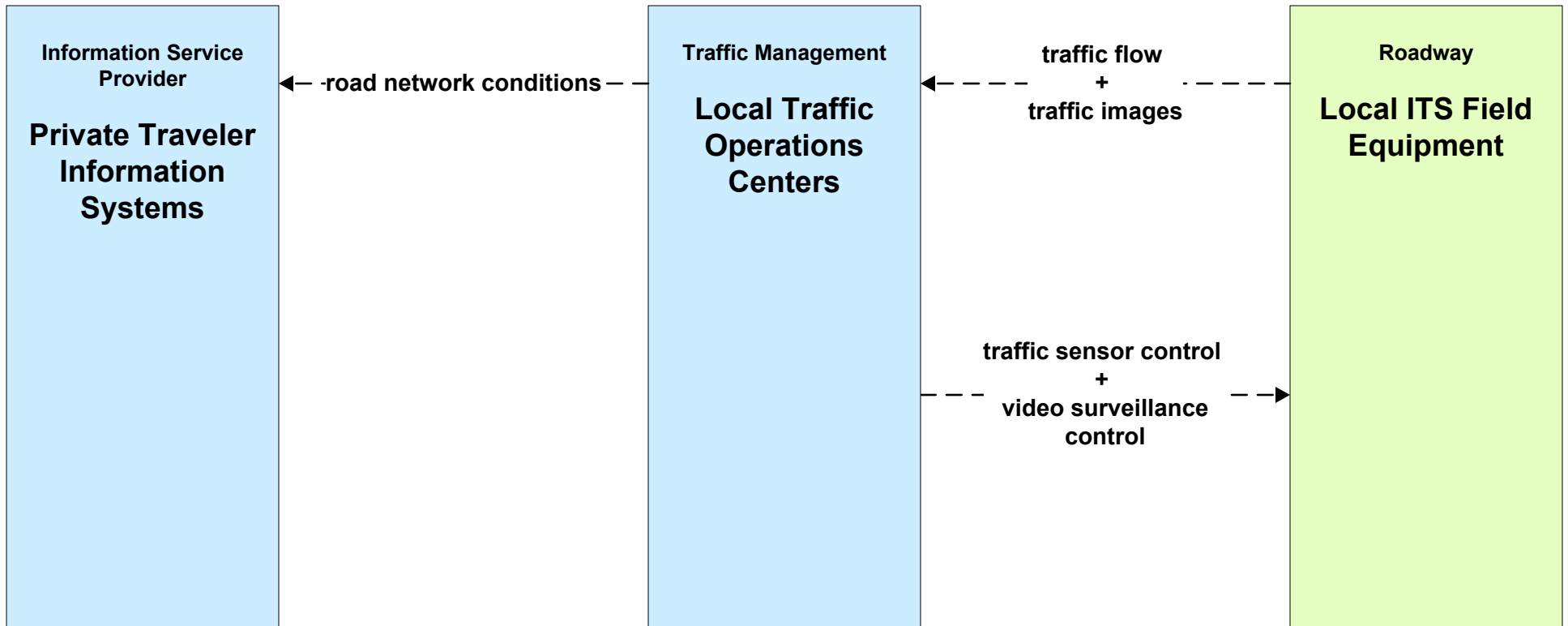
ATMS01 - Network Surveillance Fayetteville



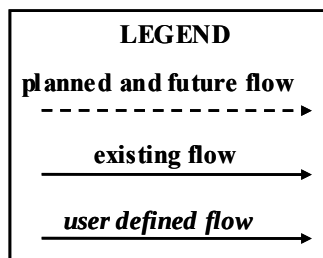
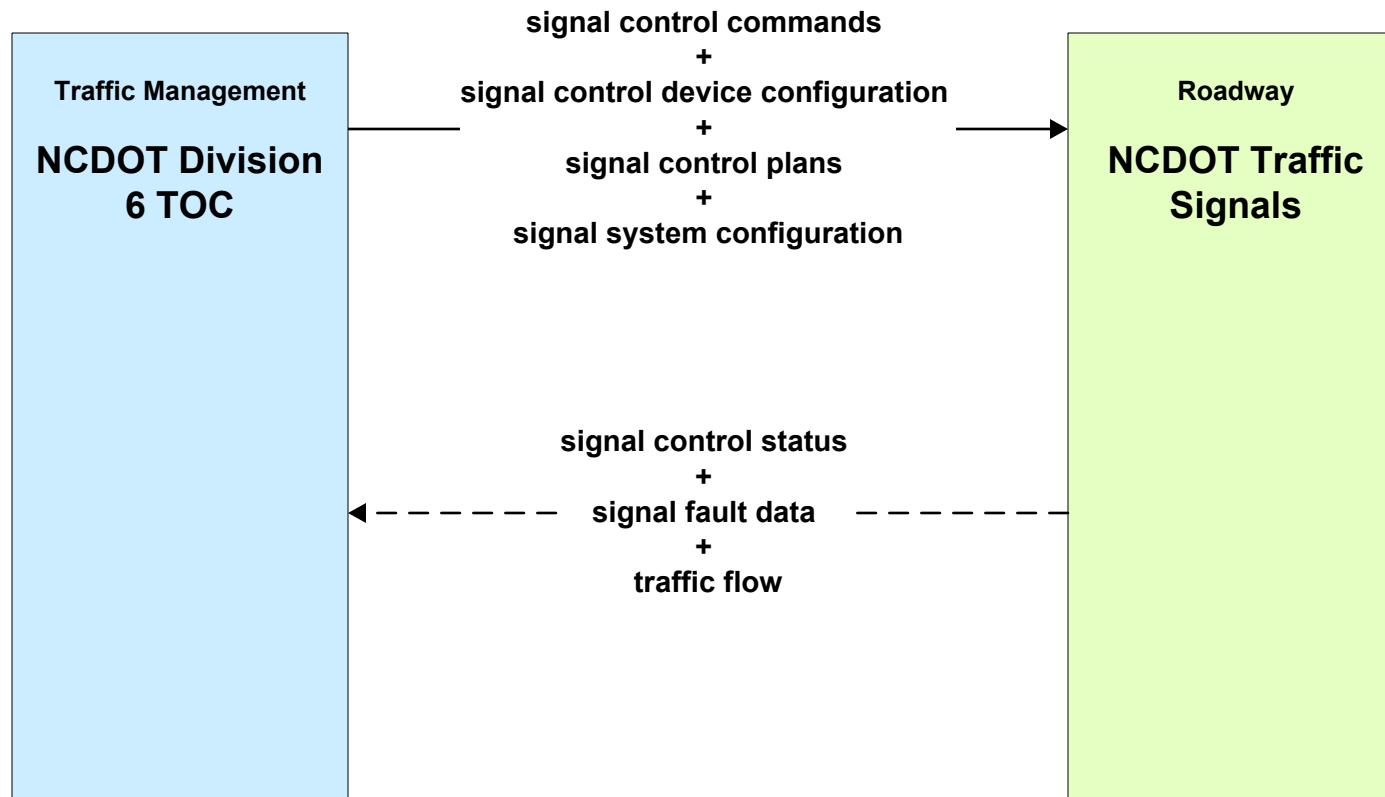
ATMS01 - Network Surveillance Fort Bragg



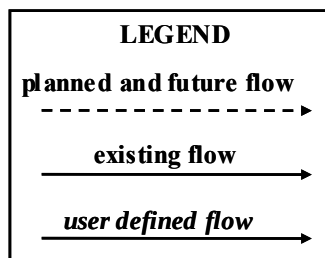
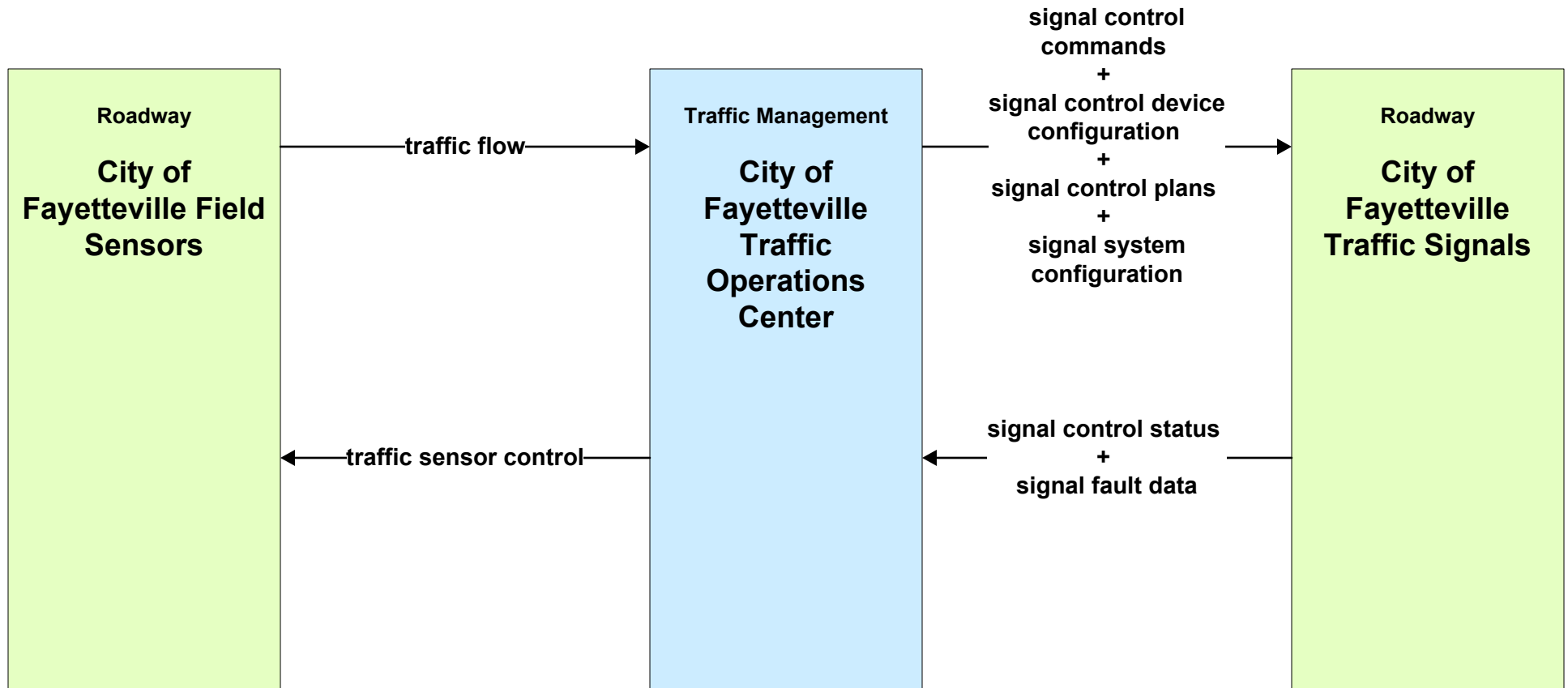
ATMS01 - Network Surveillance Local Municipalities



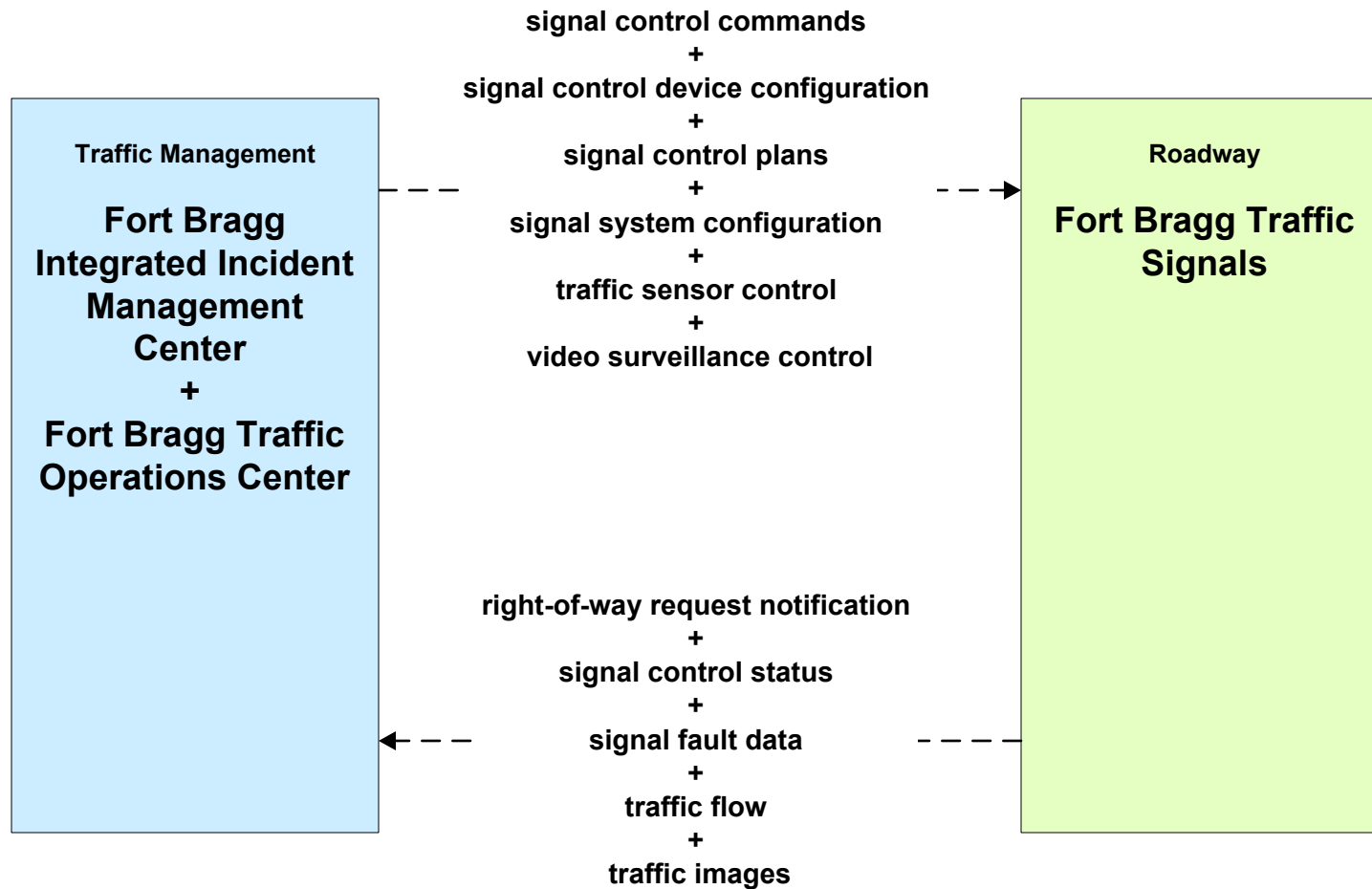
ATMS03 - Surface Street Control NCDOT



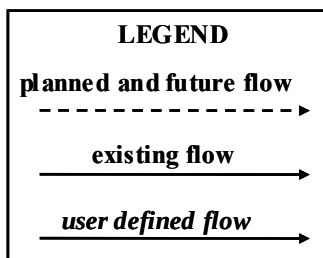
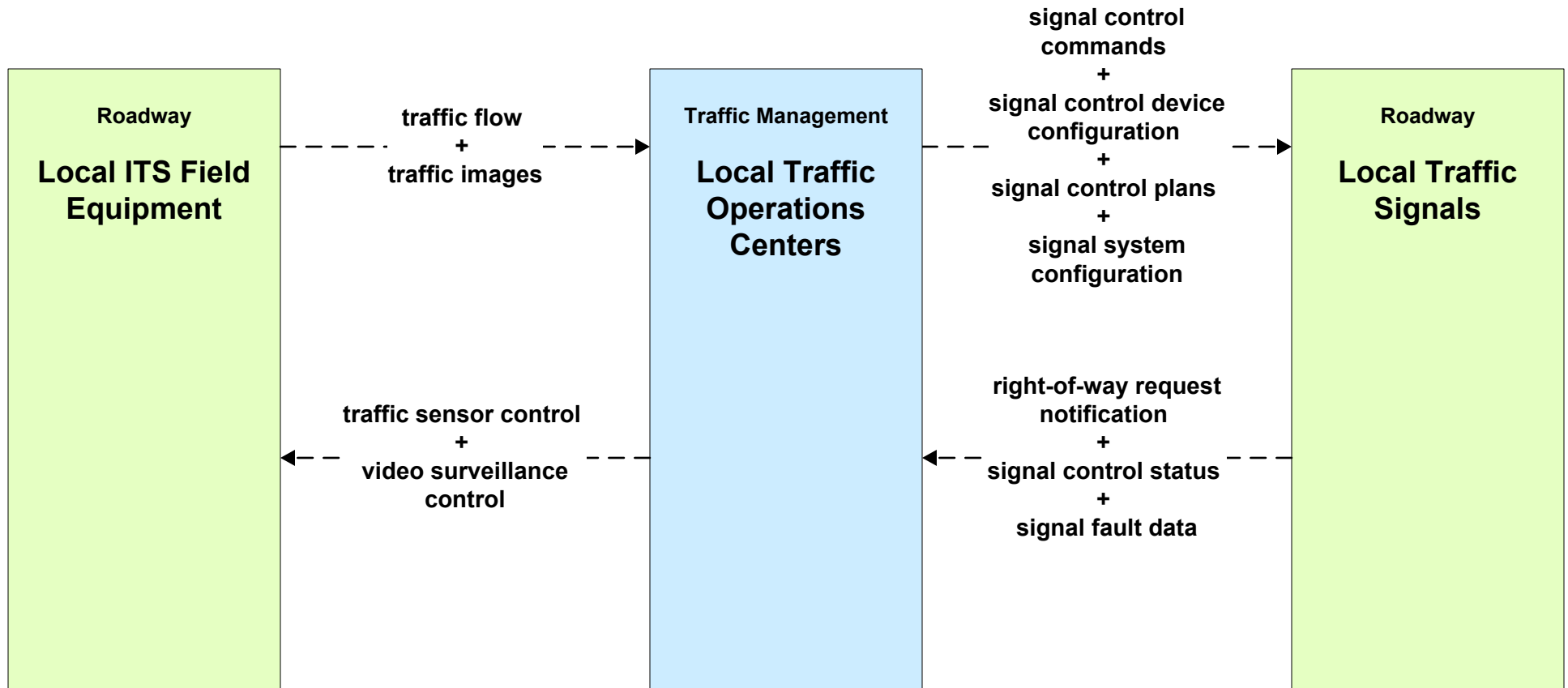
ATMS03 - Traffic Signal Control Fayetteville



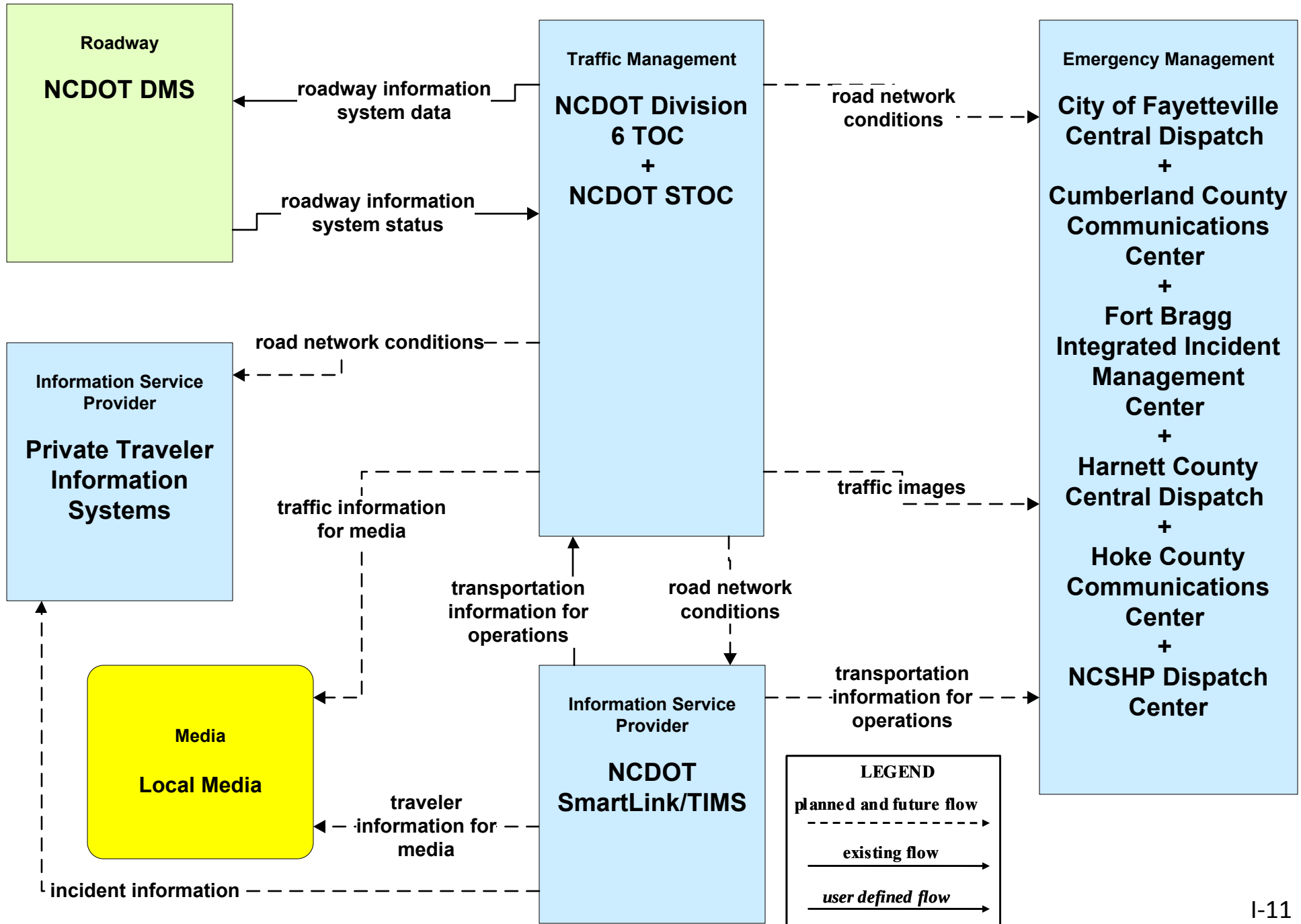
ATMS03 - Surface Street Control Fort Bragg



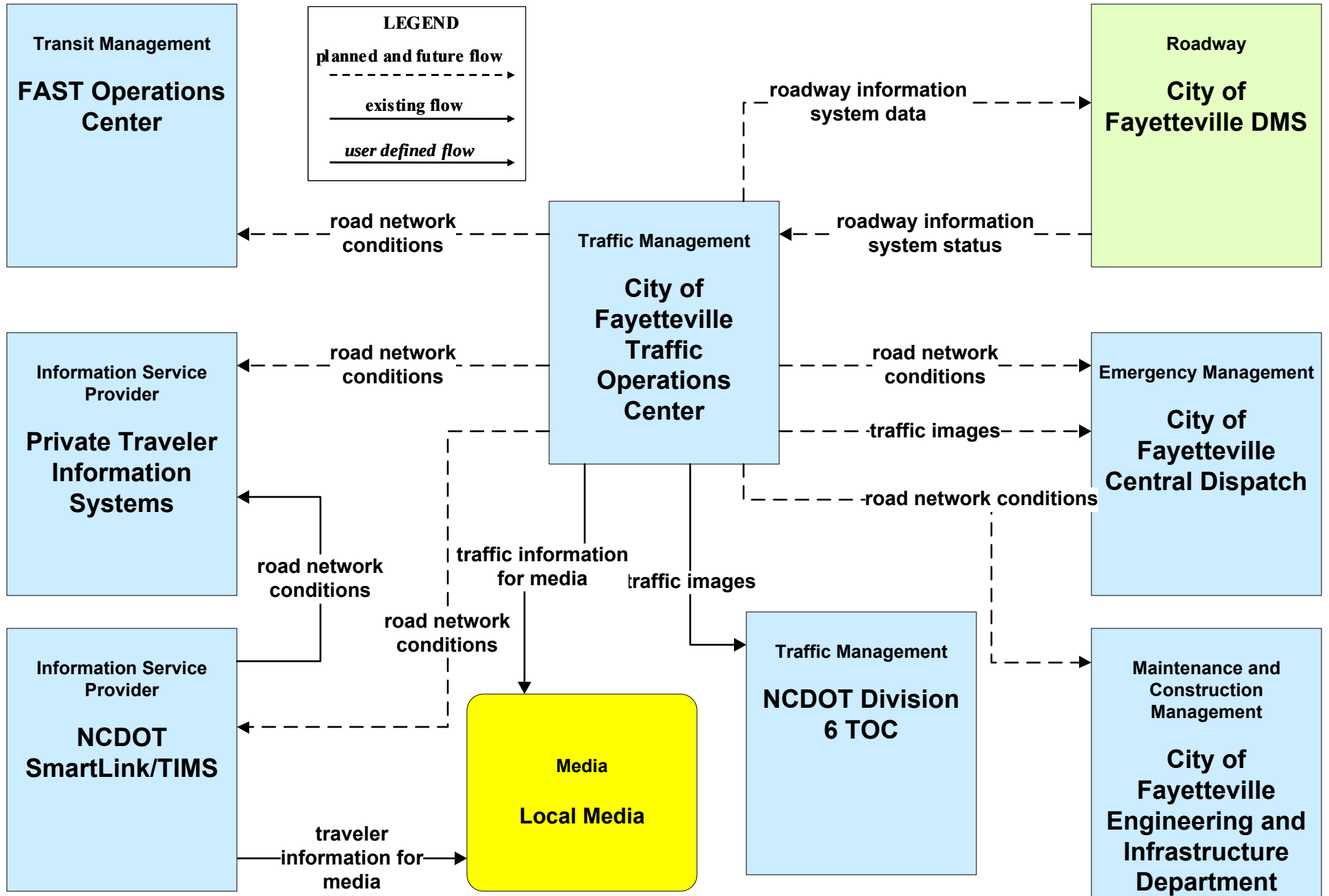
ATMS03 - Surface Street Control Local Municipalities



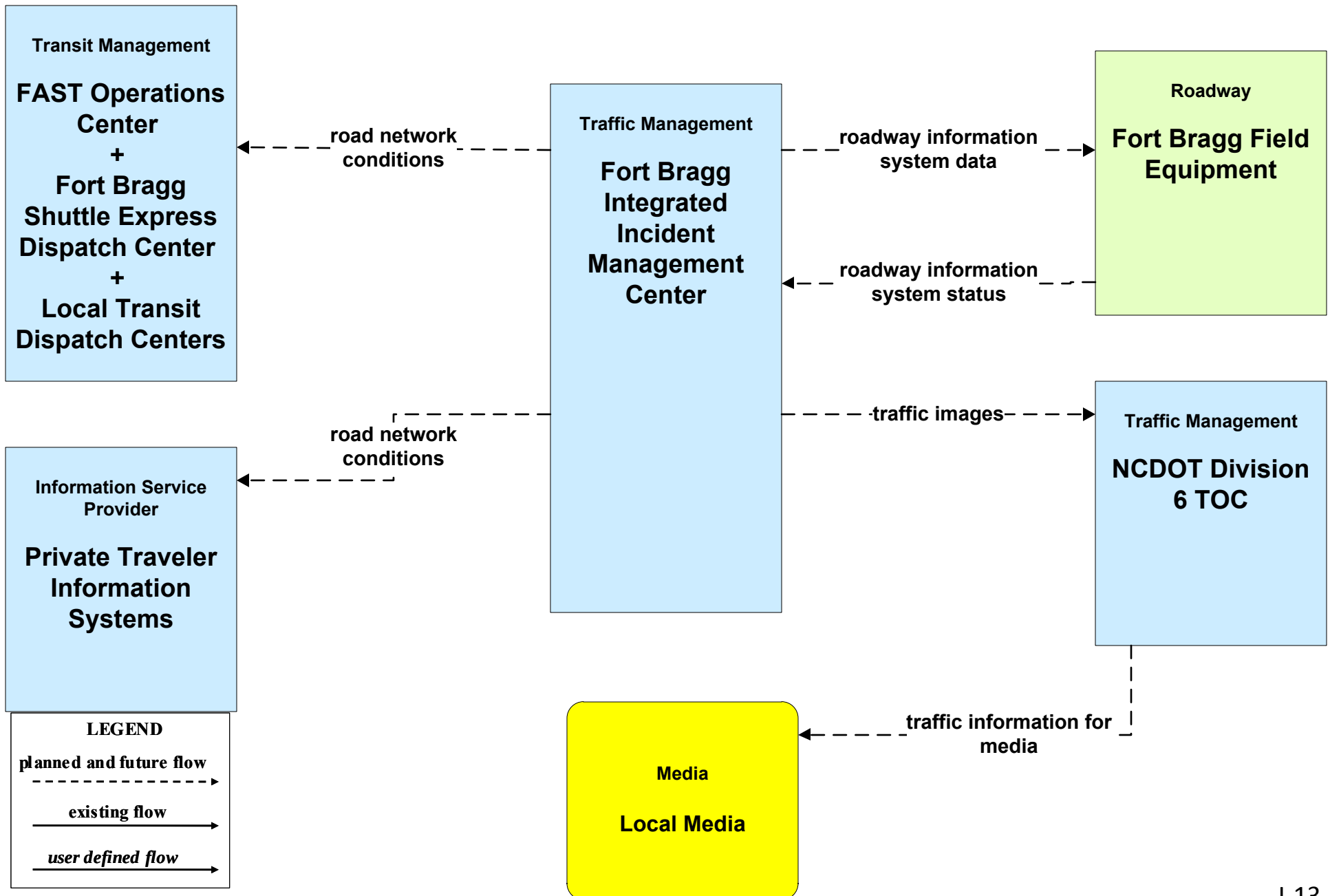
ATMS06 - Traffic Information Dissemination NCDOT



ATMS06 - Traffic Information Dissemination Fayetteville

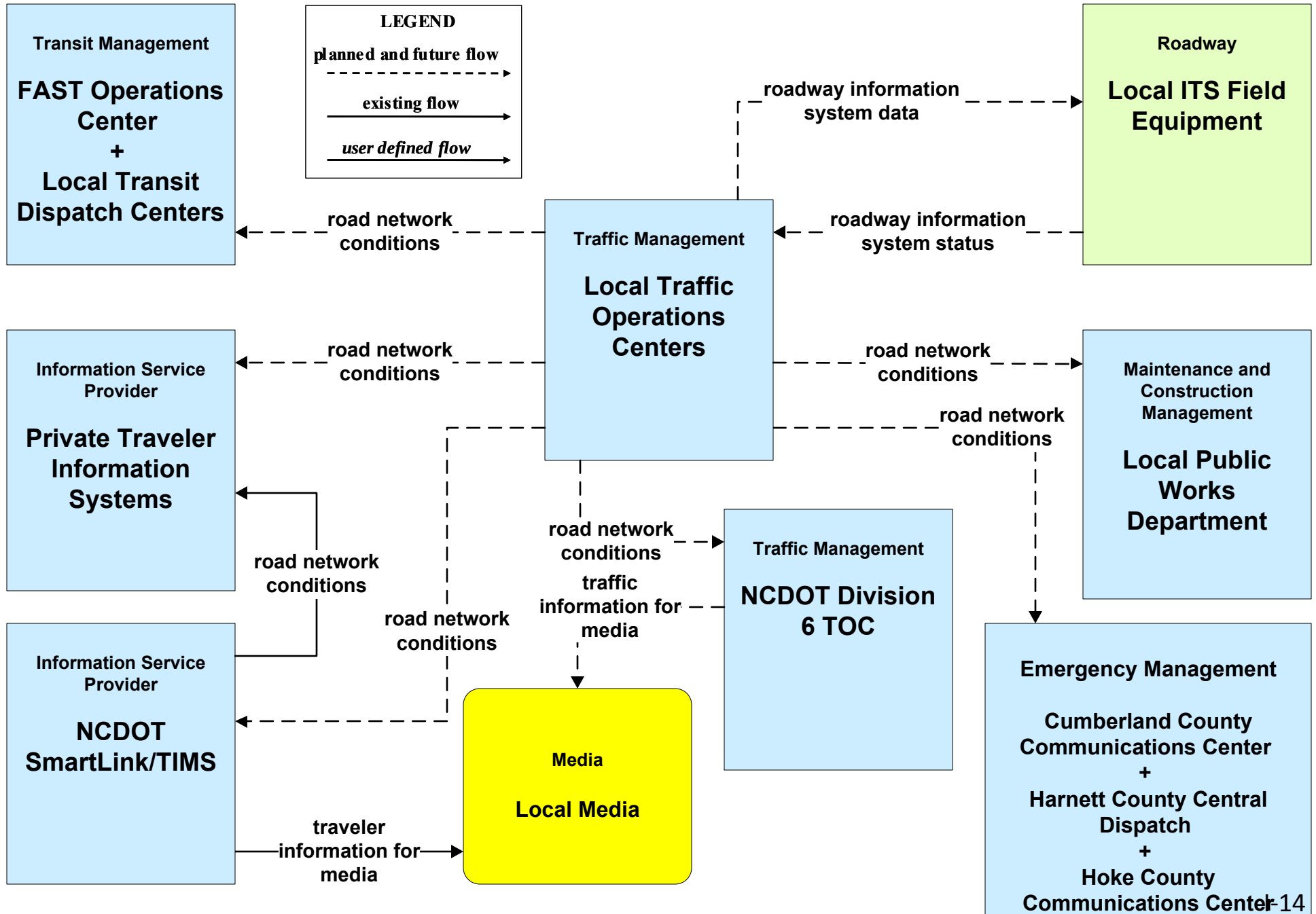


ATMS06 - Traffic Information Dissemination Fort Bragg

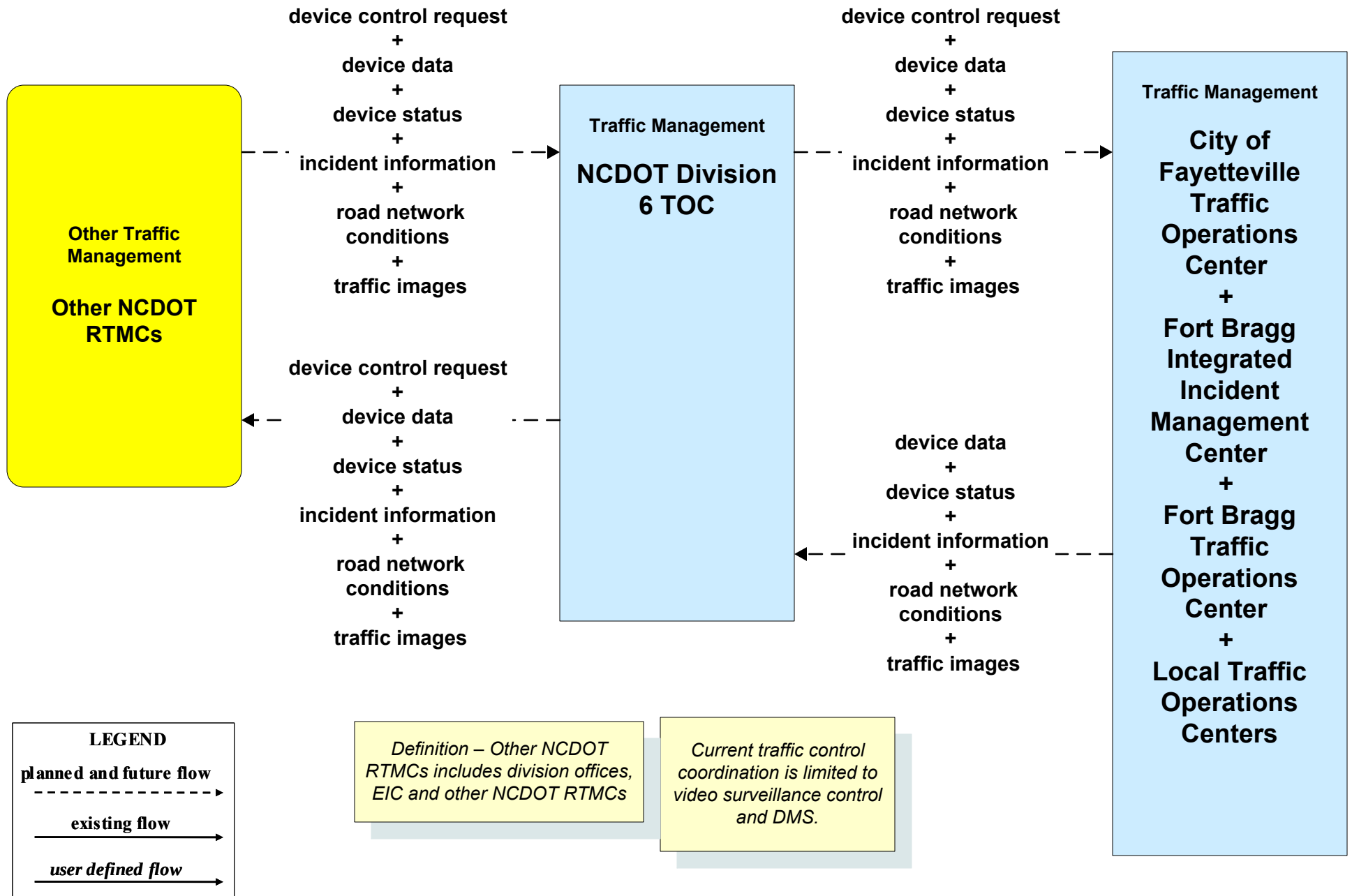


ATMS06 - Traffic Information Dissemination

Local Traffic Operations Center

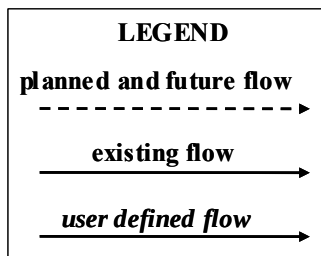
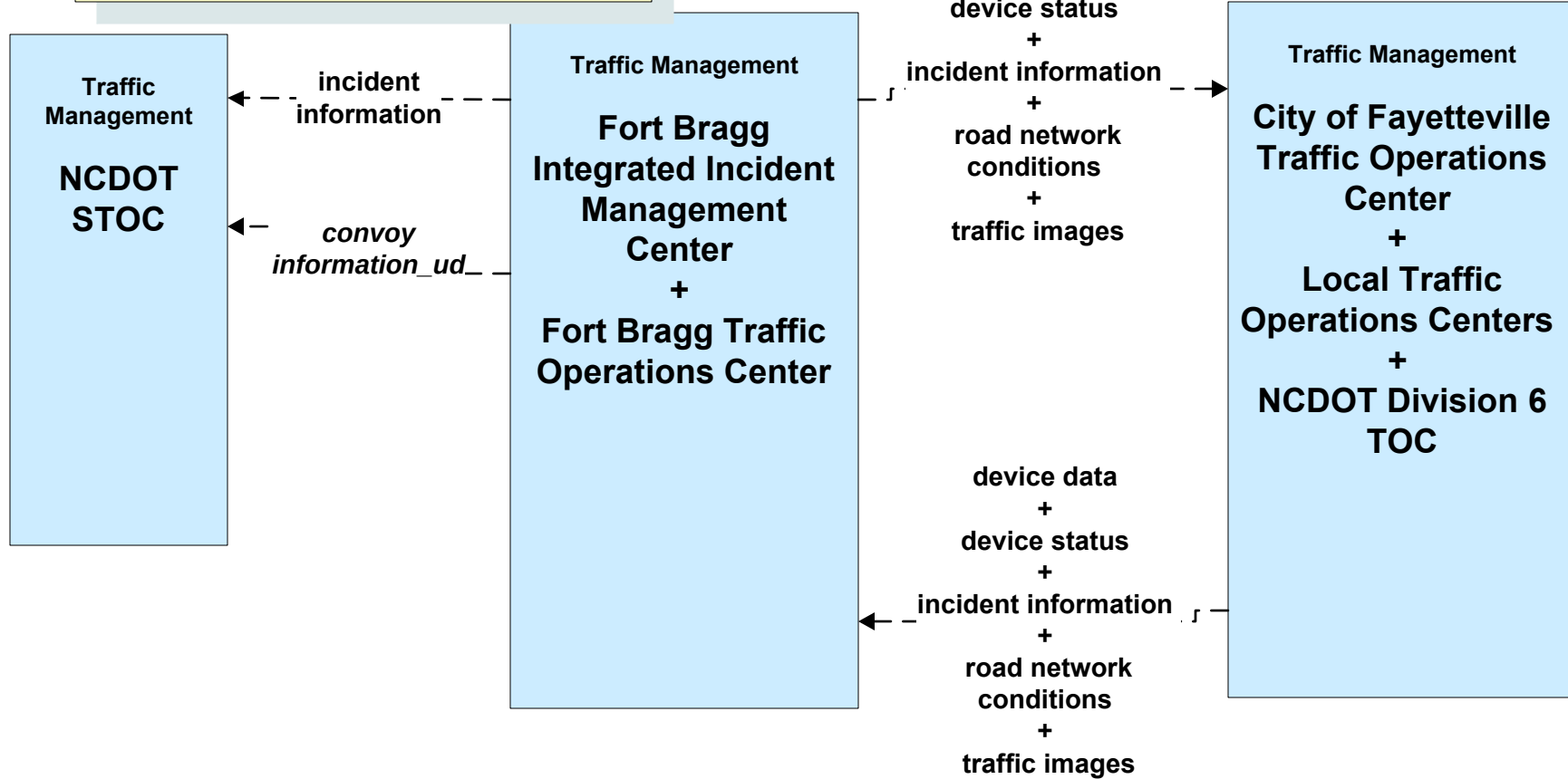


ATMS07 - Regional Traffic Management NCDOT



ATMS07 - Regional Traffic Management Fort Bragg

Incident information could include road closure info (access point status)- sharing info with STOC might be more important than to Div 6.



Incident Management Overview

ATMS08 Covered

Emergency Management <-- --> Traffic Management

Emergency Management <-- --> Maintenance and Construction

Traffic Management <-- --> Maintenance and Construction

Maintenance and Construction <-- --> Maintenance and Construction

Event Plans and Weather <-- --> Traffic Management & Emergency Management (see MCs for M&C)

ATMS06, 03, 04, etc. Covered

Traffic Management <-- --> Roadway

ATMS07 Covered

Traffic Management <-- --> Traffic Management

EM01 Covered

Emergency Management <-- --> Emergency Management

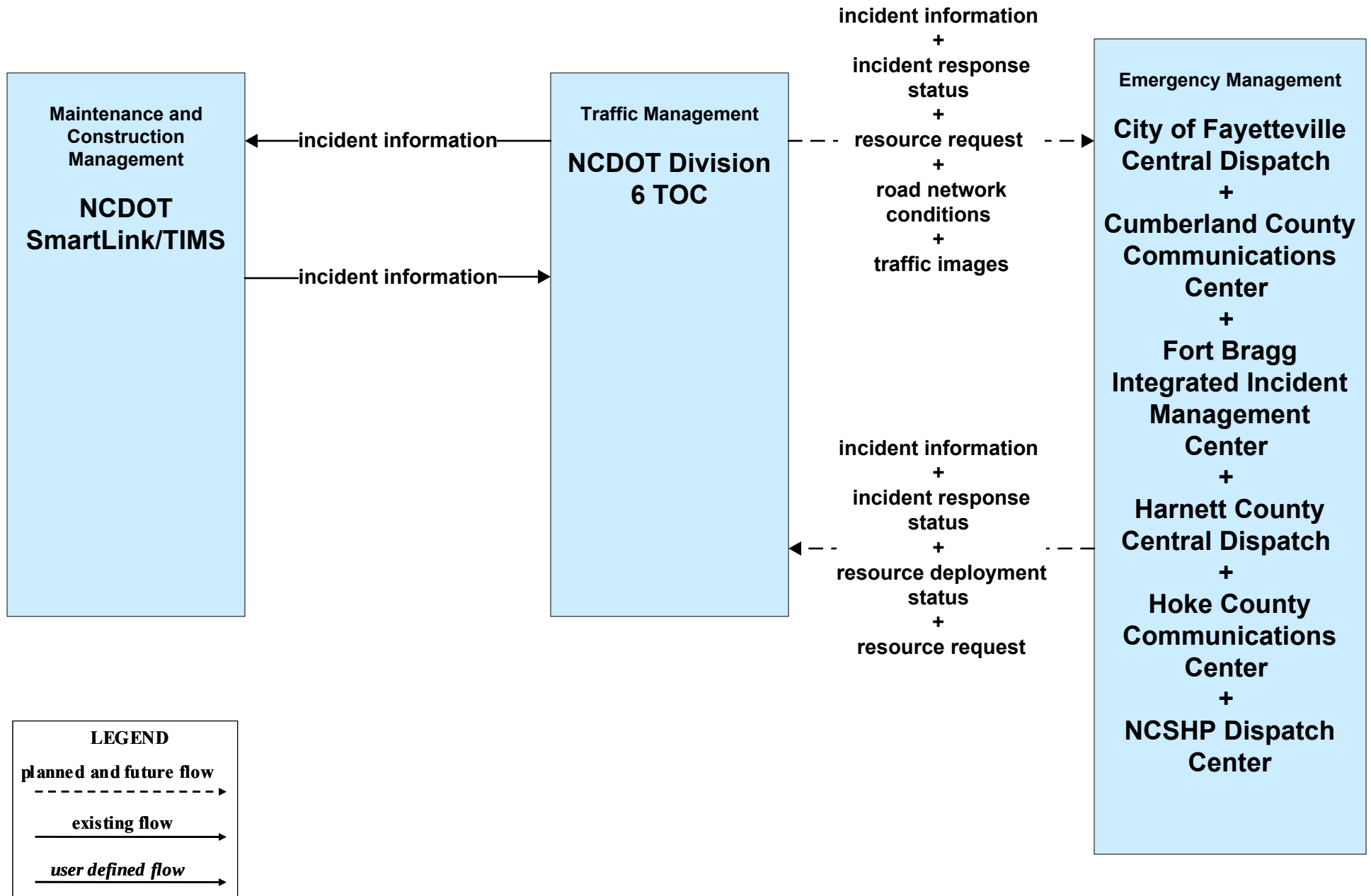
EM02 Covered

Emergency Vehicle Preemption

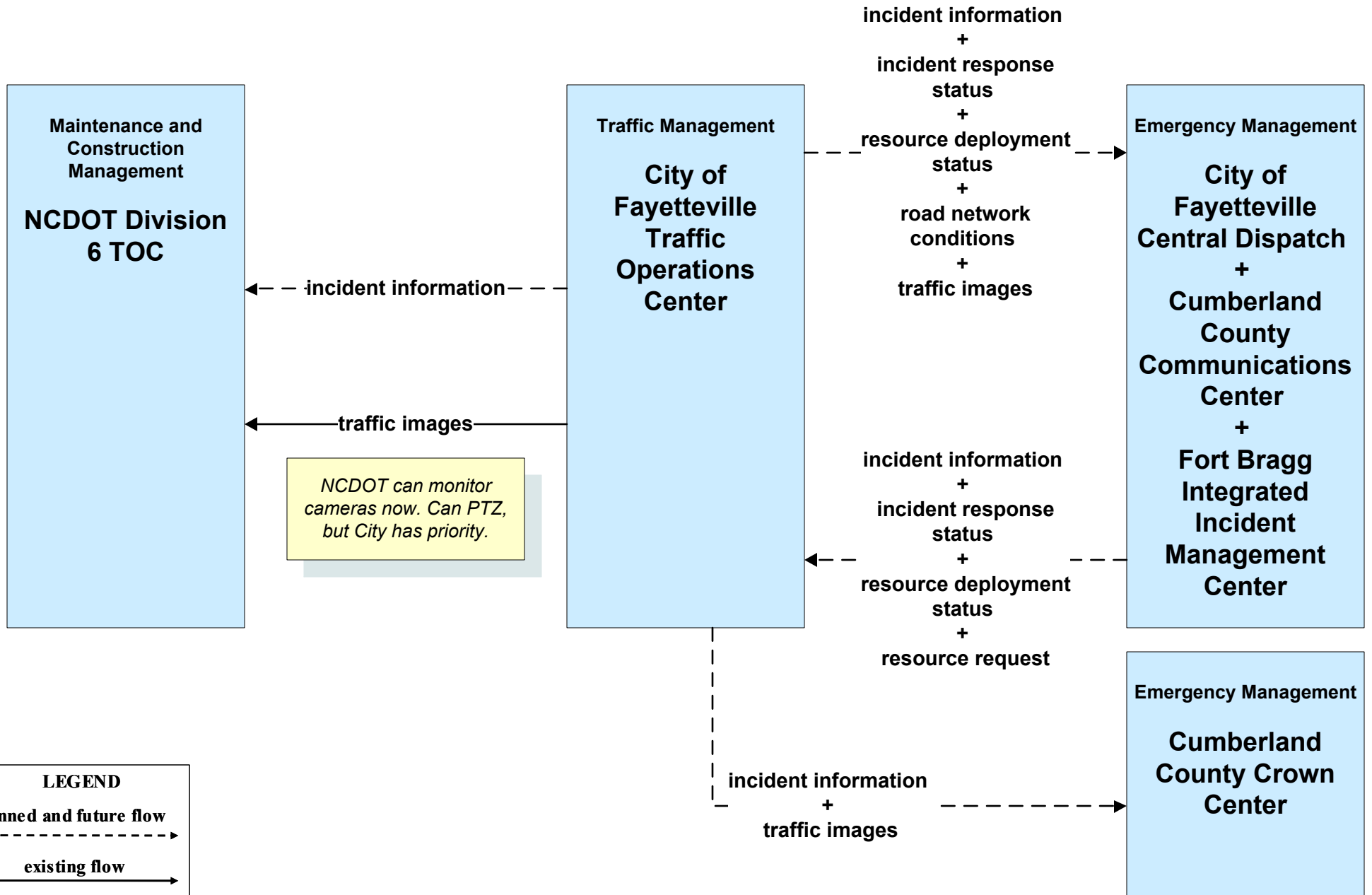
ATMS08 - Incident Management

Traffic Management <-- --> Emergency Management

ATMS08 - Incident Management NCDOT (TM to EM)



ATMS08 - Incident Management Fayetteville (TM to EM)



NCDOT can monitor cameras now. Can PTZ, but City has priority.

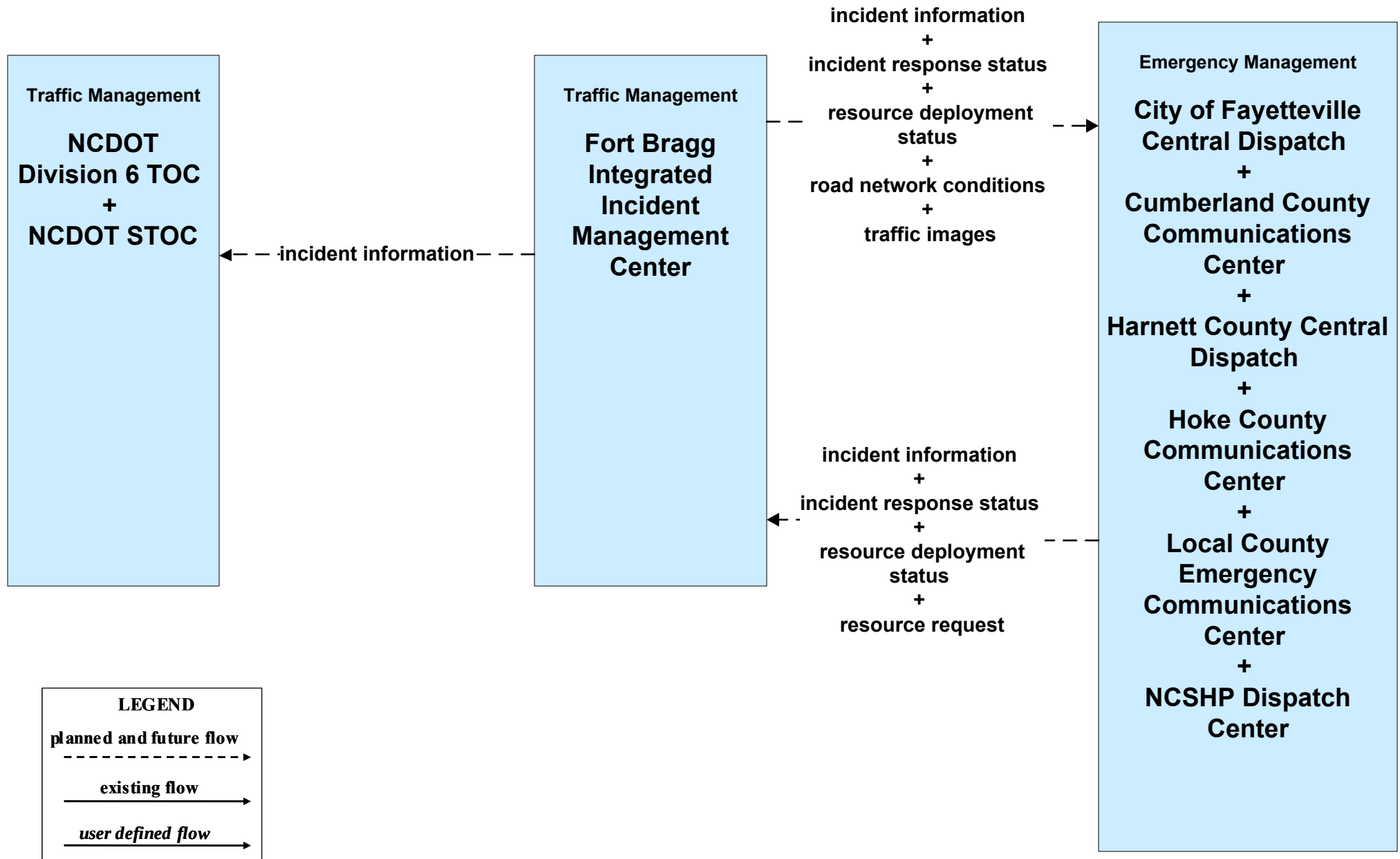
LEGEND

planned and future flow
----->

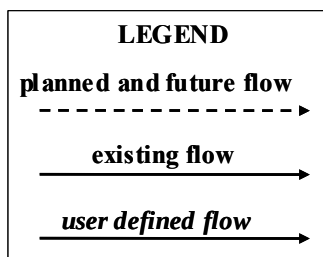
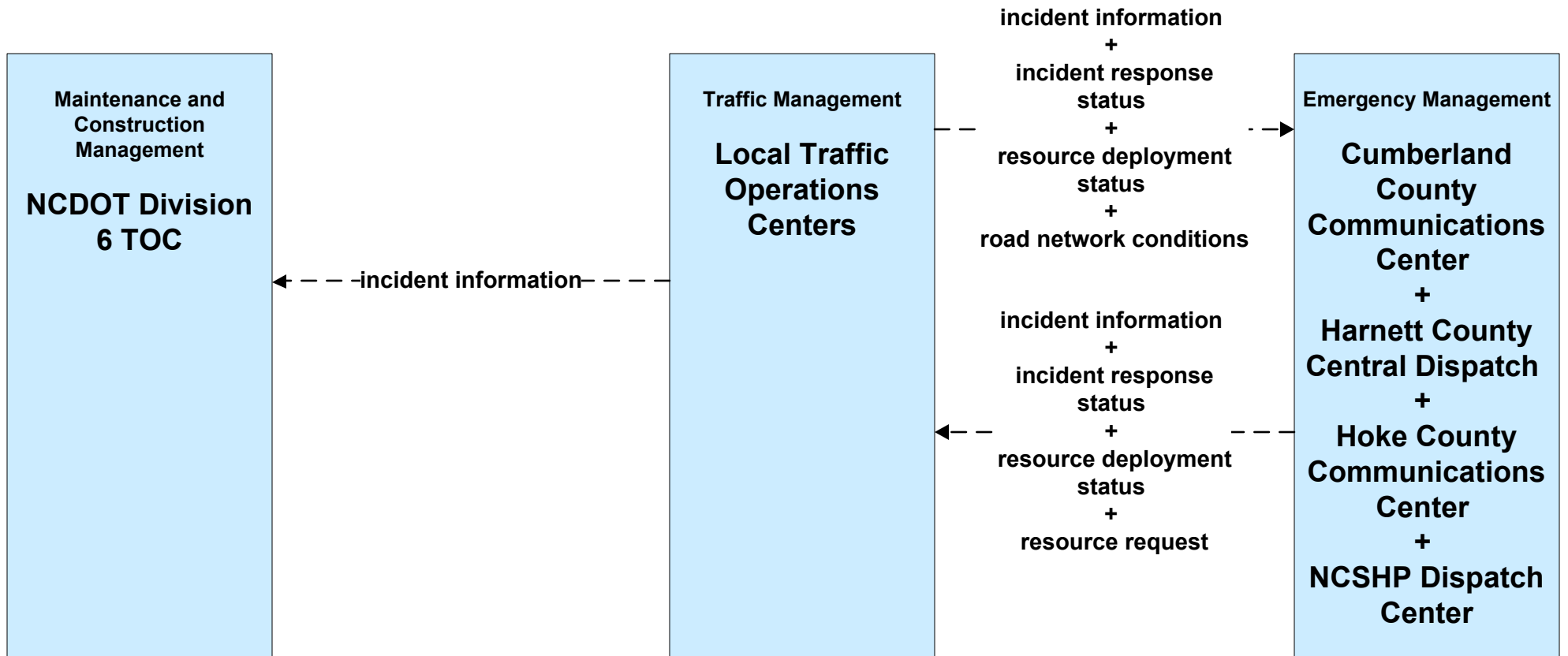
existing flow
————>

user defined flow
————>

ATMS08 - Incident Management Fort Bragg (TM to EM)



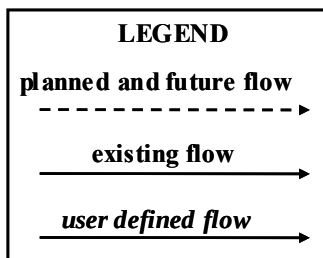
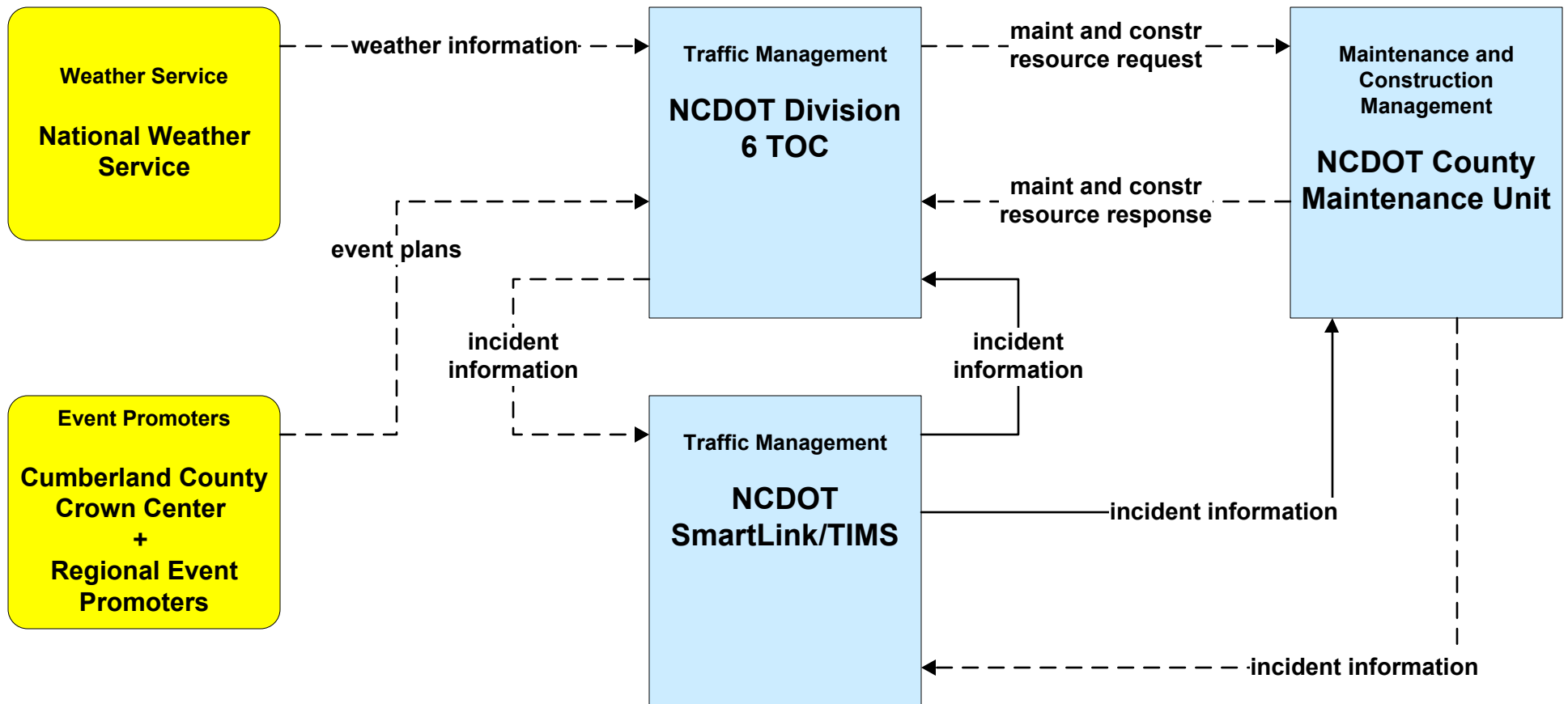
ATMS08 - Incident Management Local Municipalities (TM to EM)



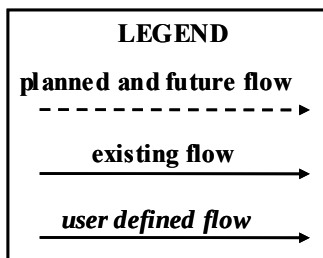
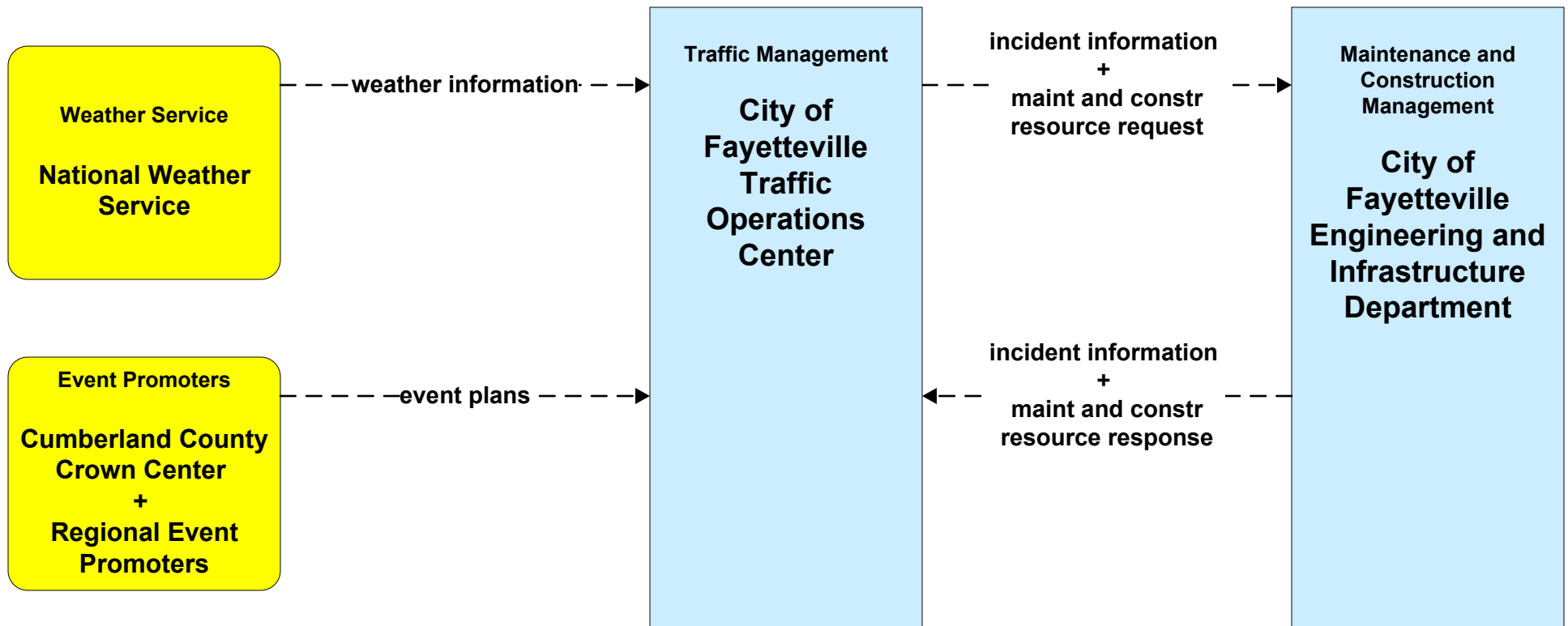
ATMS08 - Incident Management

Traffic Management <-- --> Maintenance and Construction Management

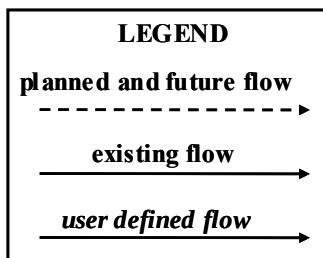
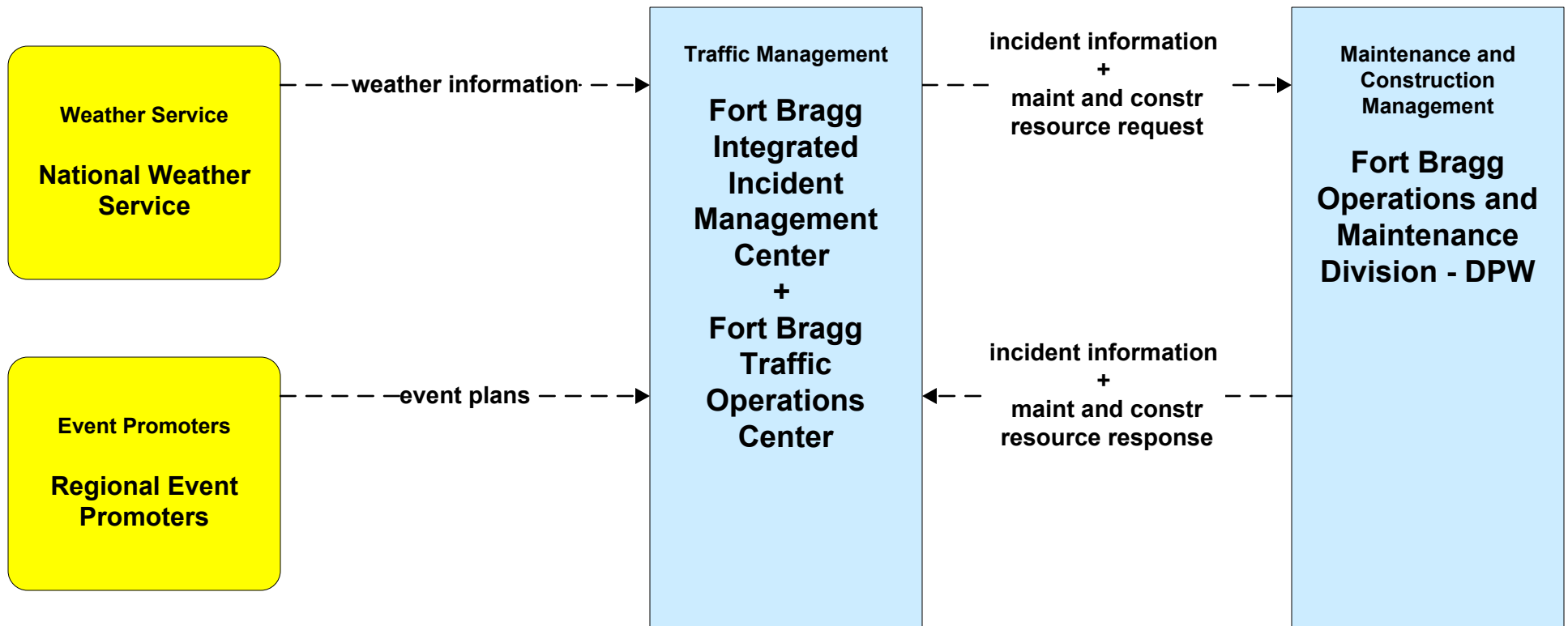
ATMS08 - Incident Management NCDOT (TM to MCM)



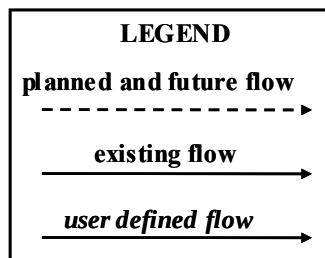
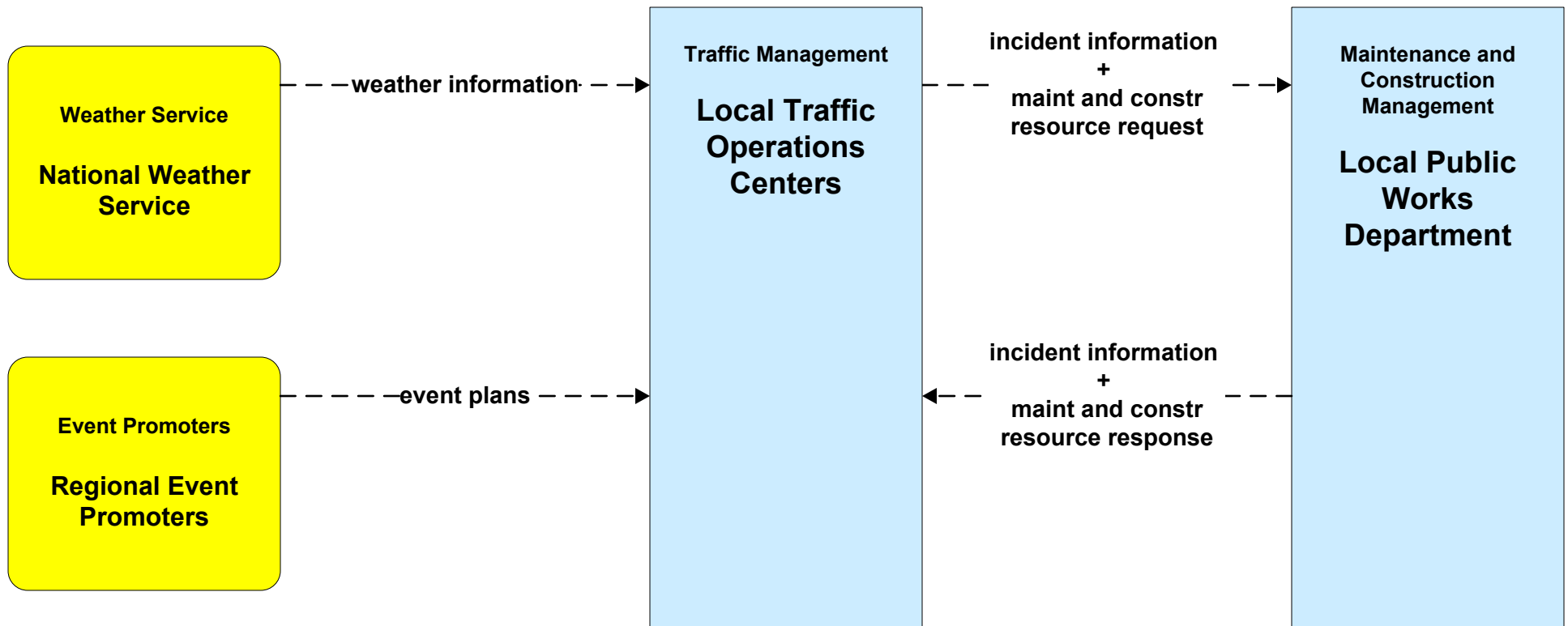
ATMS08 - Incident Management Fayetteville (TM to MCM)



ATMS08 - Incident Management Fort Bragg (TM to MCM)



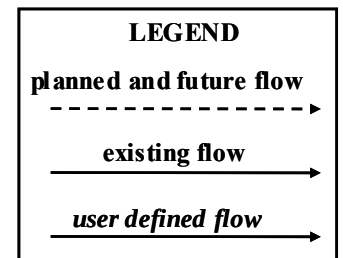
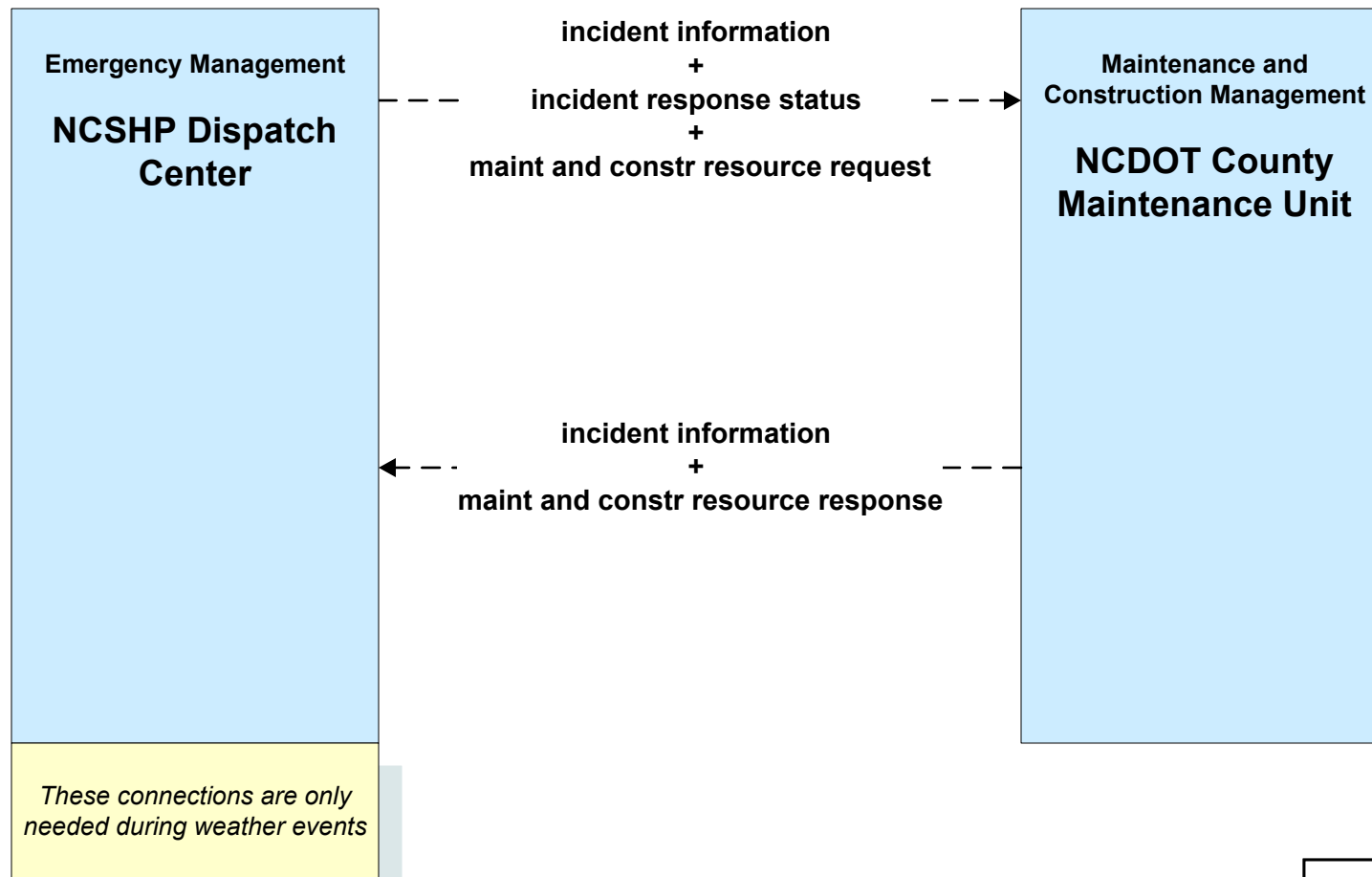
ATMS08 - Incident Management Local Municipalities (TM to MCM)



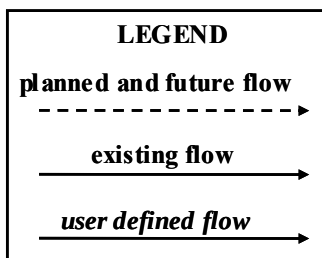
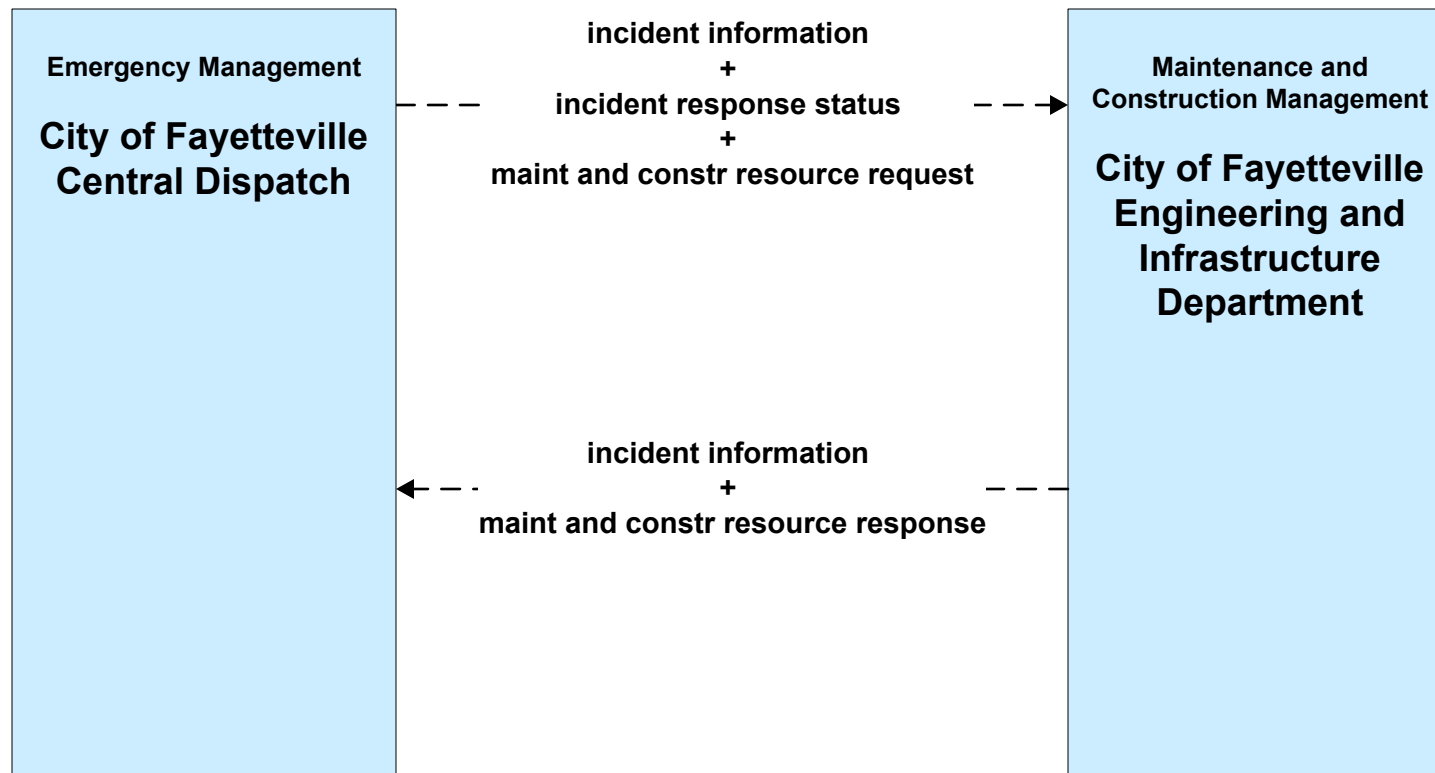
ATMS08 - Incident Management

Emergency Management <-- --> Maintenance and Construction Management

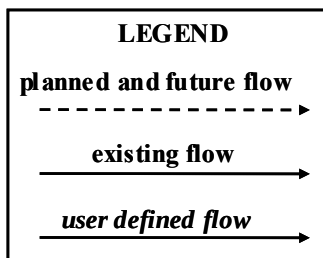
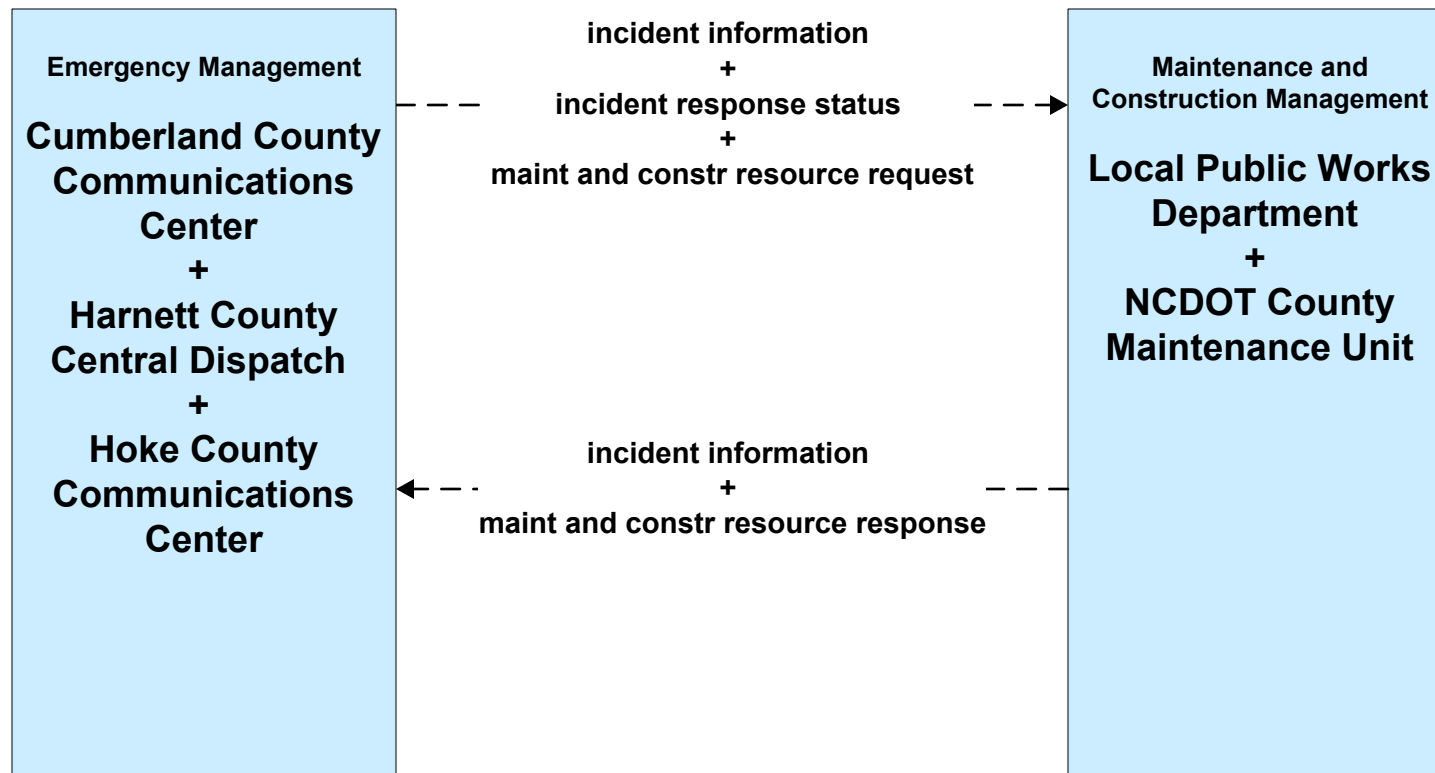
ATMS08 - Incident Management
North Carolina State Highway Patrol (EM to MCM)



ATMS08 - Incident Management Fayetteville (EM to MCM)



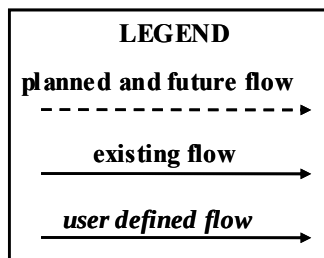
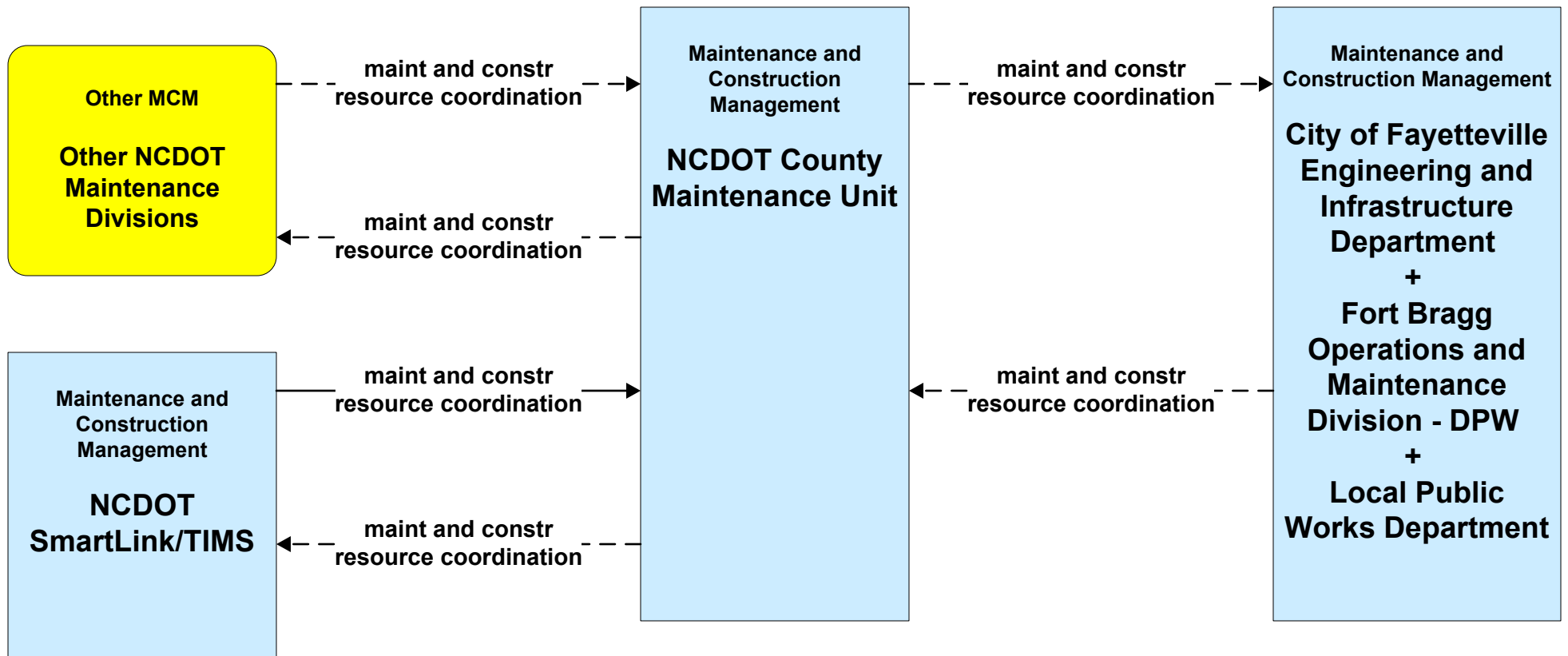
**ATMS08 - Incident Management
County Communications Center (EM to MCM)**



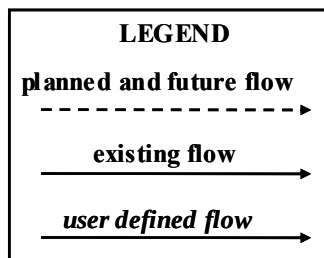
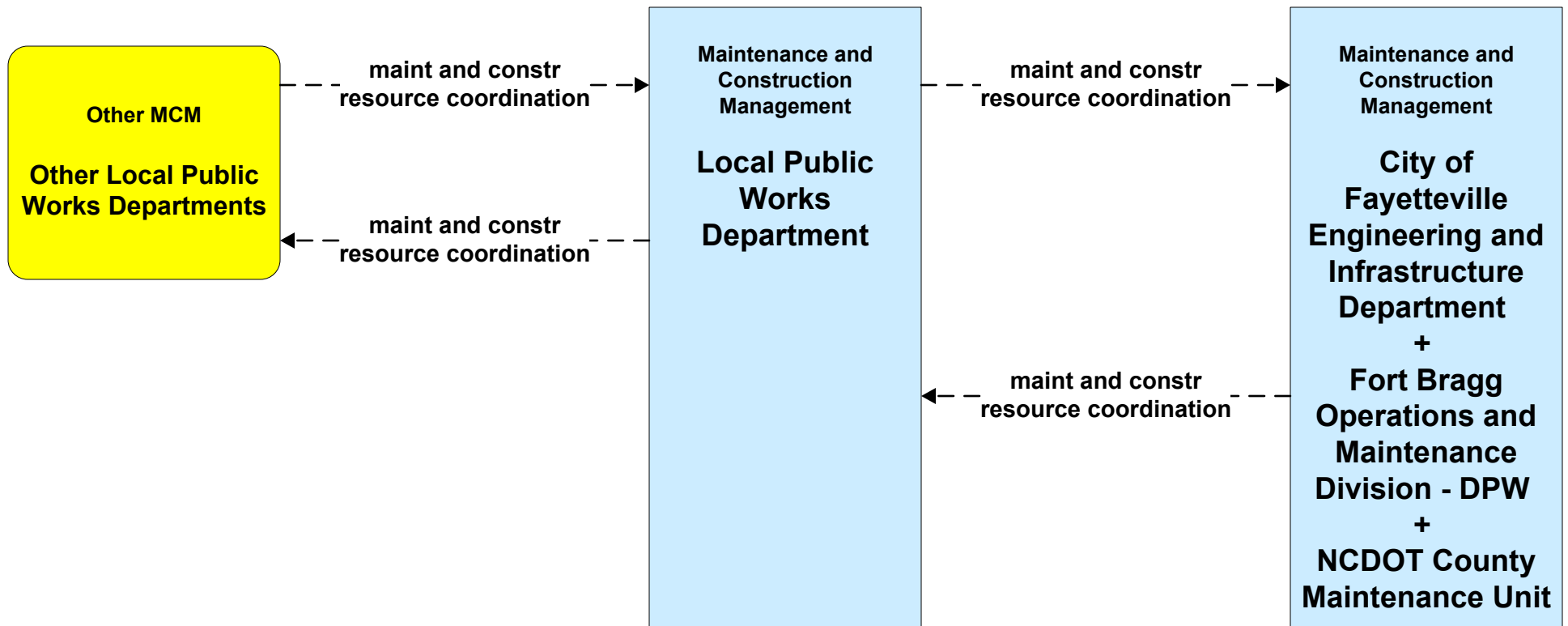
ATMS08 - Incident Management

Maintenance and Construction Management <-- --> Maintenance and Construction Management

**ATMS08 - Incident Management
NCDOT (MCM to MCM)**



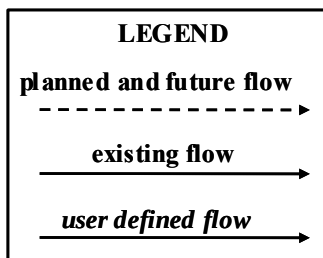
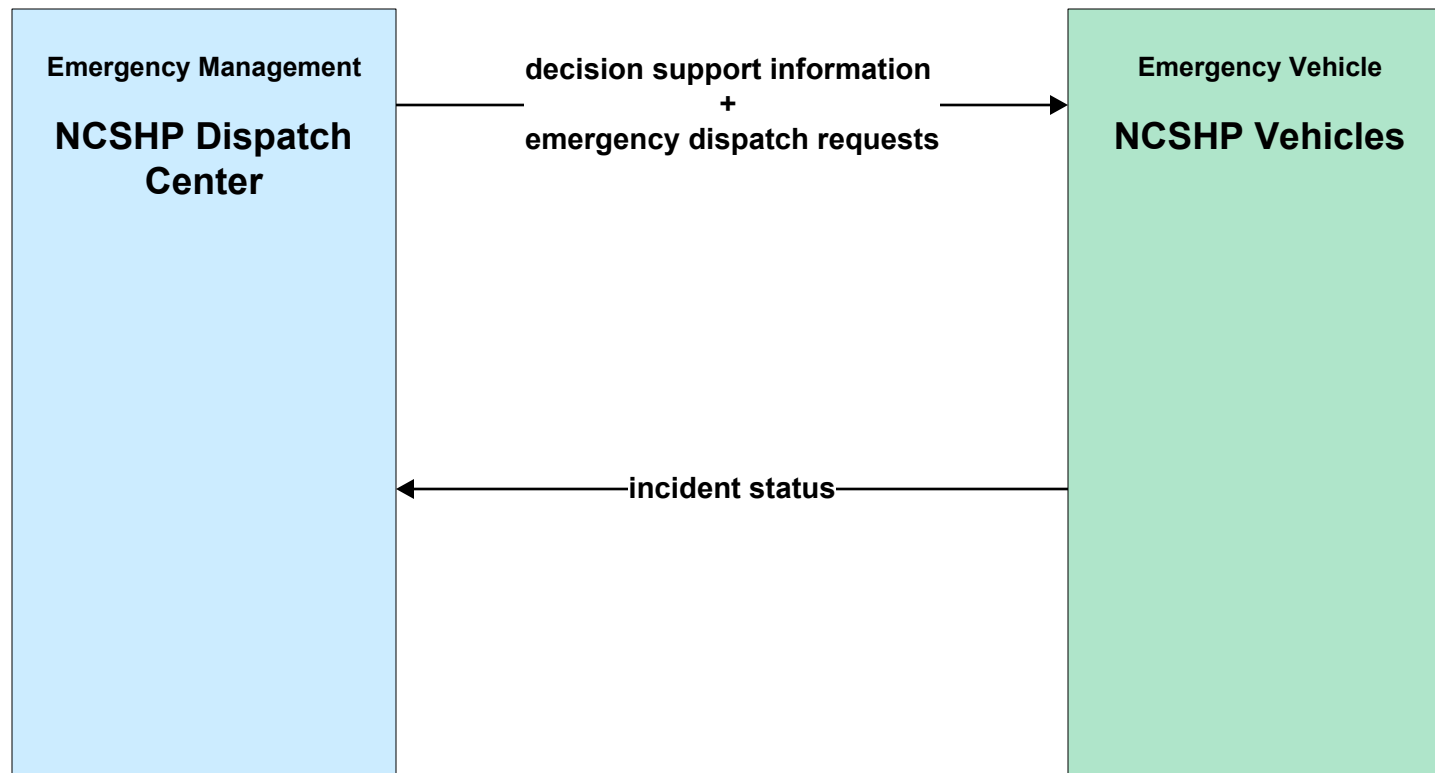
**ATMS08 - Incident Management
Local Municipalities (MCM to MCM)**



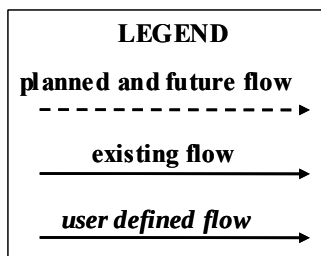
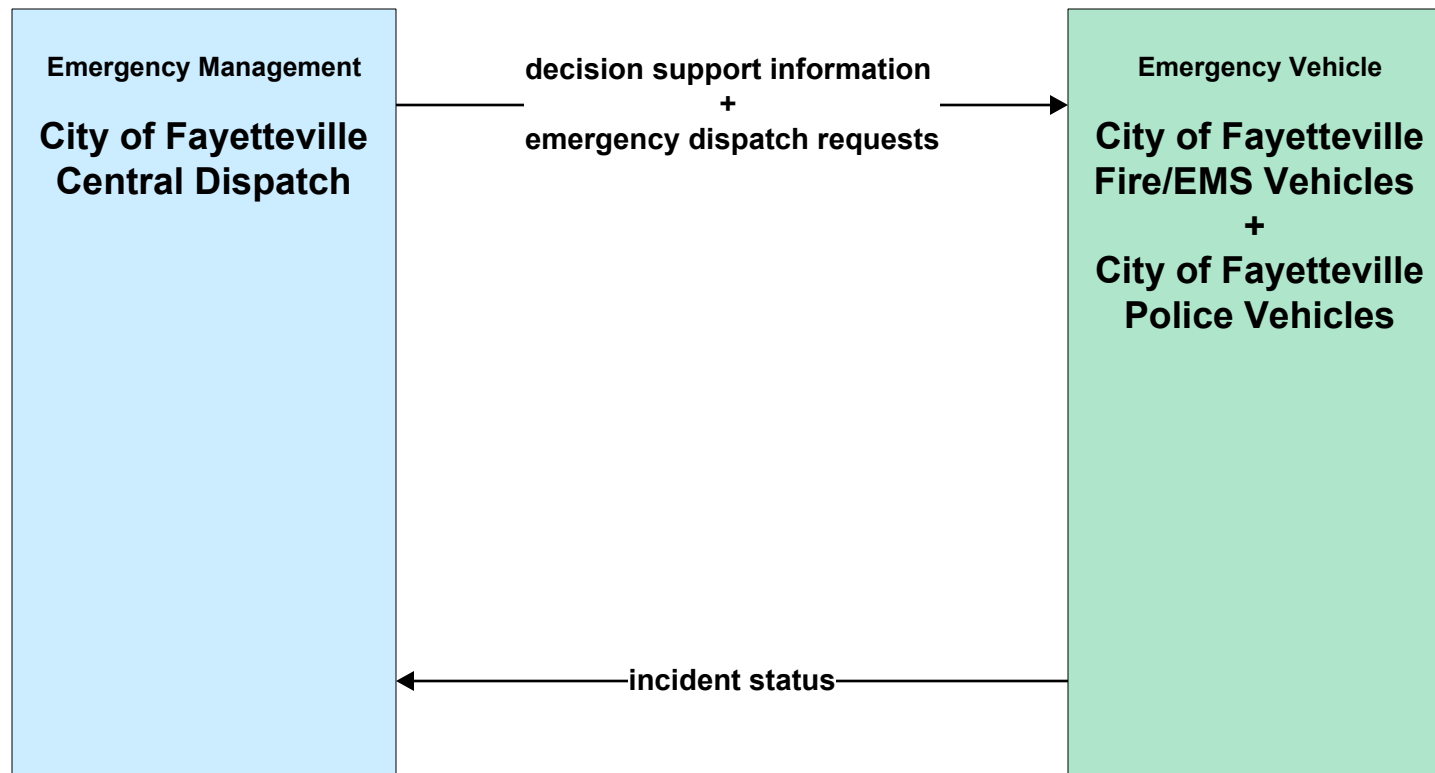
ATMS08 - Incident Management

Emergency Management <-- --> Emergency Vehicles

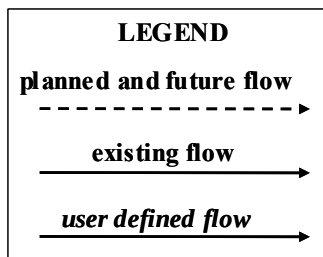
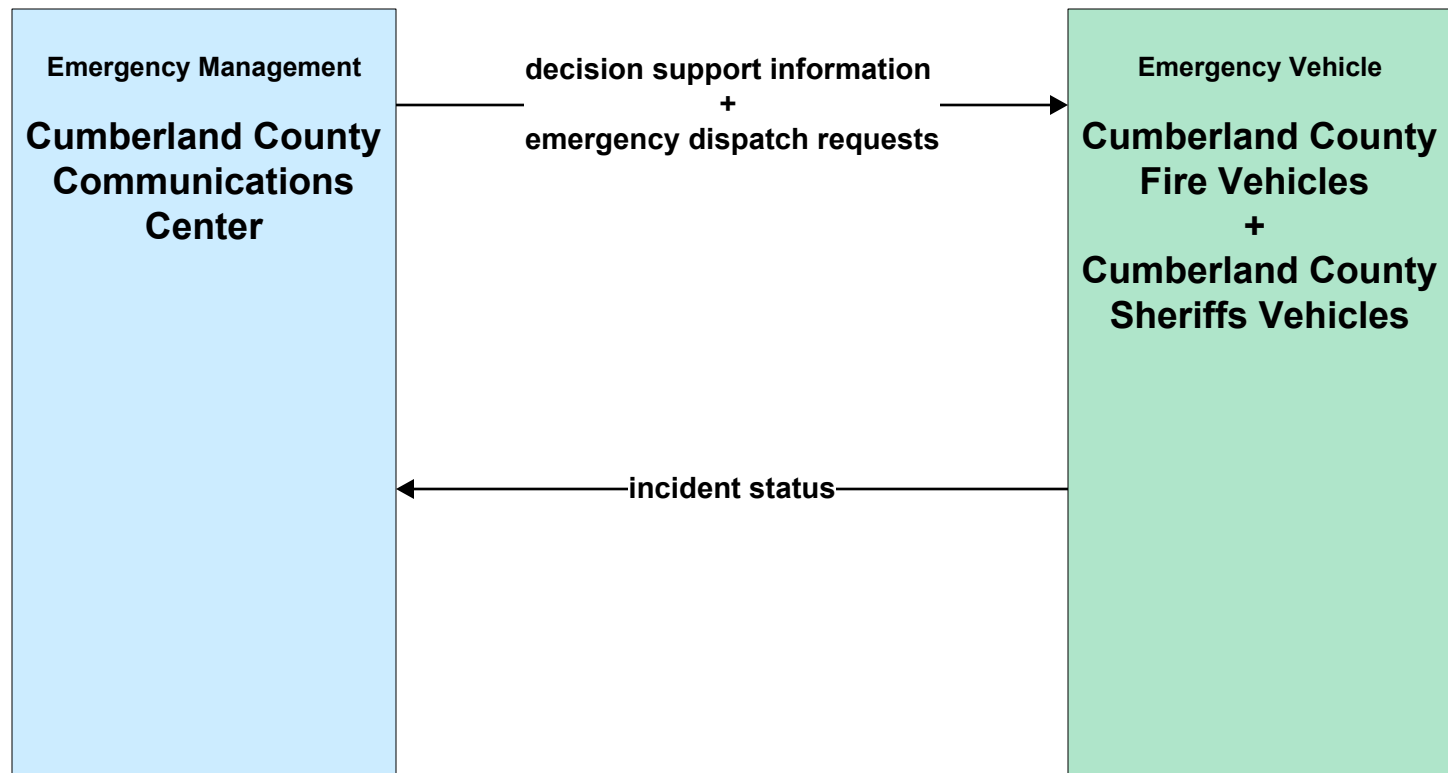
ATMS08 - Incident Management
North Carolina State Highway Patrol (EM to EVS)



ATMS08 - Incident Management Fayetteville (EM to EVS)

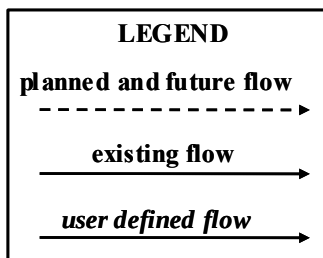
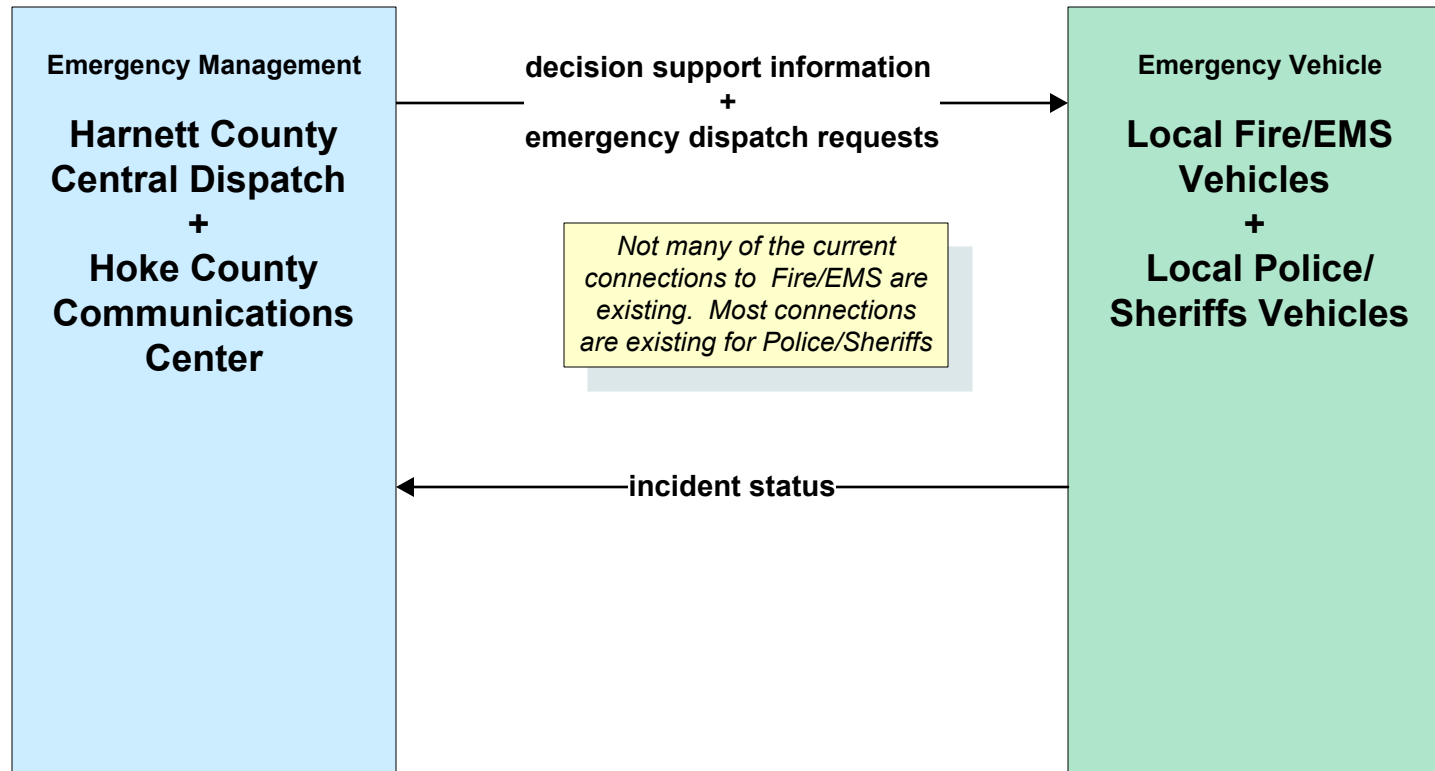


ATMS08 - Incident Management
Cumberland County Communications Center (EM to EVS)

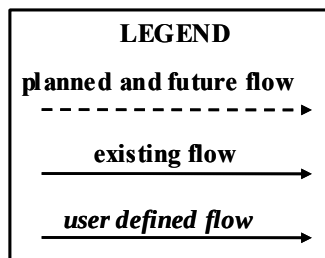
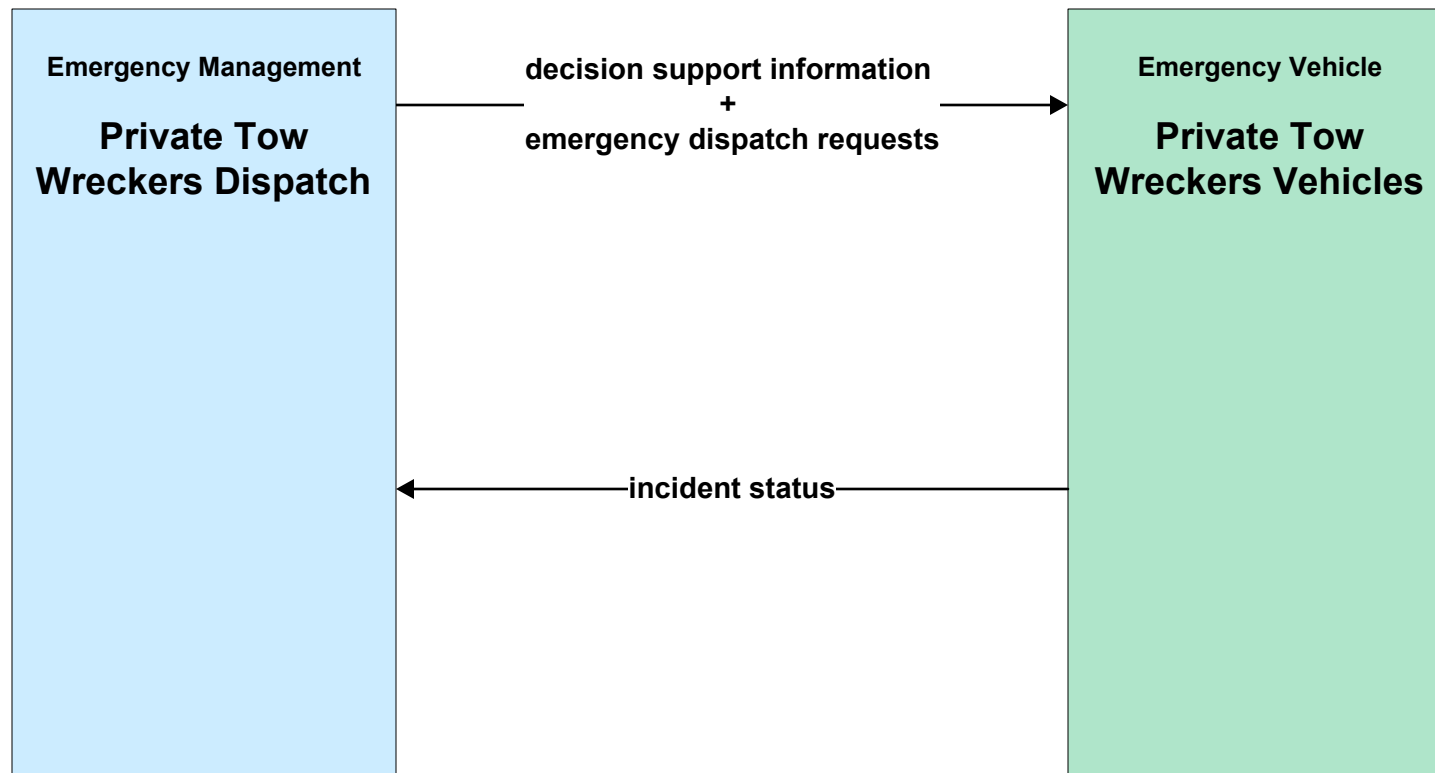


ATMS08 - Incident Management

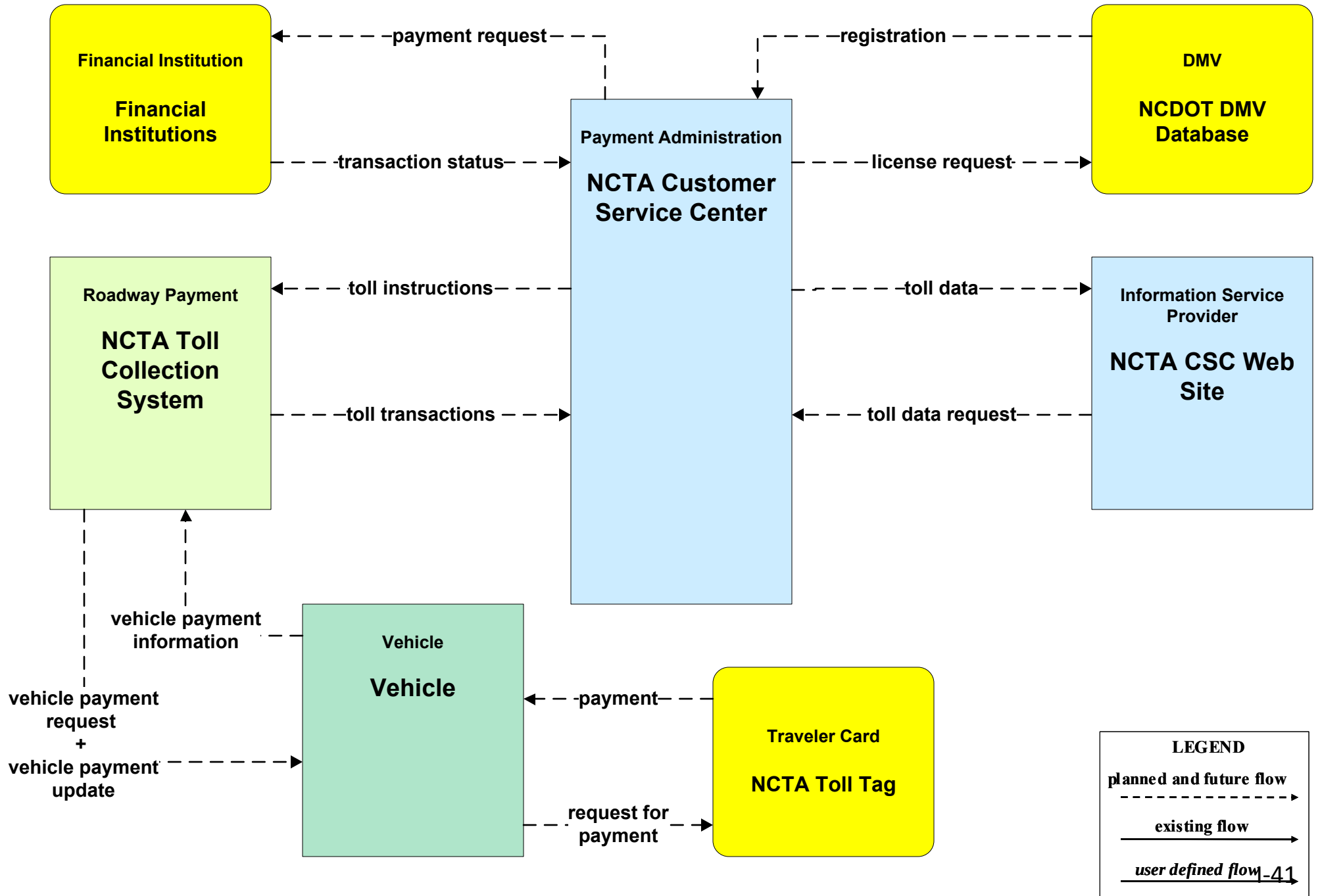
County Communications Center (EM to EVS)



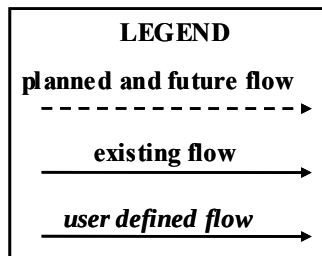
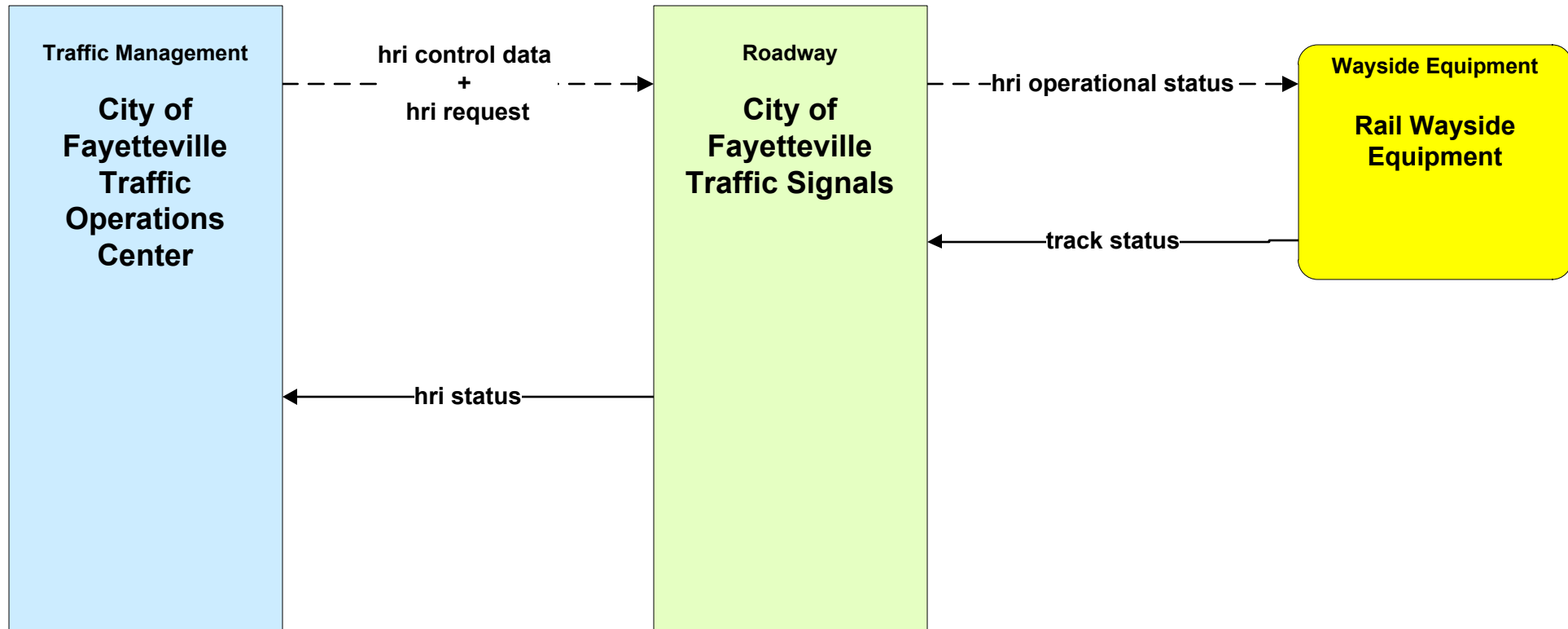
**ATMS08 - Incident Management
Private Tow Wreckers (EM to EVS)**



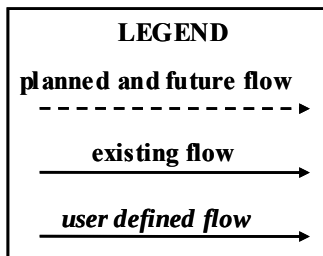
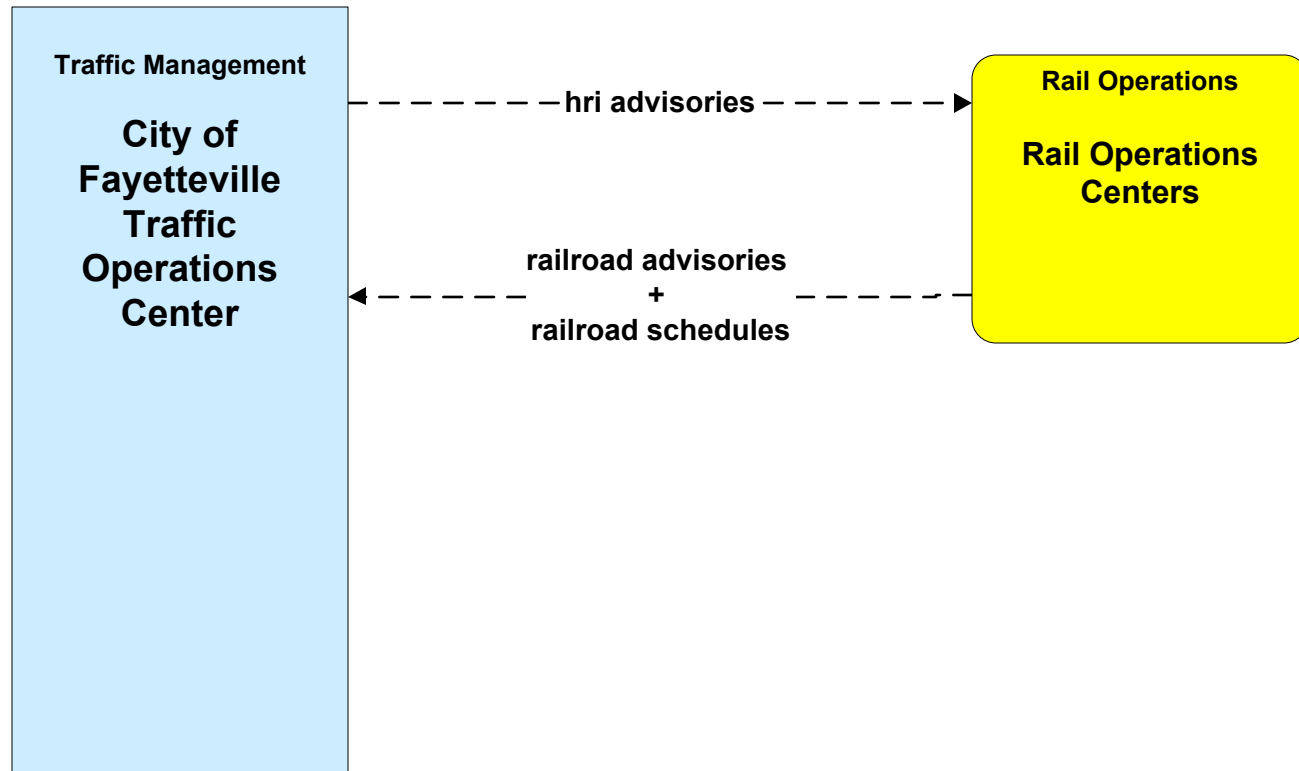
ATMS10 – Electronic Toll Collection North Carolina Turnpike Authority



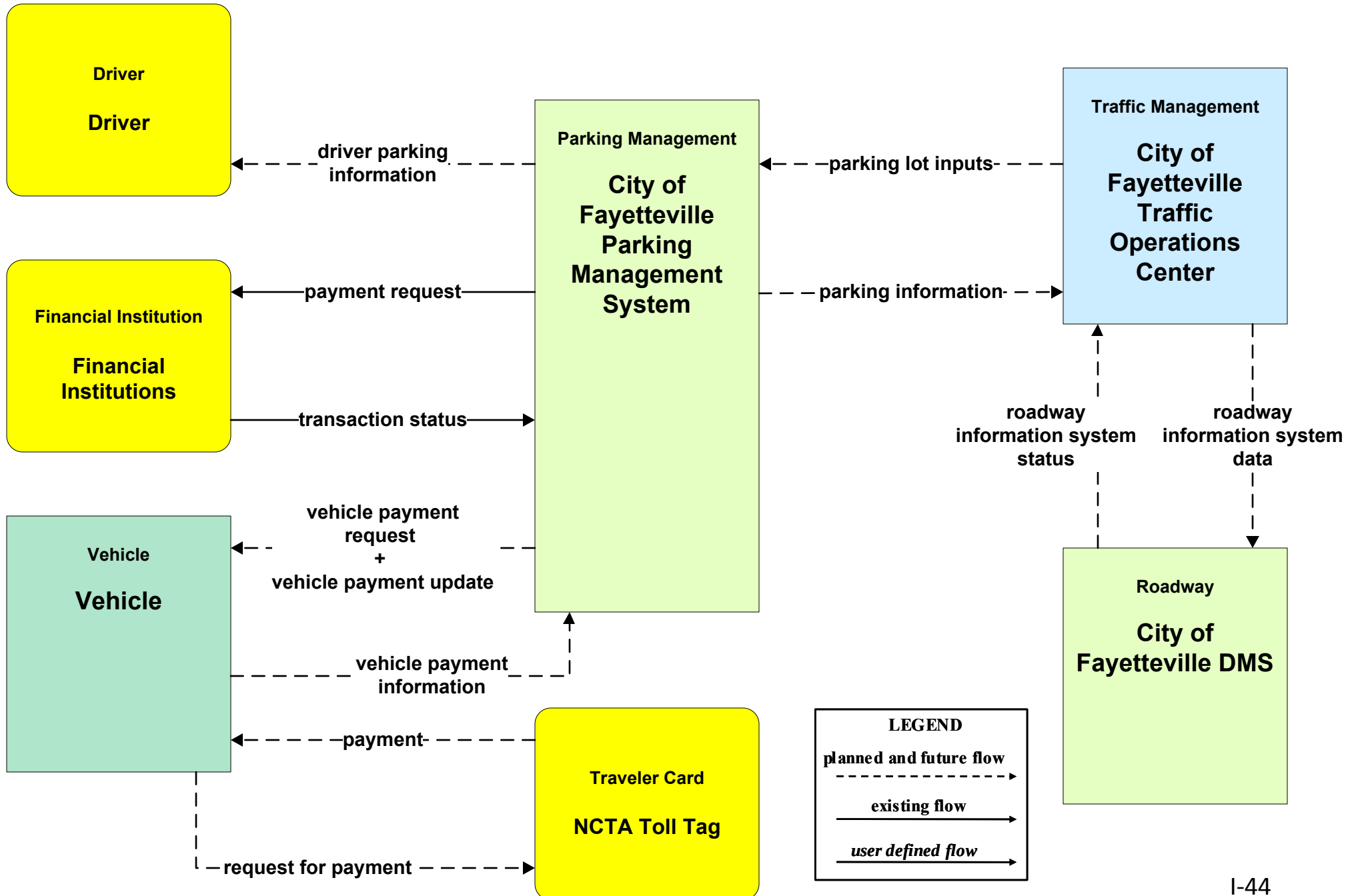
ATMS13 - Standard Railroad Crossing Fayetteville



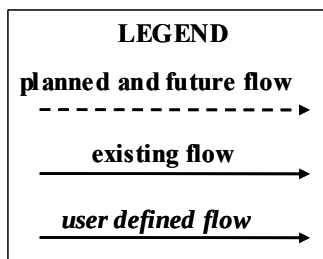
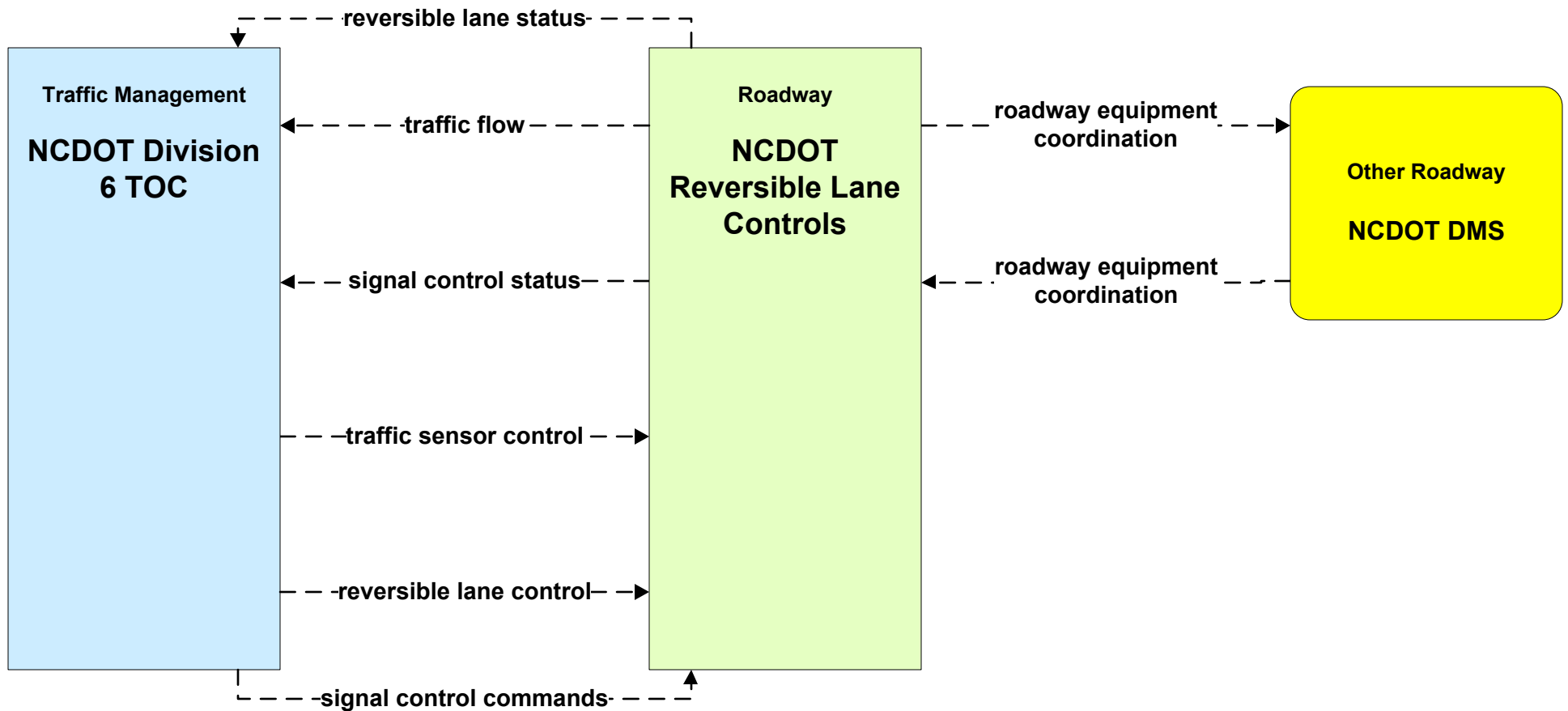
ATMS15 – Railroad Operations Coordination City of Fayetteville



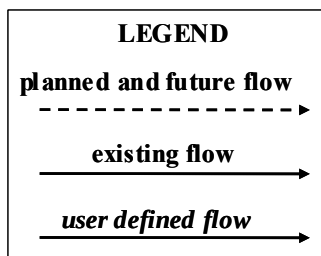
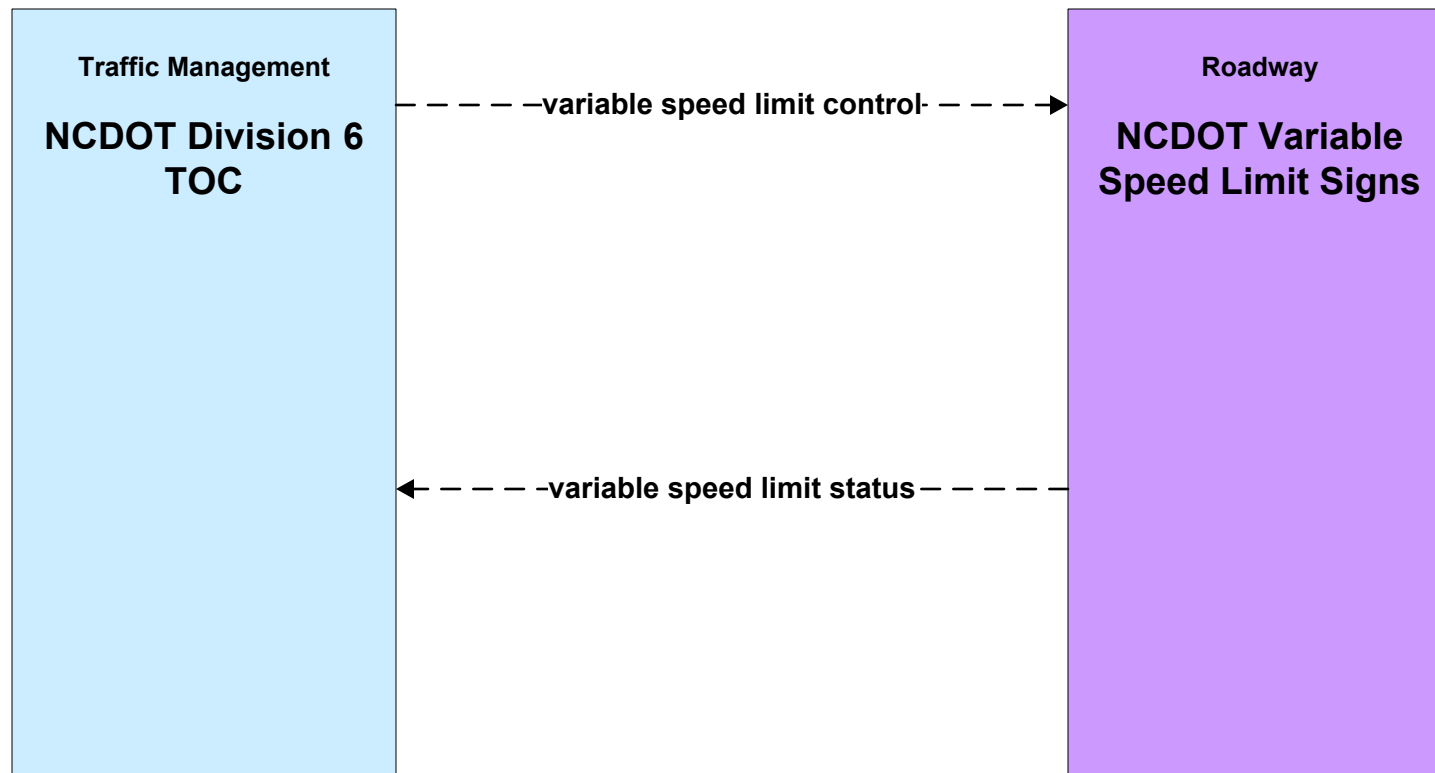
ATMS16 - Parking Facility Management Fayetteville



ATMS18 - Reversible Lane Management NCDOT



ATMS22 – Variable Speed Limits NCDOT

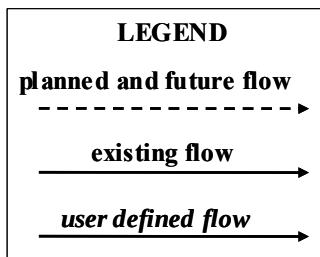
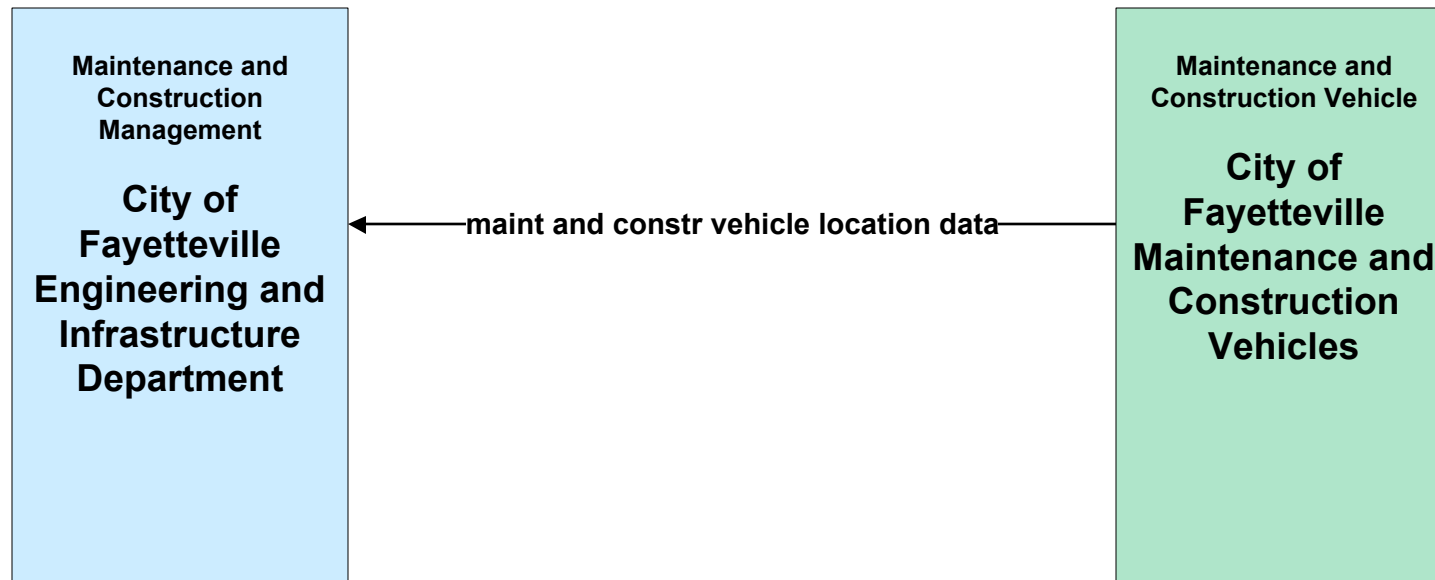


FAMPO Regional ITS Architecture

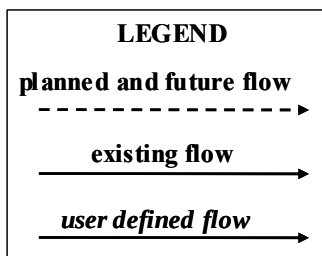
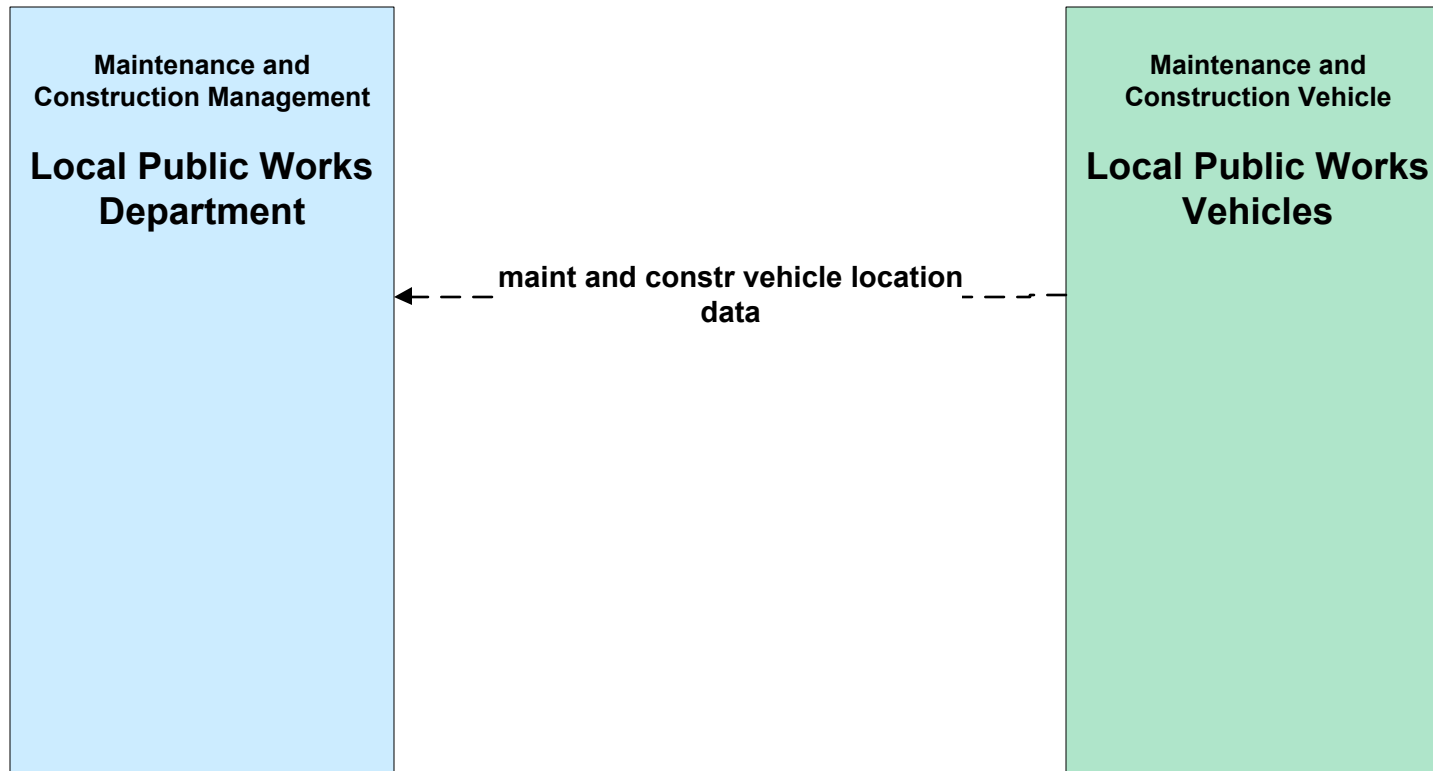
Customized Service Package Diagrams

Maintenance and Construction (MC)

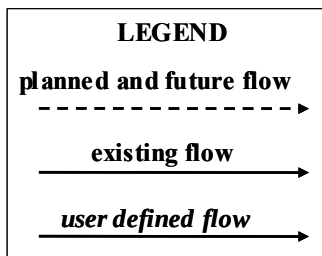
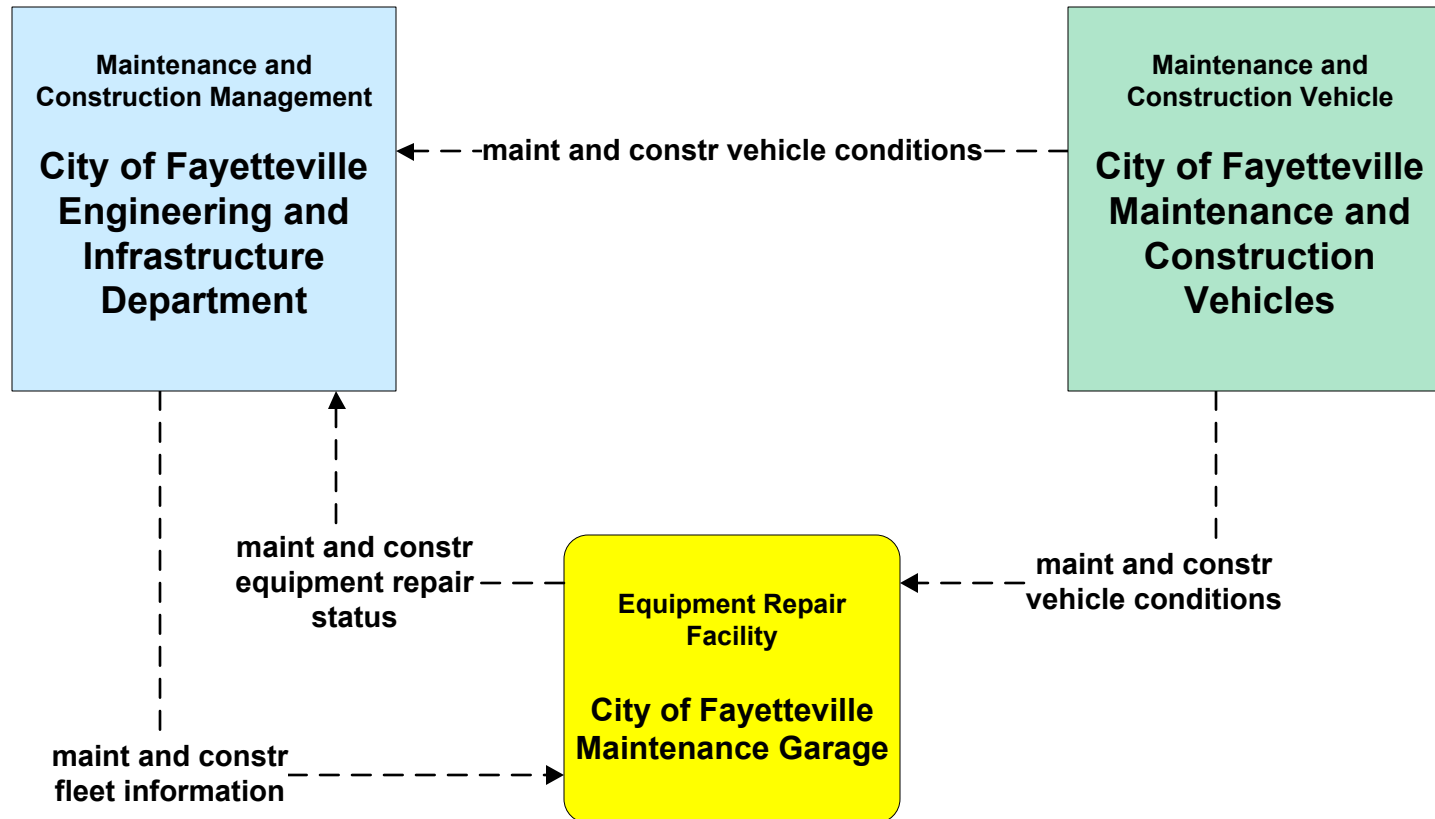
MC01 - Maintenance and Construction Vehicle Tracking



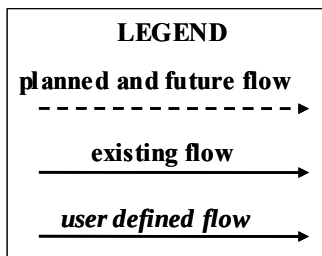
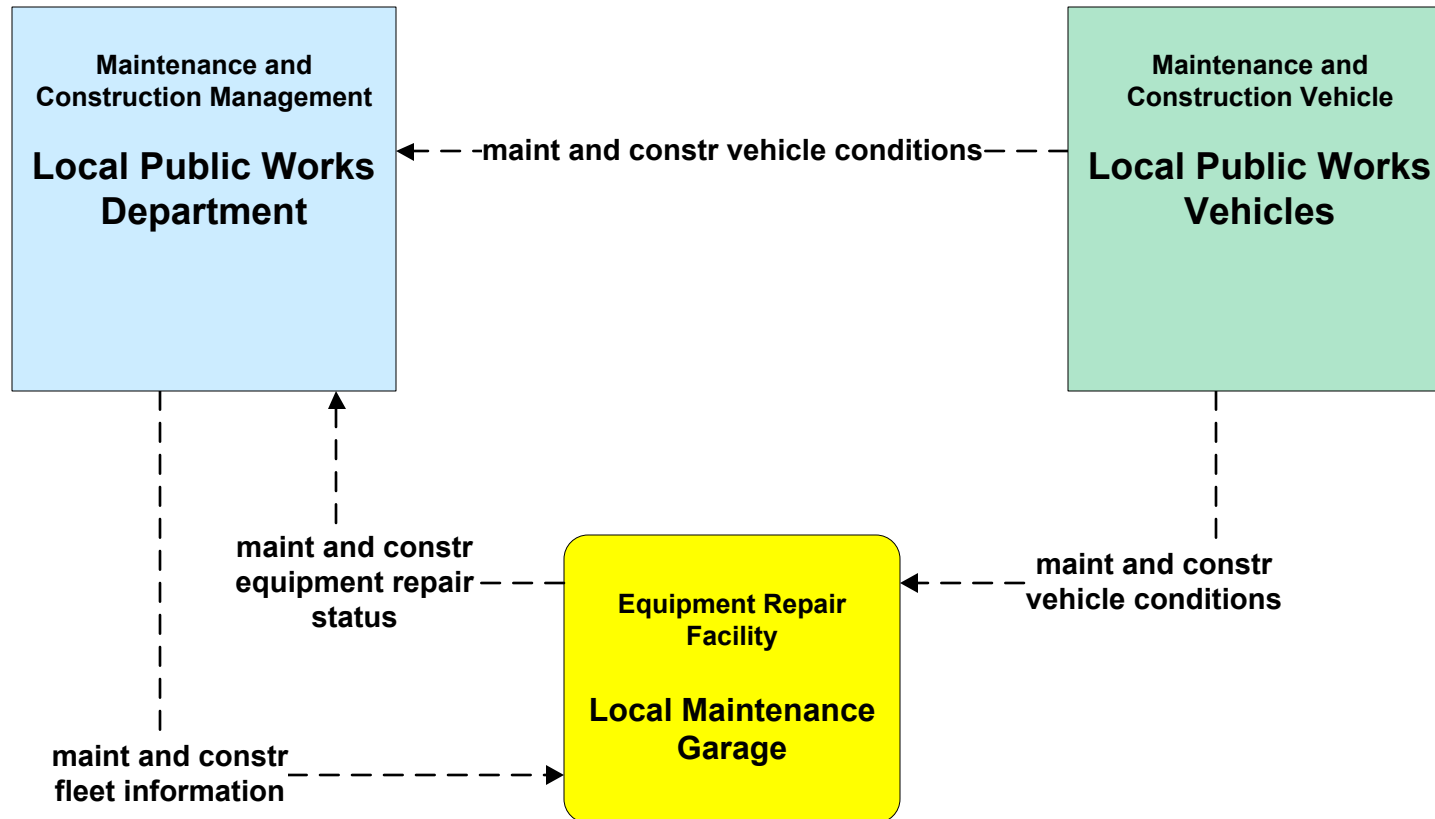
**MC01 - Maintenance and Construction Vehicle and Equipment Tracking
Local Counties and Municipalities**



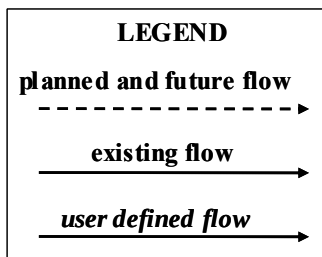
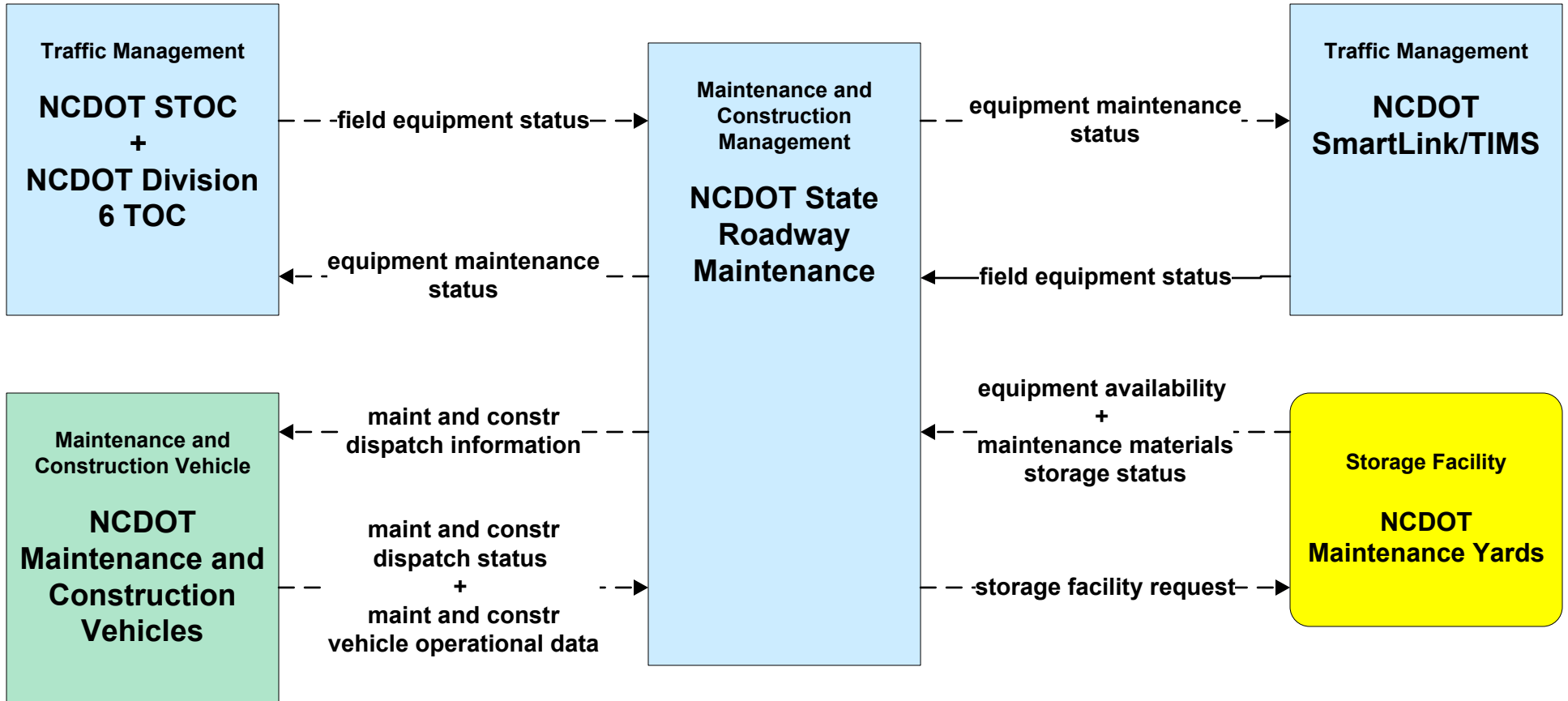
MC02 - Maintenance and Construction Vehicle Maintenance Fayetteville



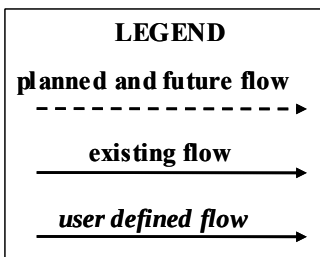
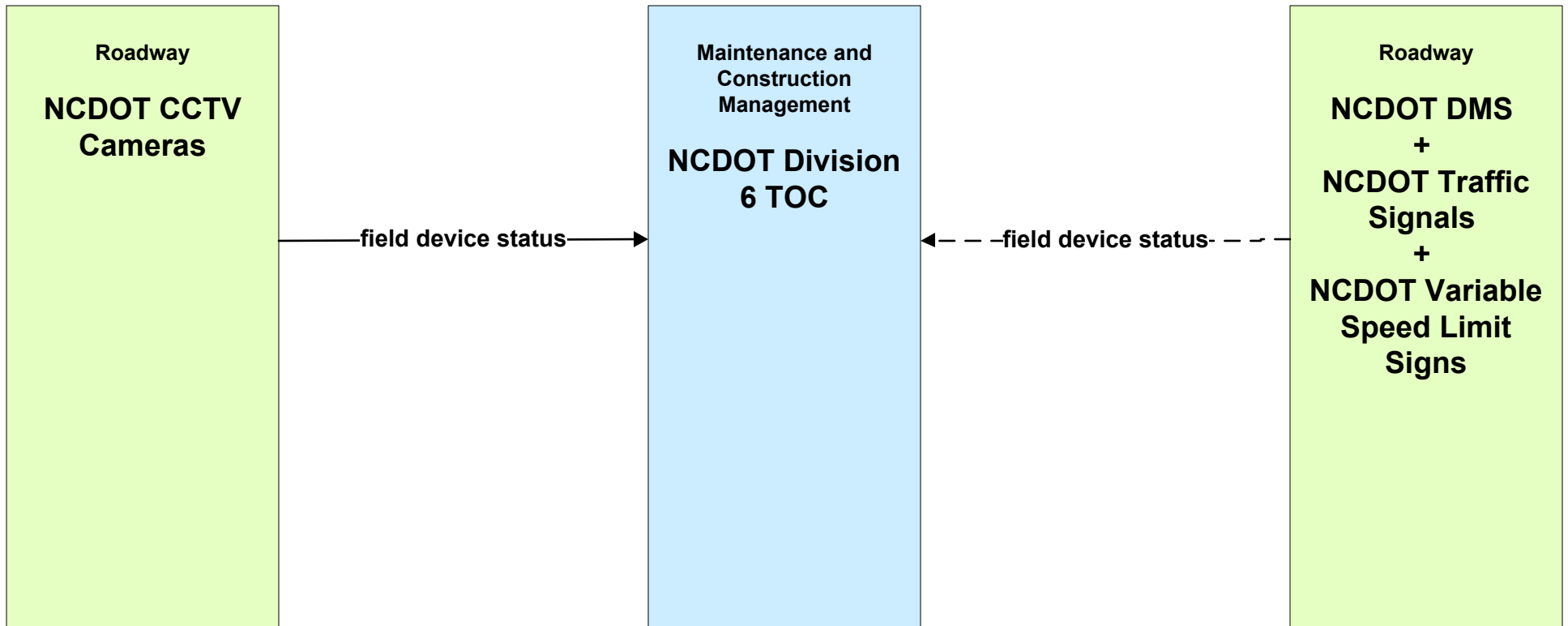
MC02 - Maintenance and Construction Vehicle Maintenance Local Counties and Municipalities



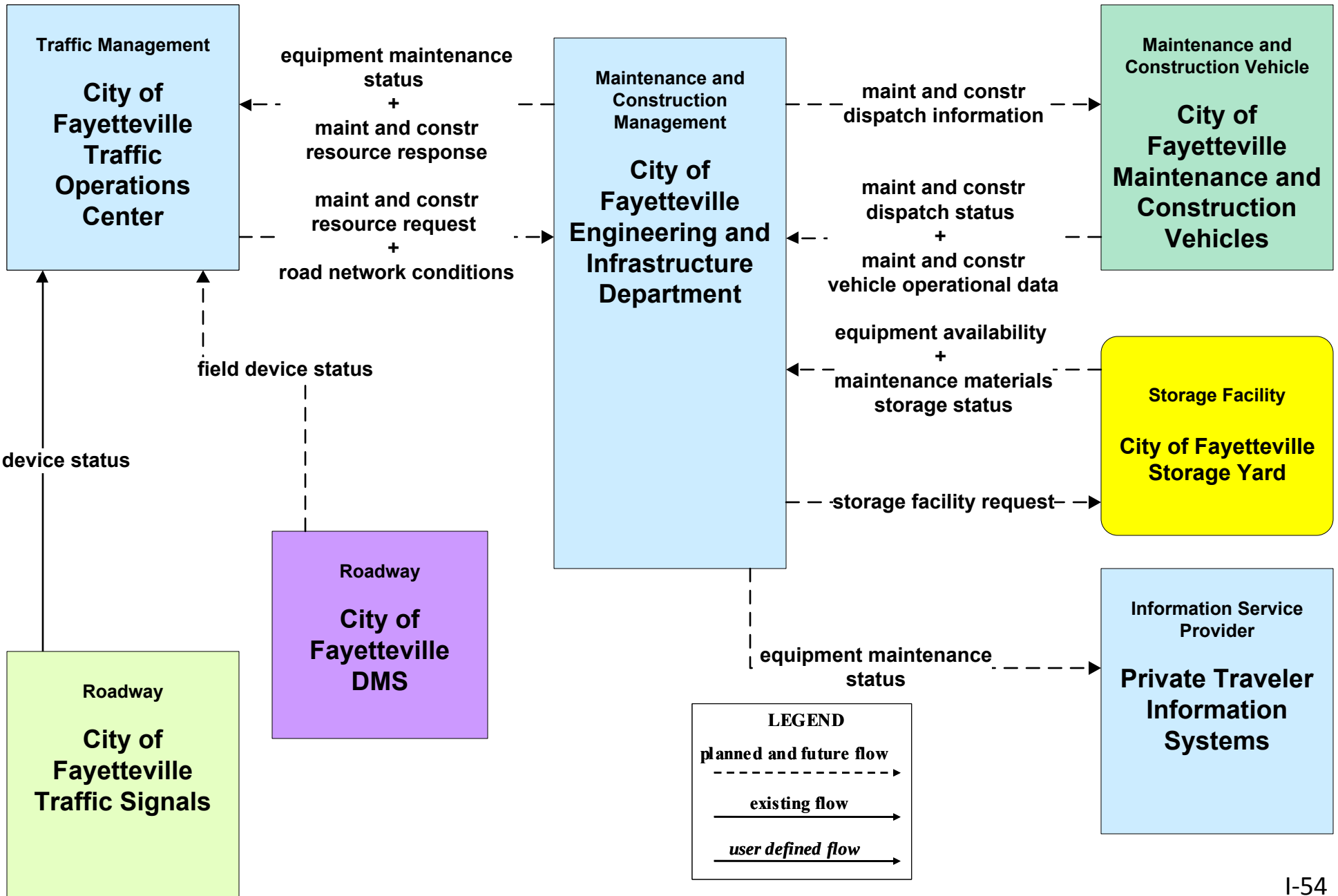
MC07 - Roadway Maintenance and Construction NCDOT (1 of 2)



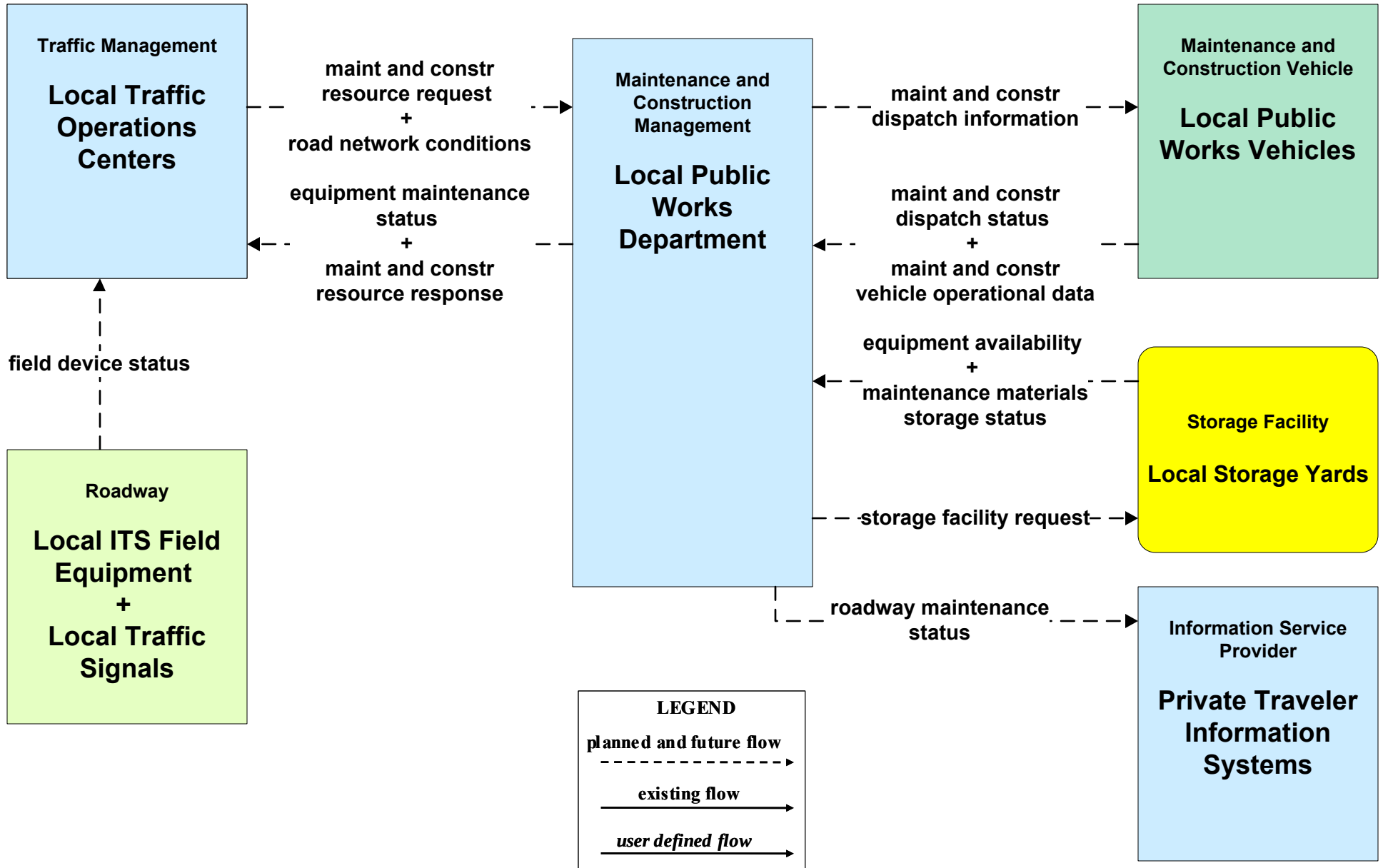
**MC07 - Roadway Maintenance and Construction
NCDOT (2 of 2)**



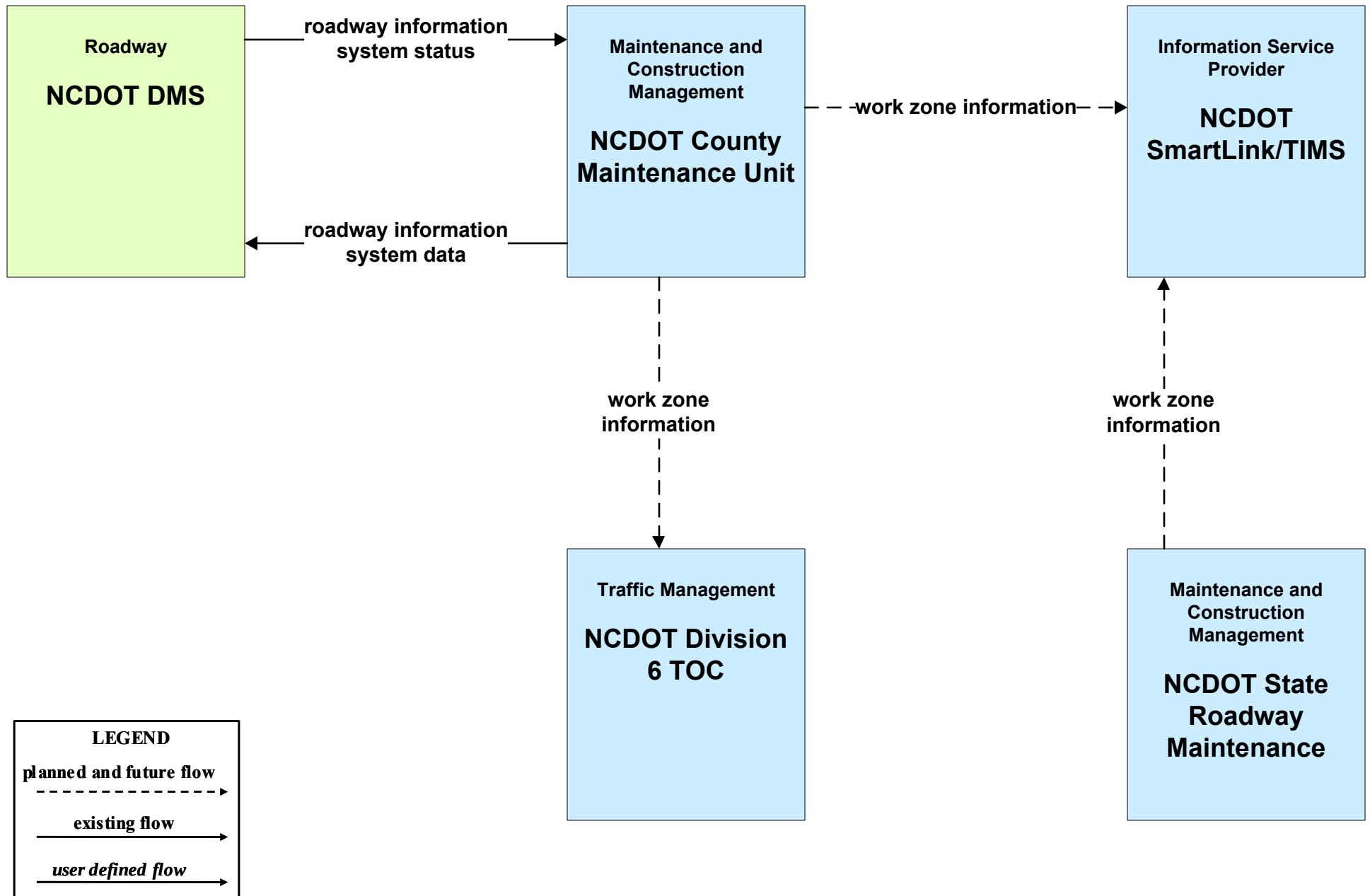
MC07 - Roadway Maintenance and Construction Fayetteville



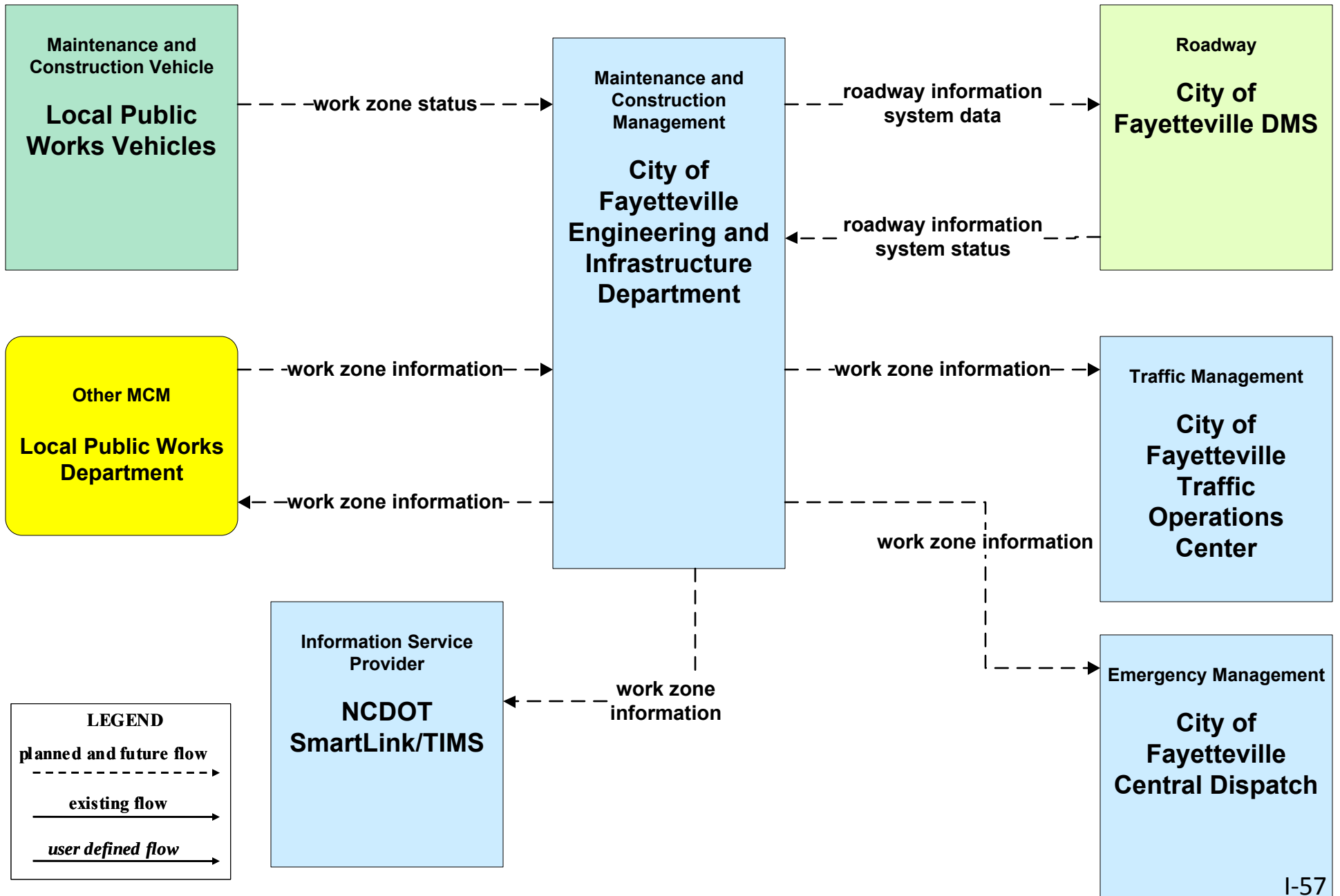
MC07 - Roadway Maintenance and Construction Local Municipalities



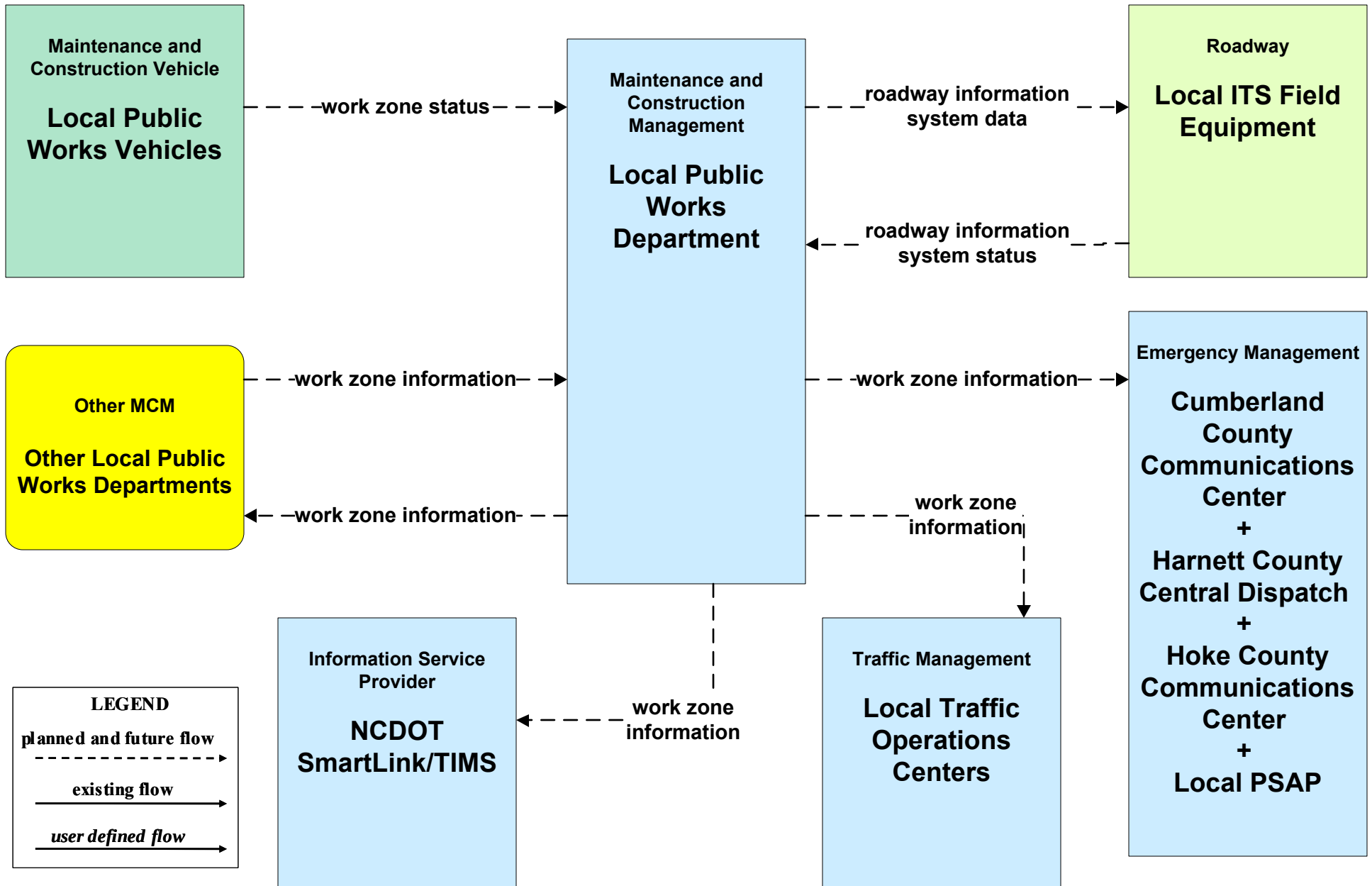
MC08 - Work Zone Management NCDOT



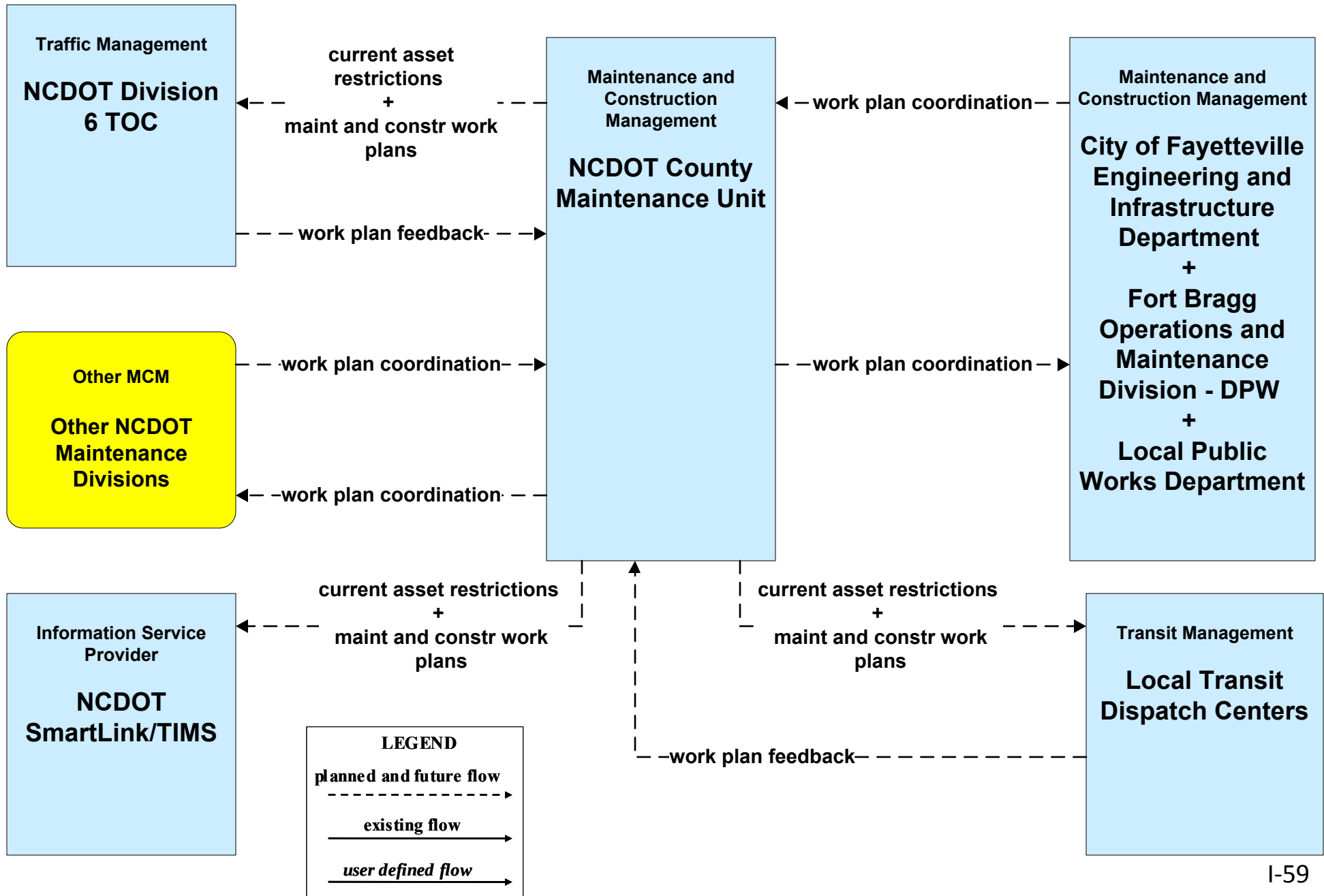
MC08 - Work Zone Management Fayetteville



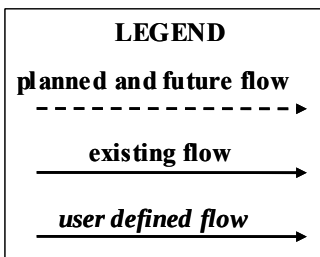
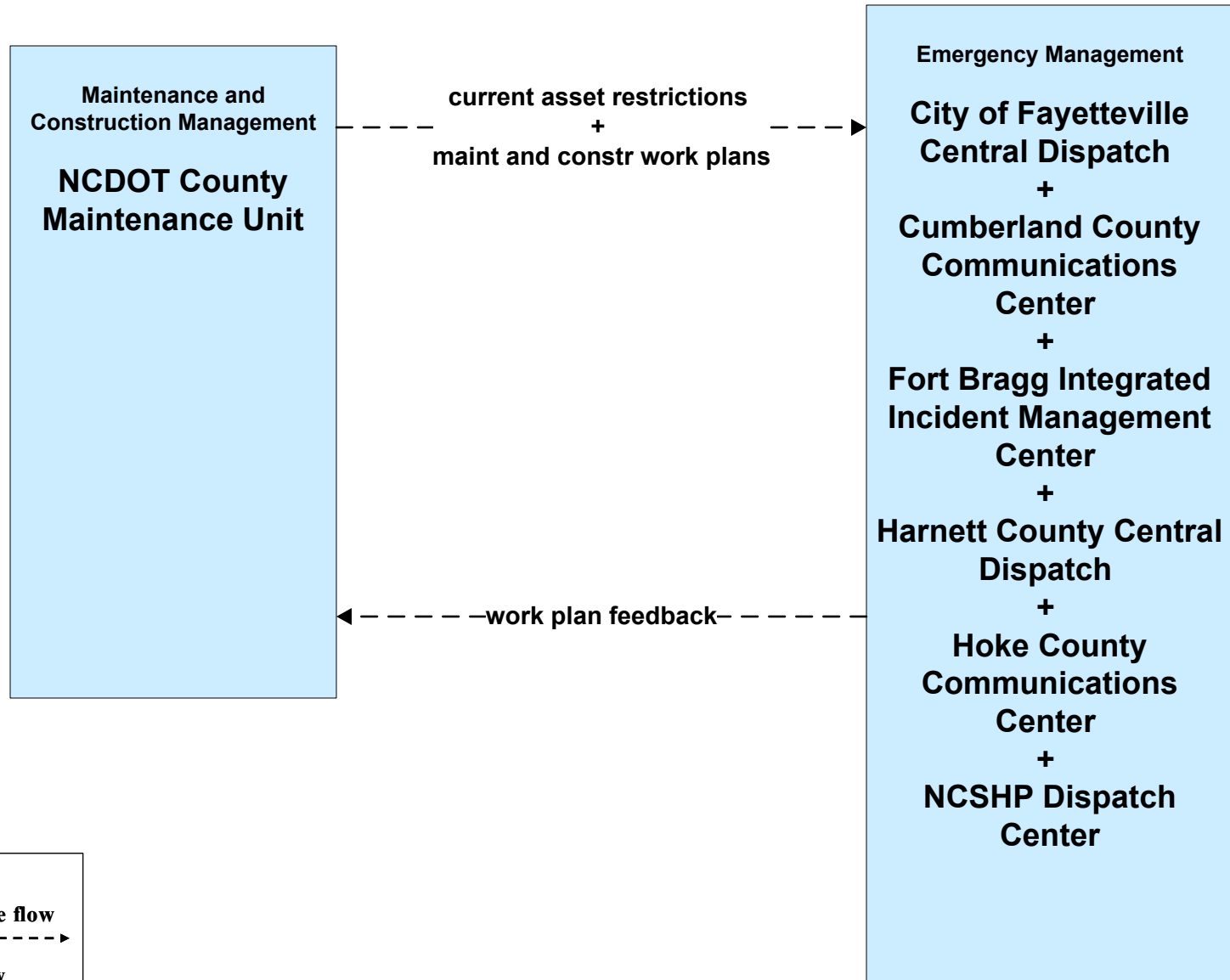
MC08 - Work Zone Management Local Municipalities



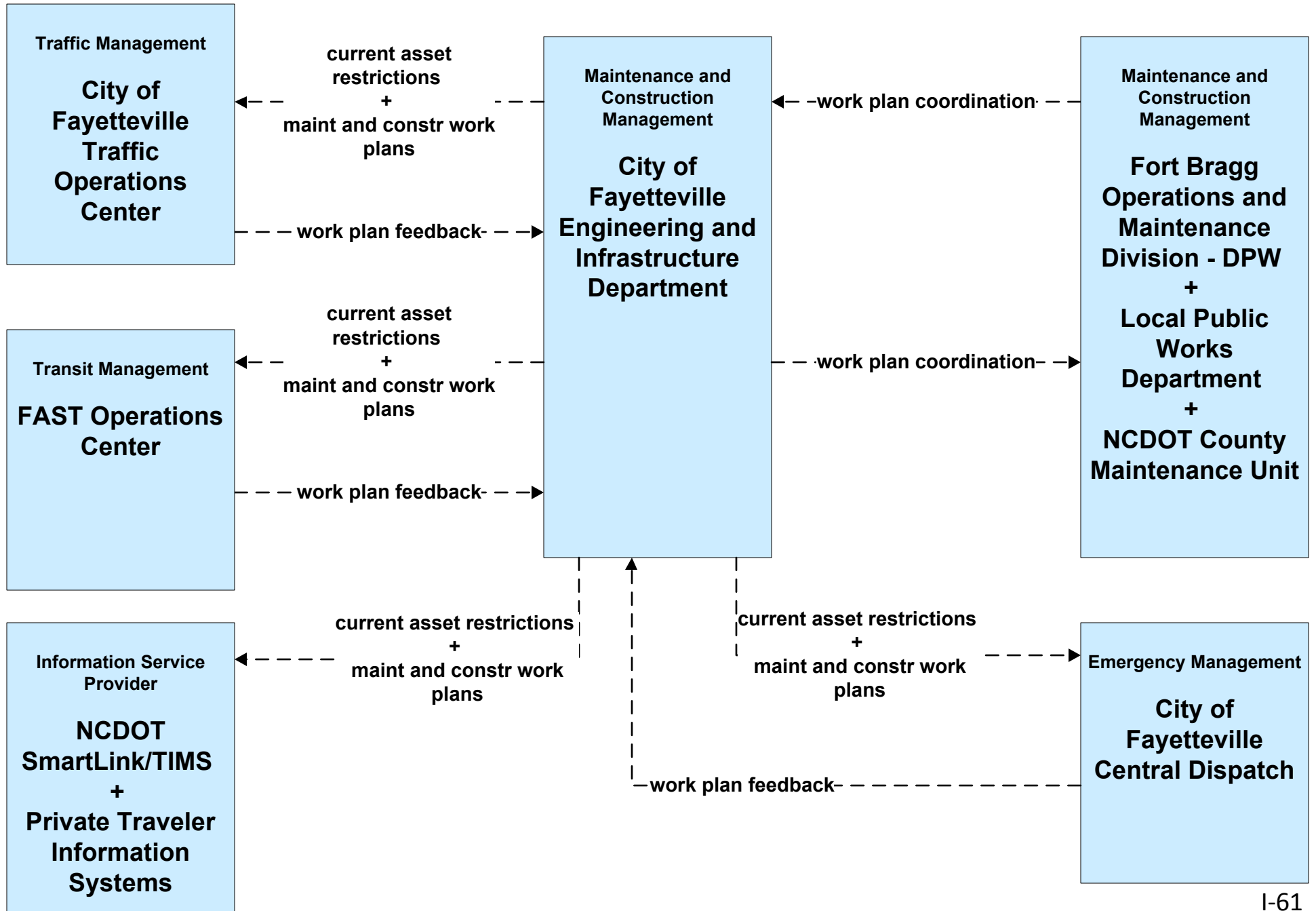
MC10 - Maintenance and Construction Activity Coordination NCDOT (1 of 2)



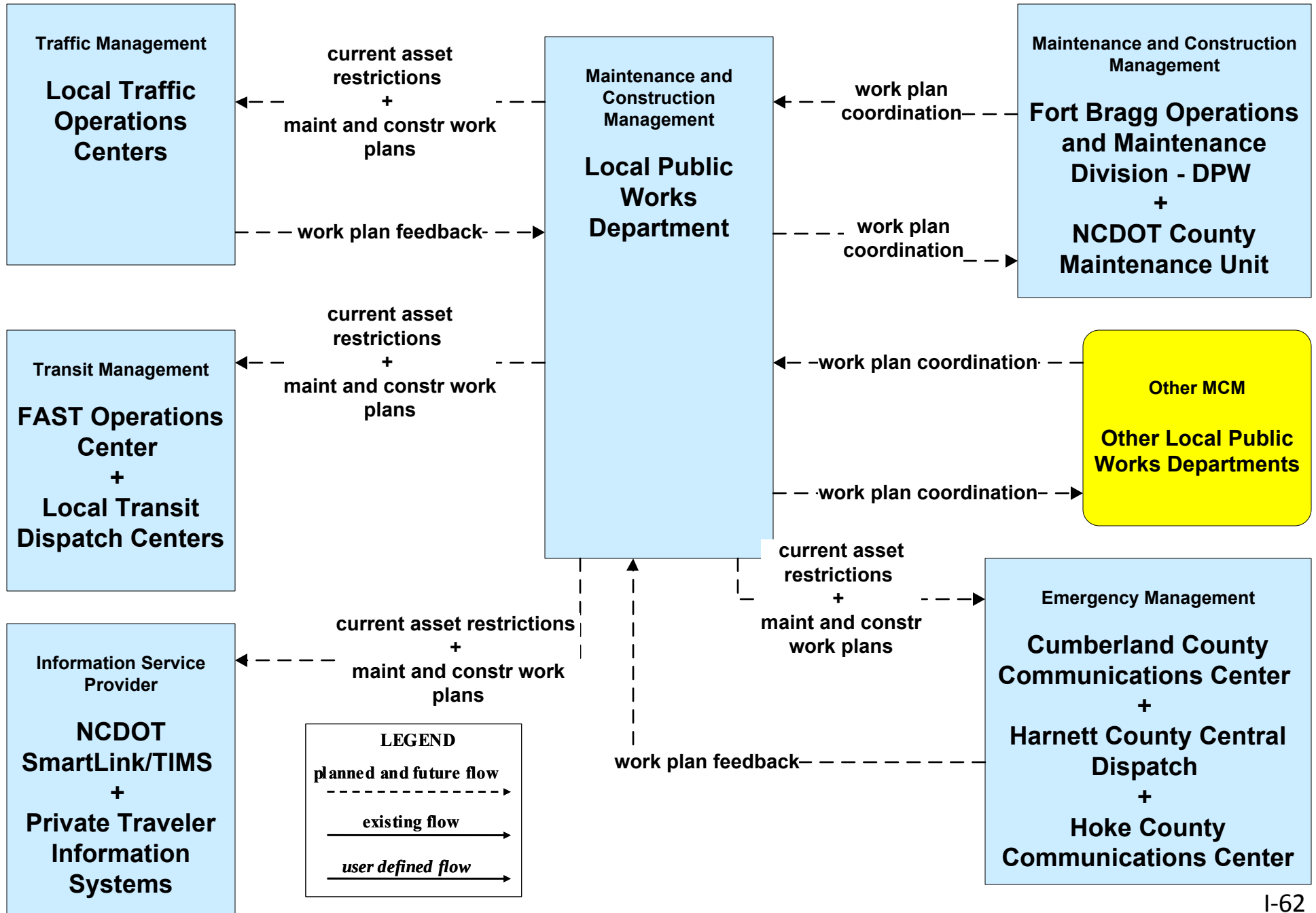
**MC10 - Maintenance and Construction Activity Coordination
NCDOT (2 of 2)**



MC10 - Maintenance and Construction Activity Coordination Fayetteville



MC10 - Maintenance and Construction Activity Coordination Local Counties and Municipalities

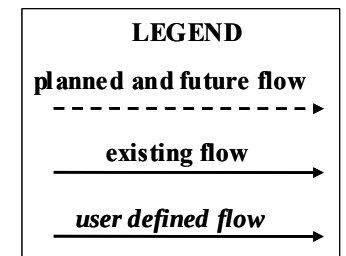
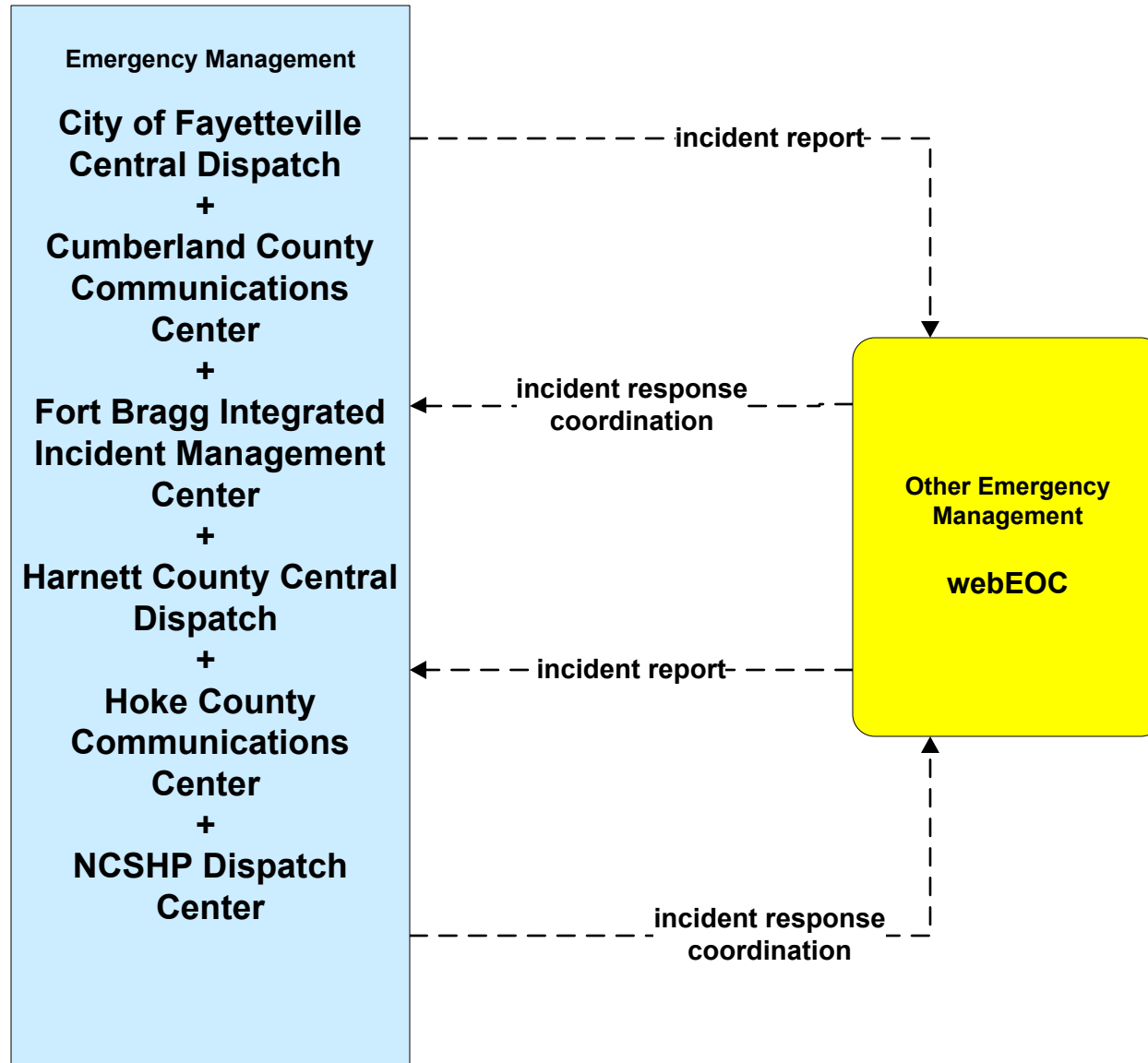


FAMPO Regional ITS Architecture

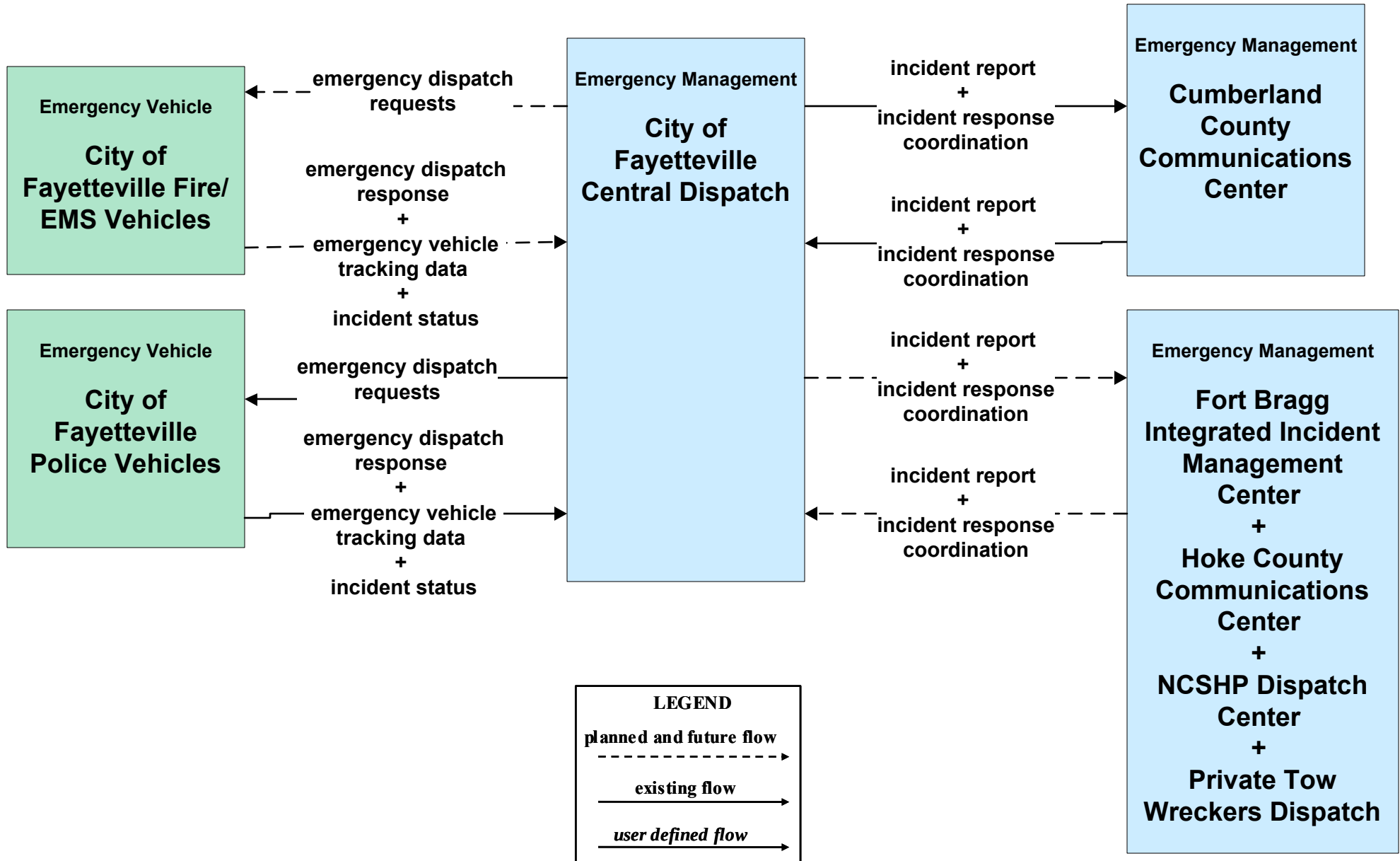
Customized Service Package Diagrams

Emergency Management (EM)

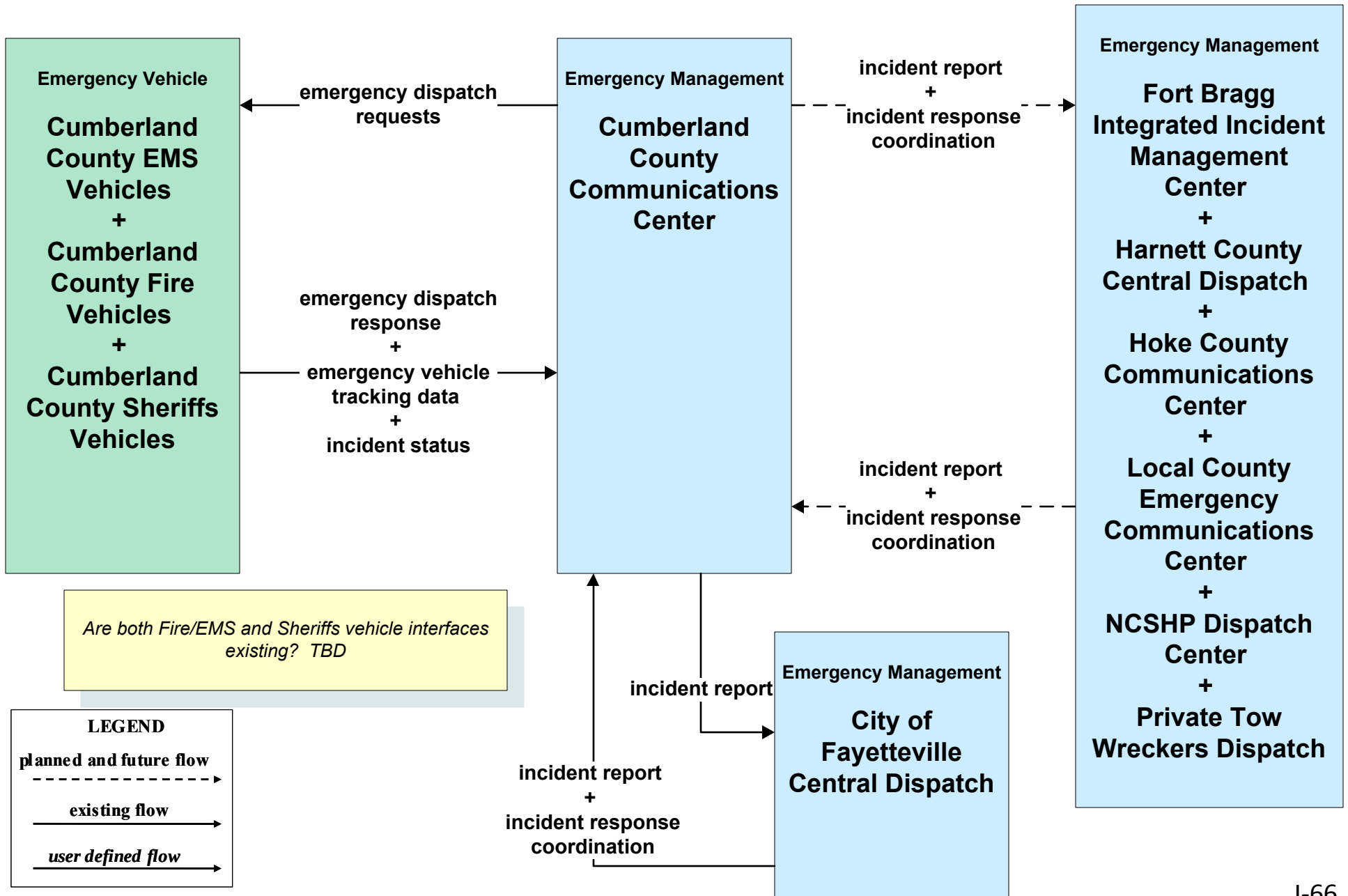
EM01 - Emergency Call-Taking and Dispatch
Regional Emergency Communications Network (EM to Other EM)



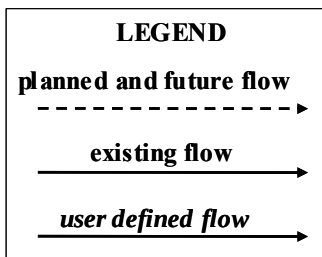
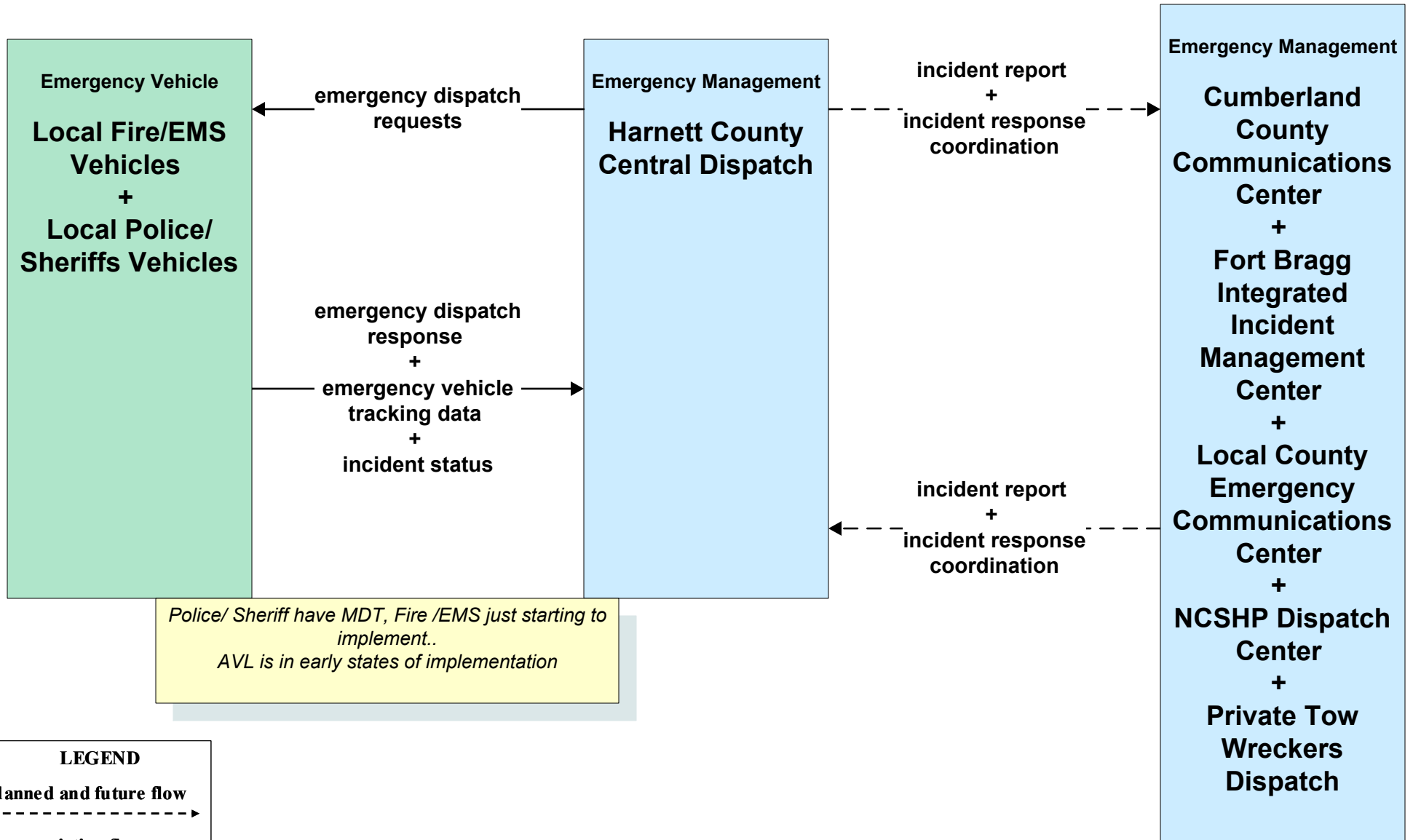
EM01 - Emergency Call Taking and Dispatch Fayetteville



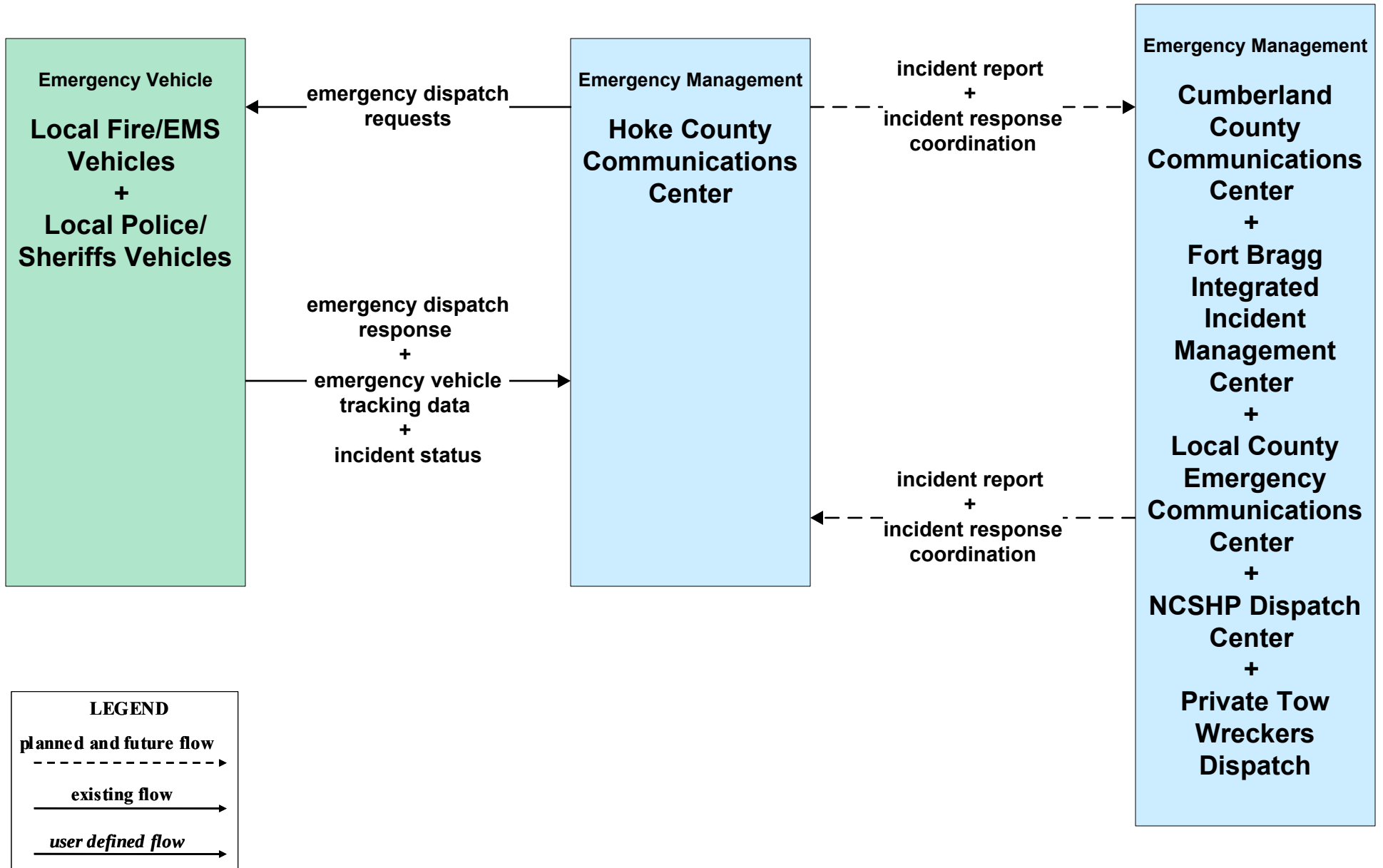
EM01 - Emergency Call Taking and Dispatch Cumberland County Communications Center



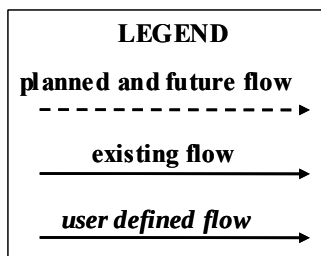
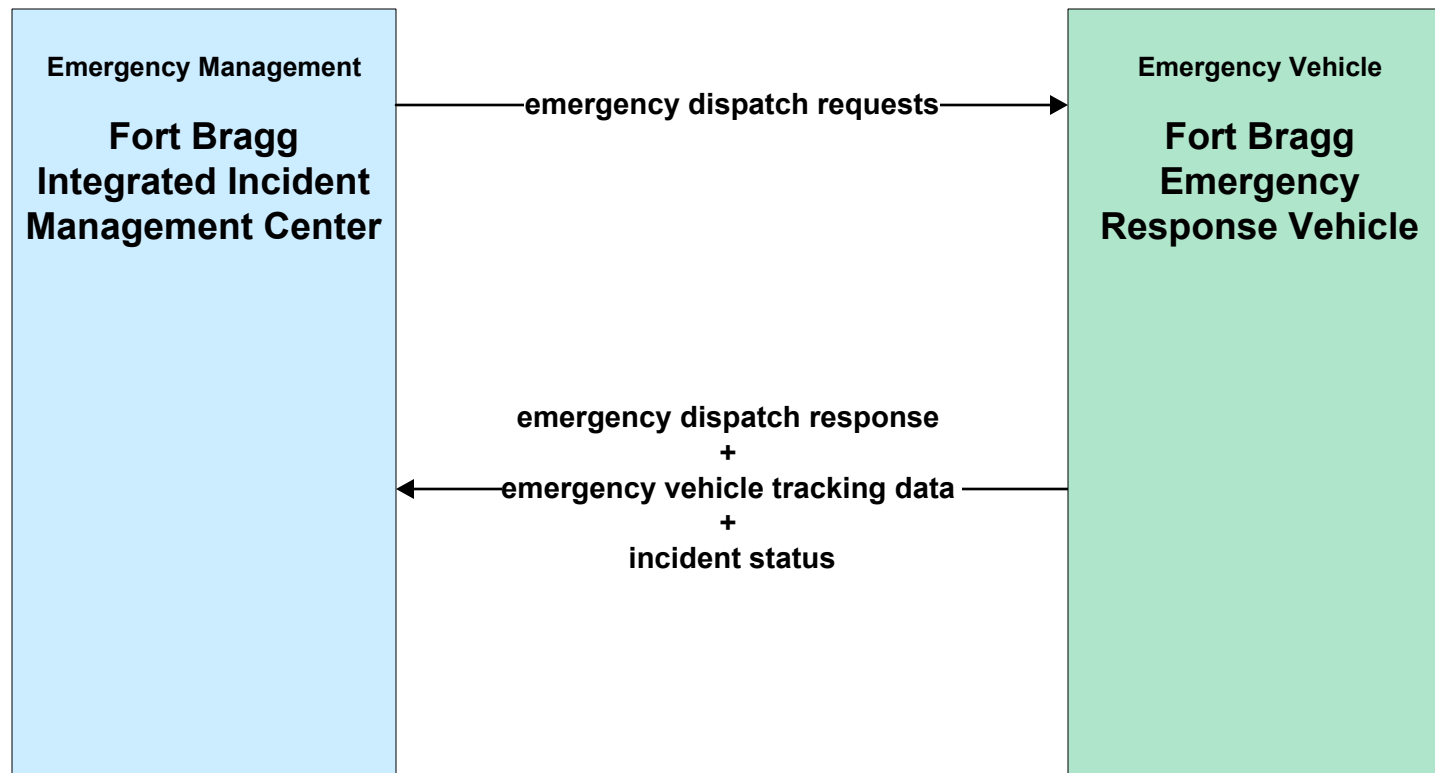
EM01 - Emergency Call Taking and Dispatch Harnett County Central Dispatch



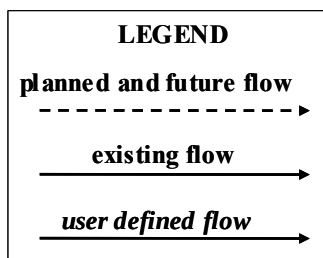
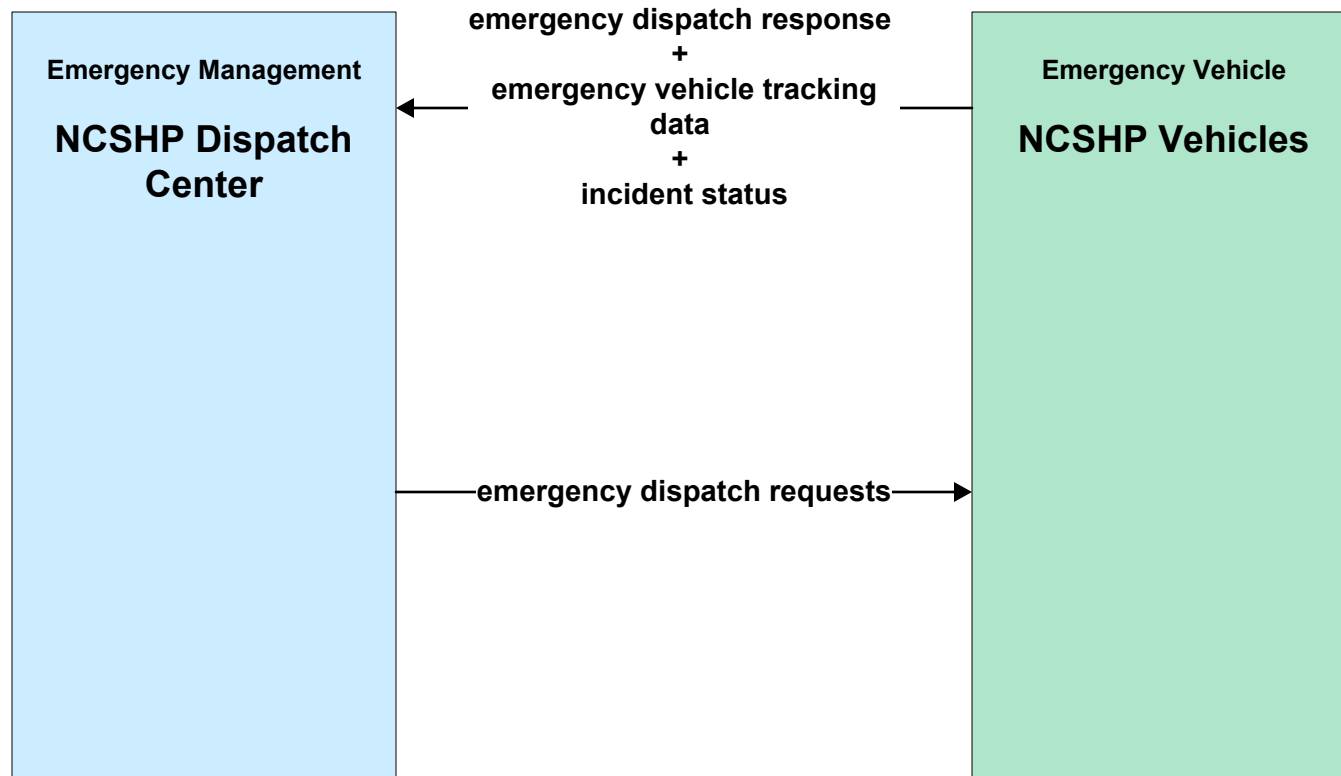
EM01 - Emergency Call Taking and Dispatch Hoke County Communications Center



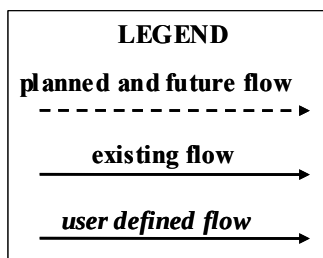
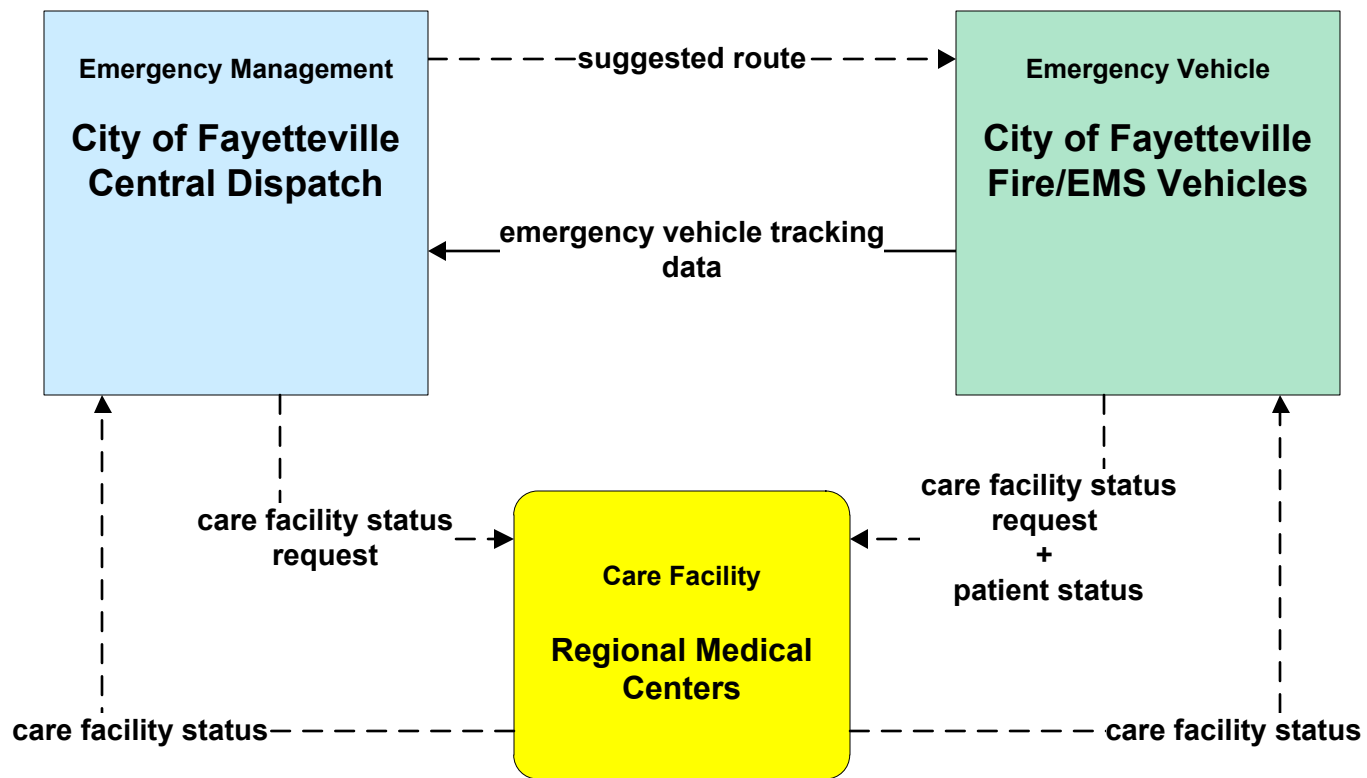
EM01 - Emergency Call Taking and Dispatch Fort Bragg



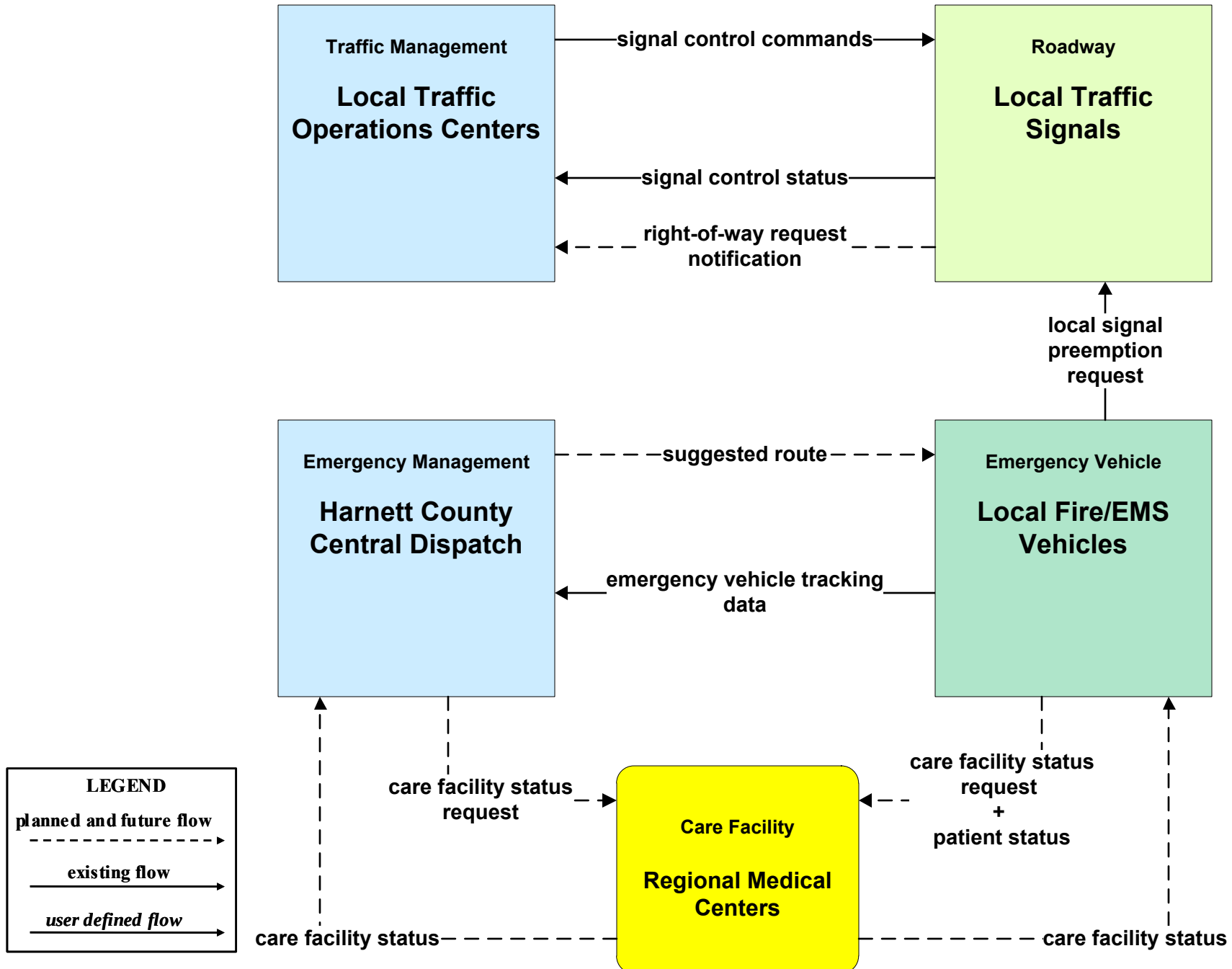
EM01 - Emergency Call-Taking and Dispatch North Carolina State Highway Patrol



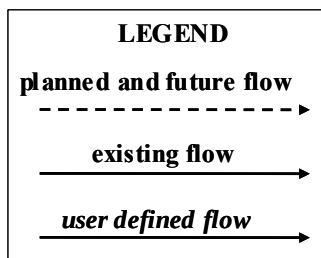
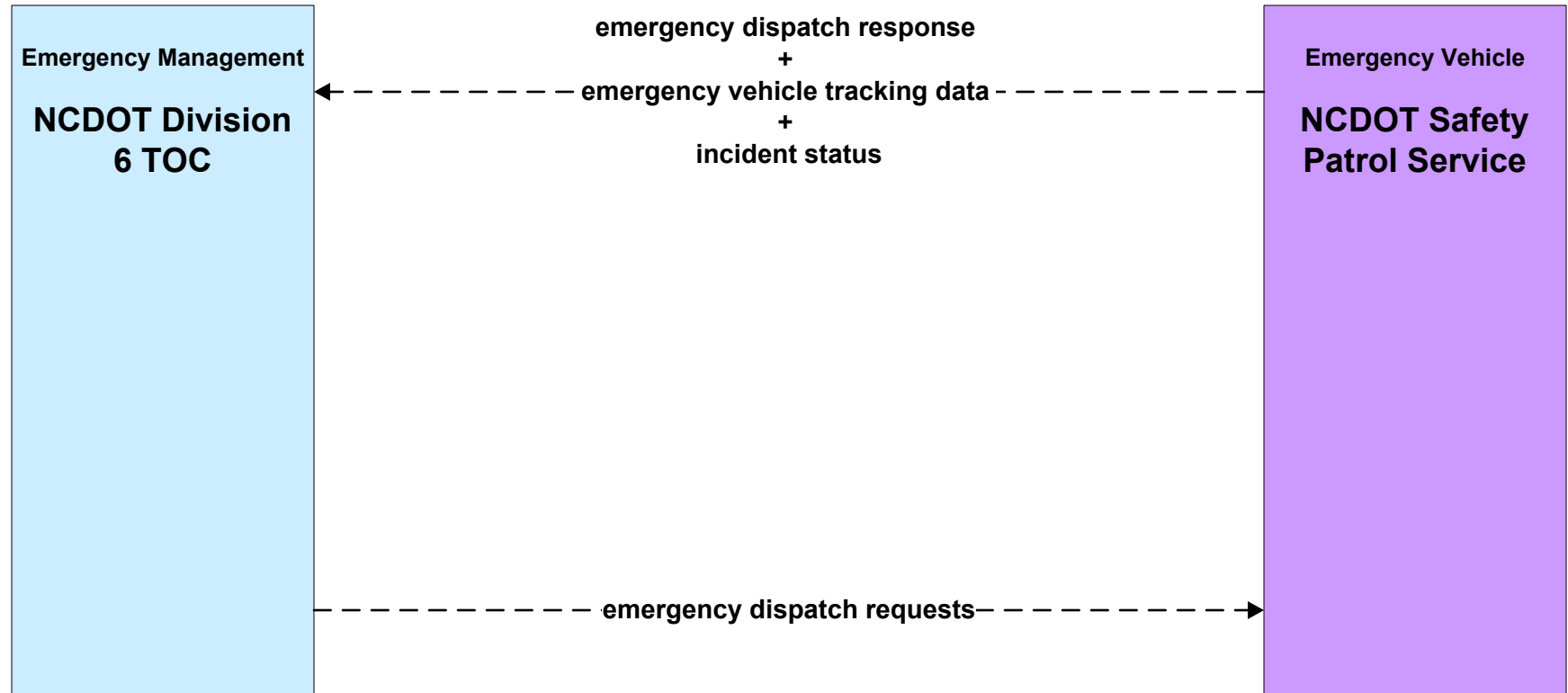
EM02 - Emergency Routing Fayetteville



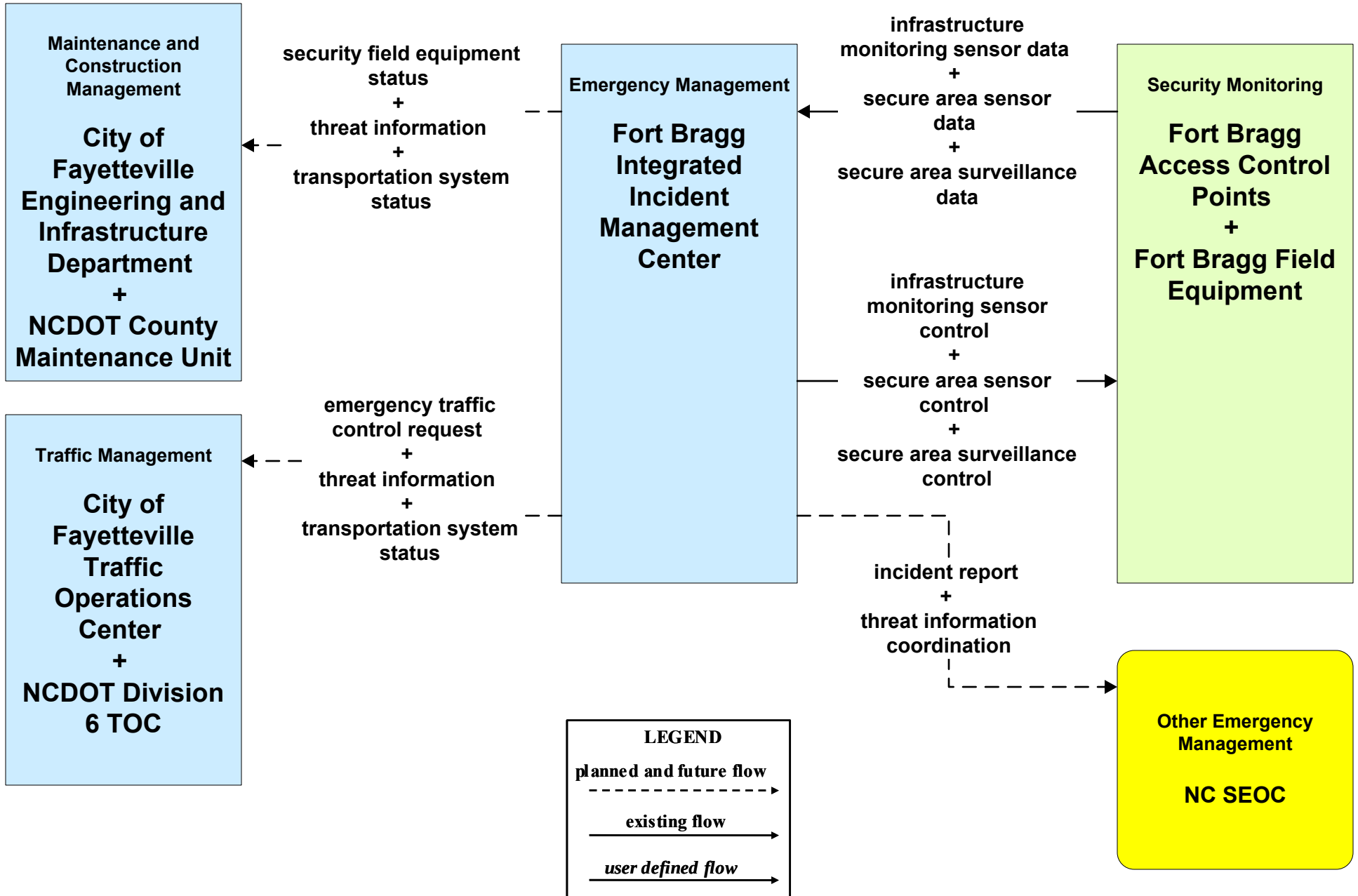
EM02 - Emergency Routing Harnett County



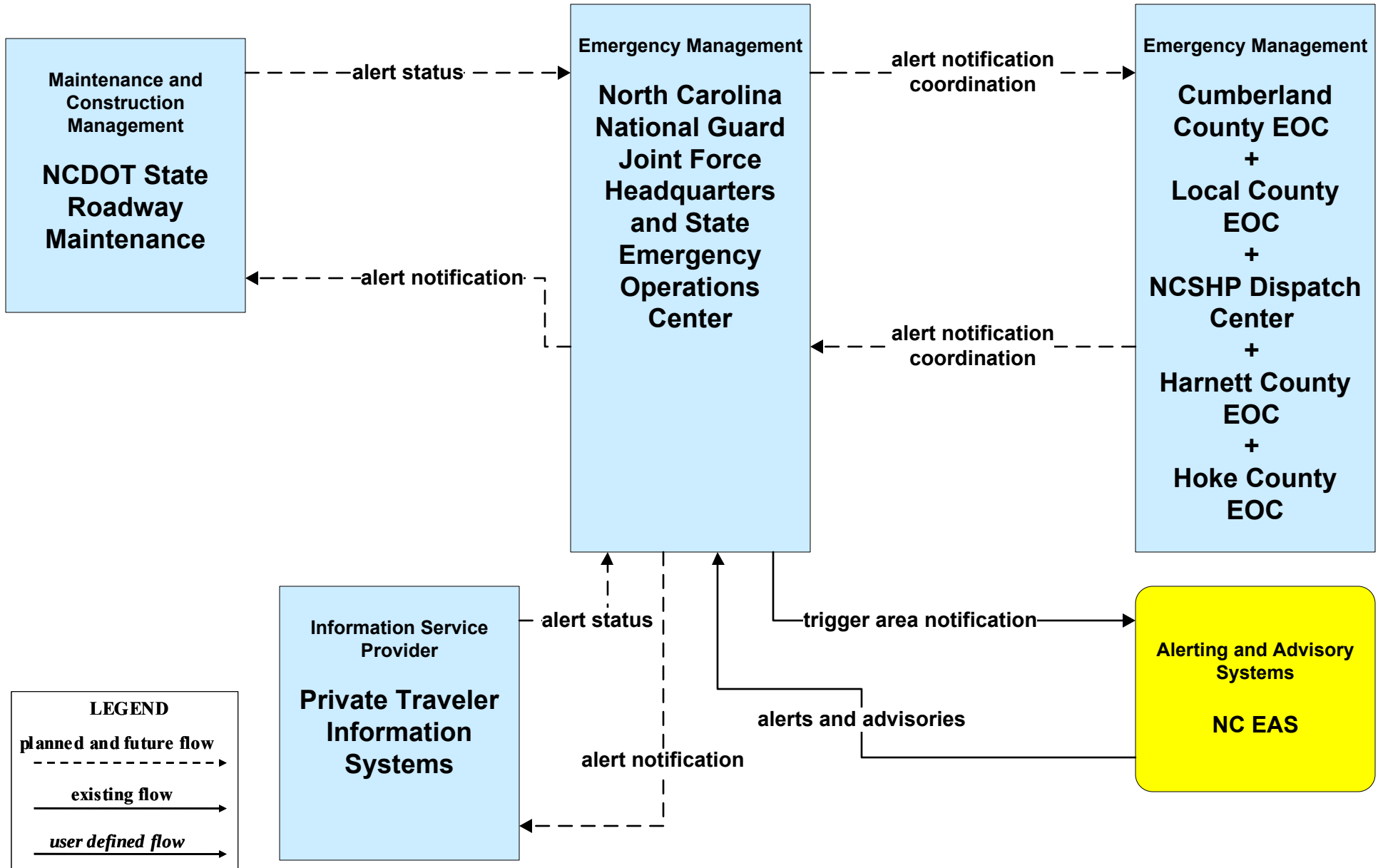
EM04 - Roadway Service Patrols NCDOT Safety Patrol Service



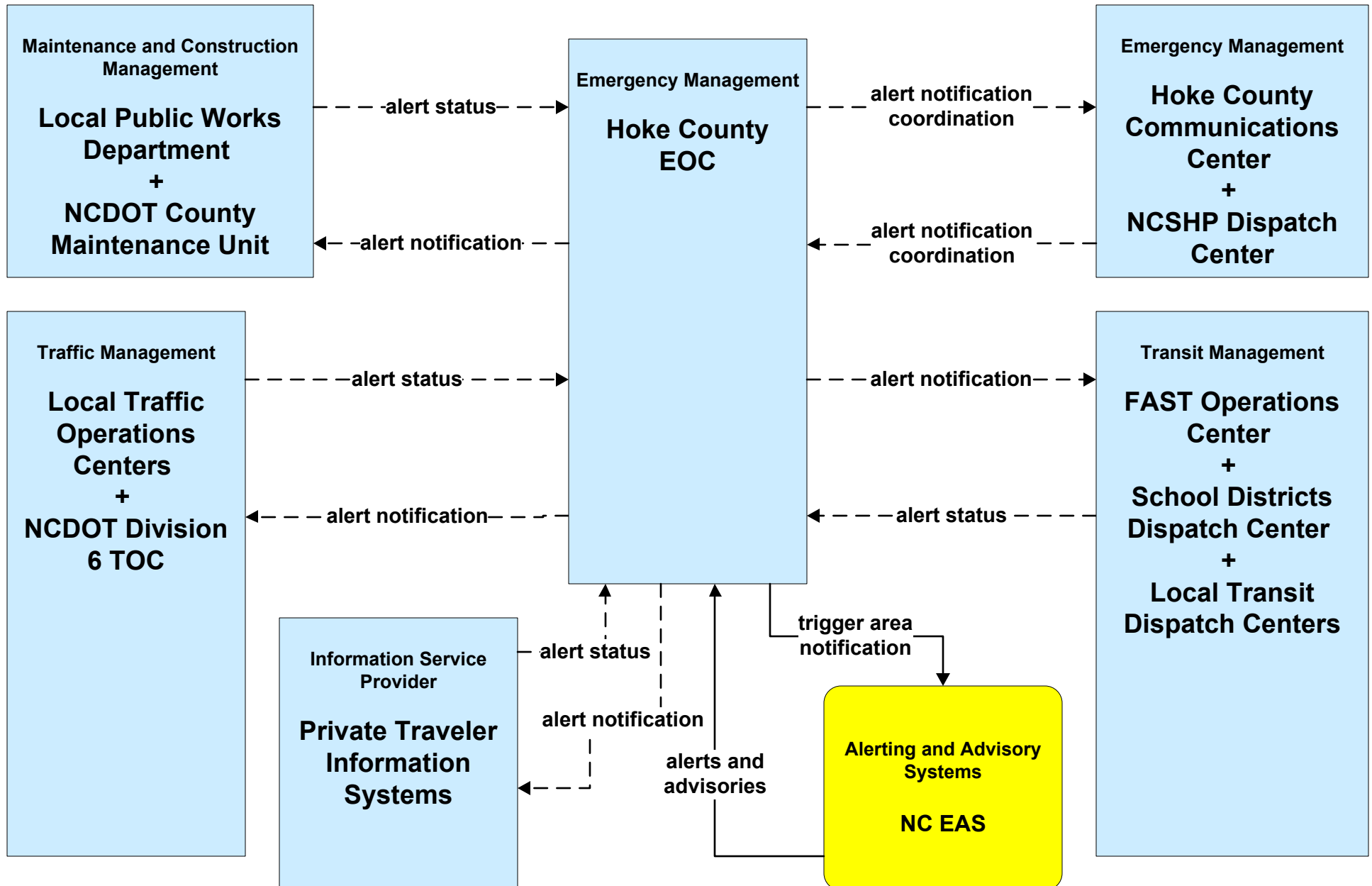
EM05 - Transportation Infrastructure Protection Fort Bragg



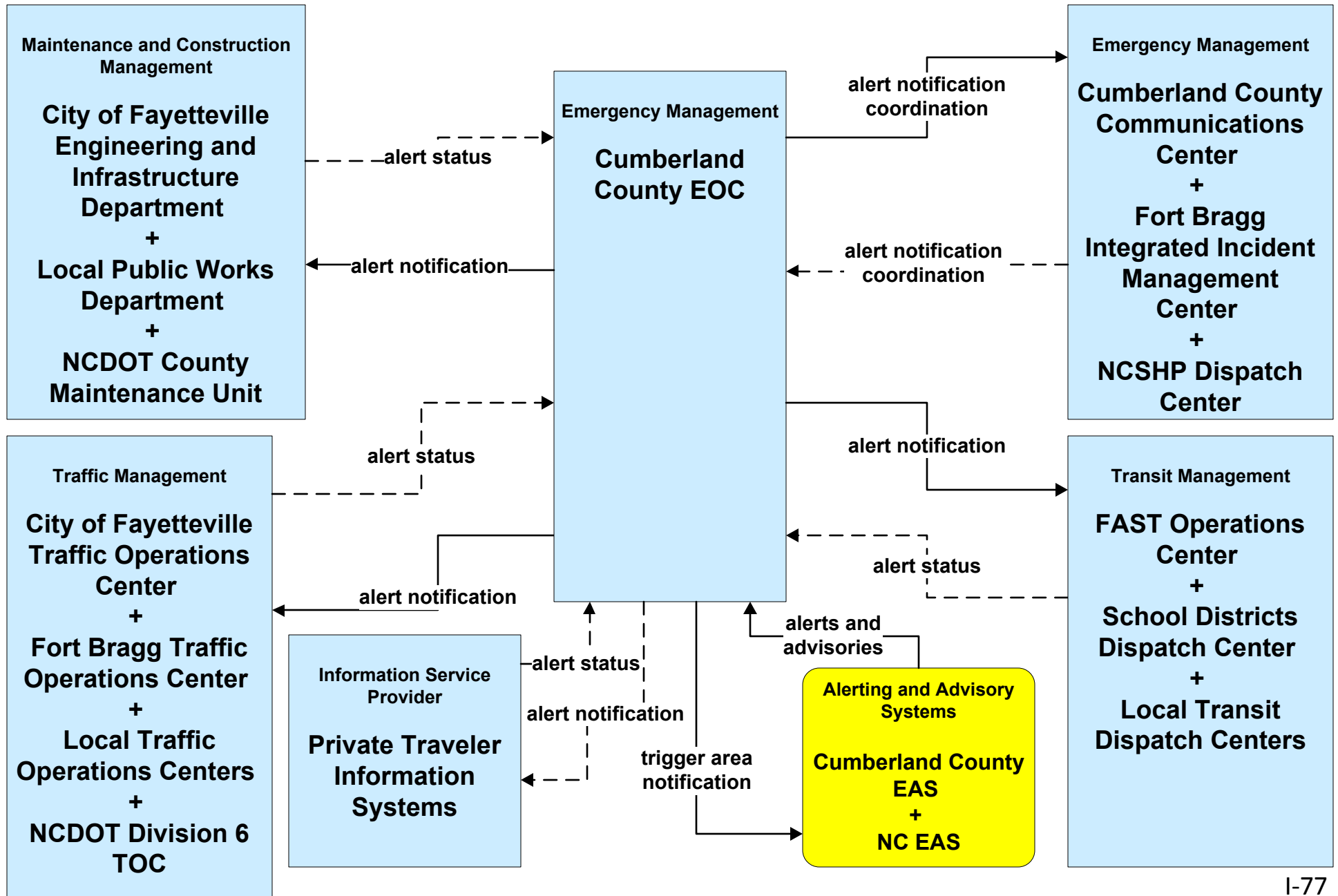
EM06 - Wide Area Alert State Level



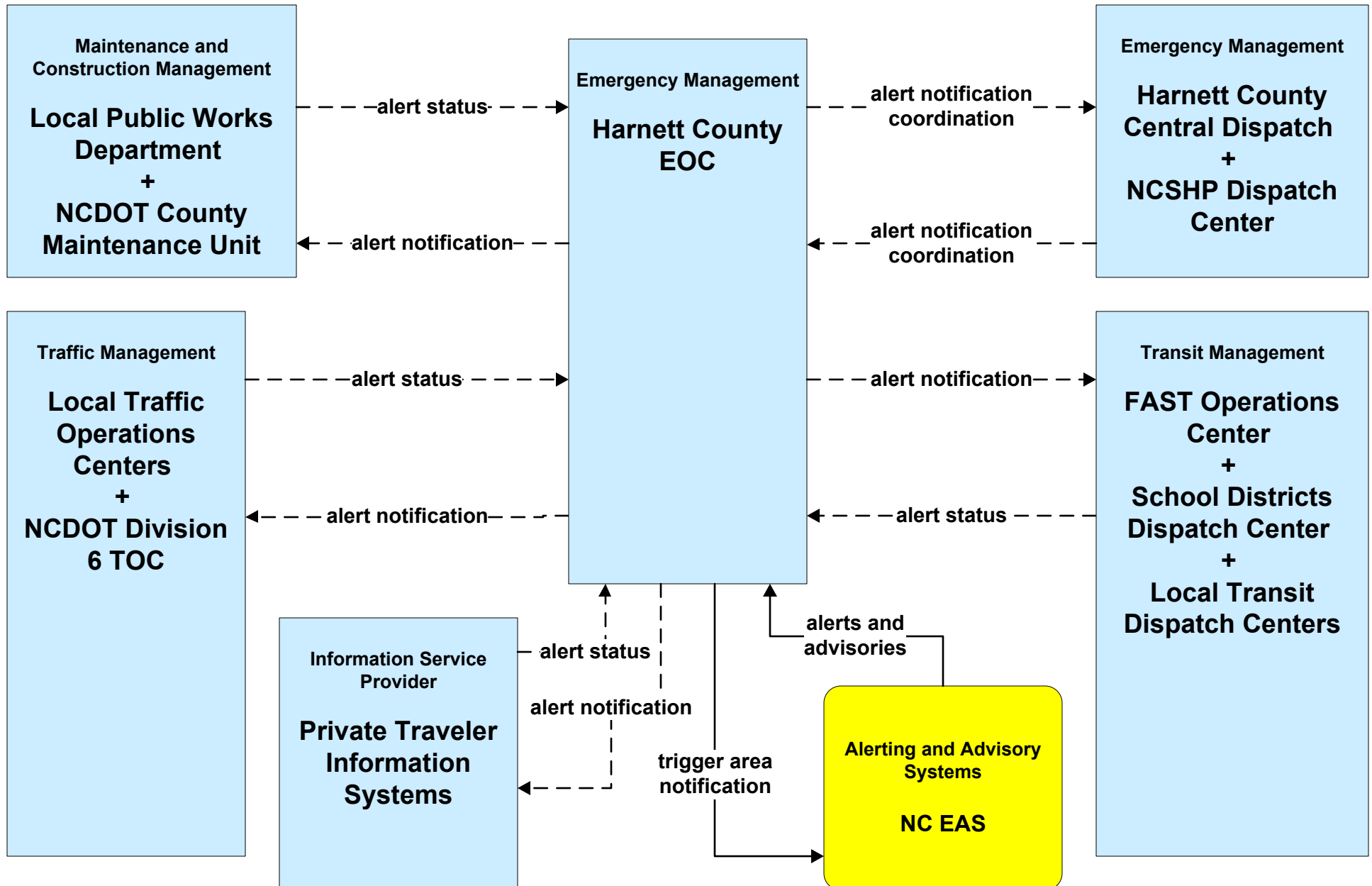
EM06 - Wide Area Alert Hoke County EOC



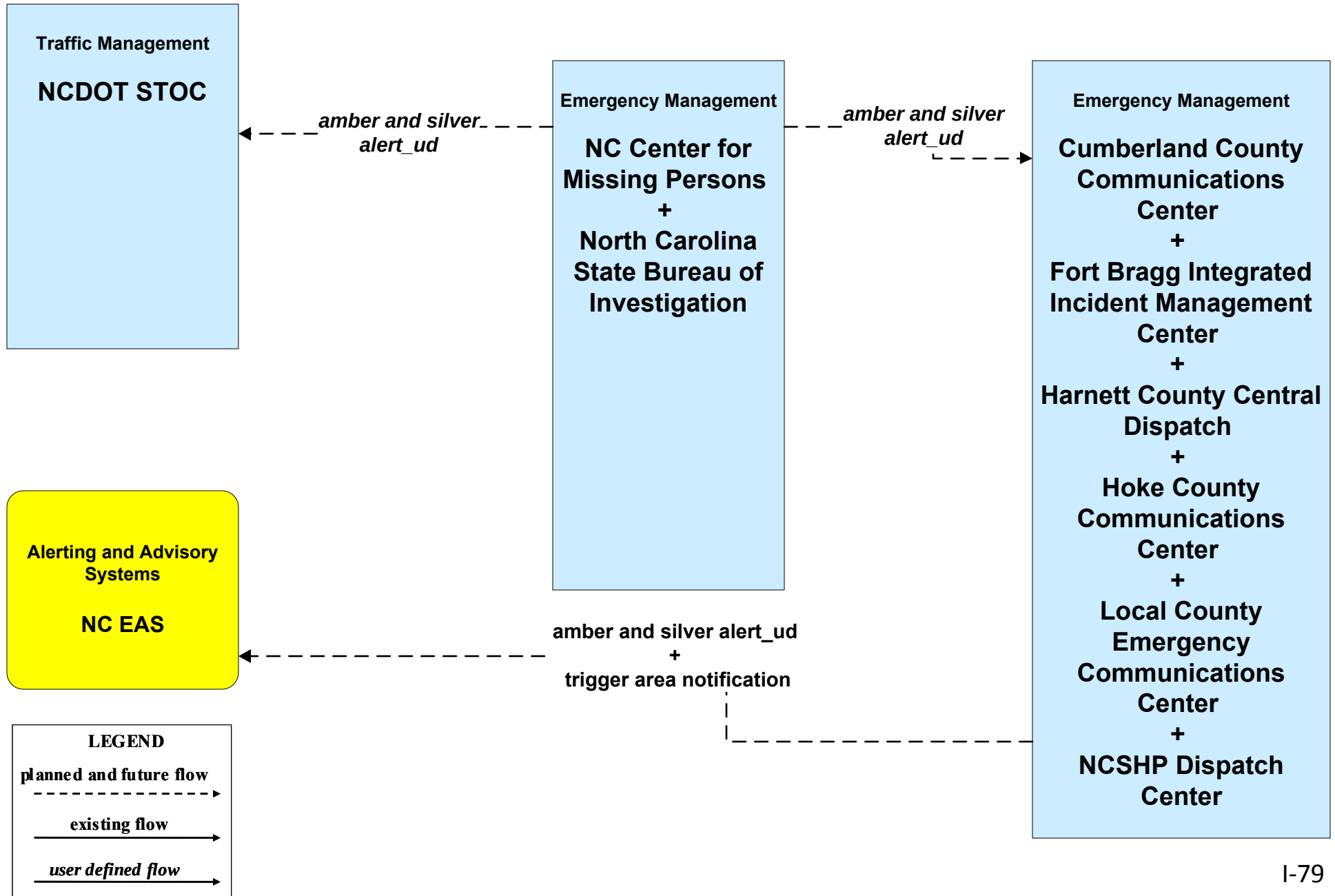
EM06 - Wide Area Alert Cumberland County EOC



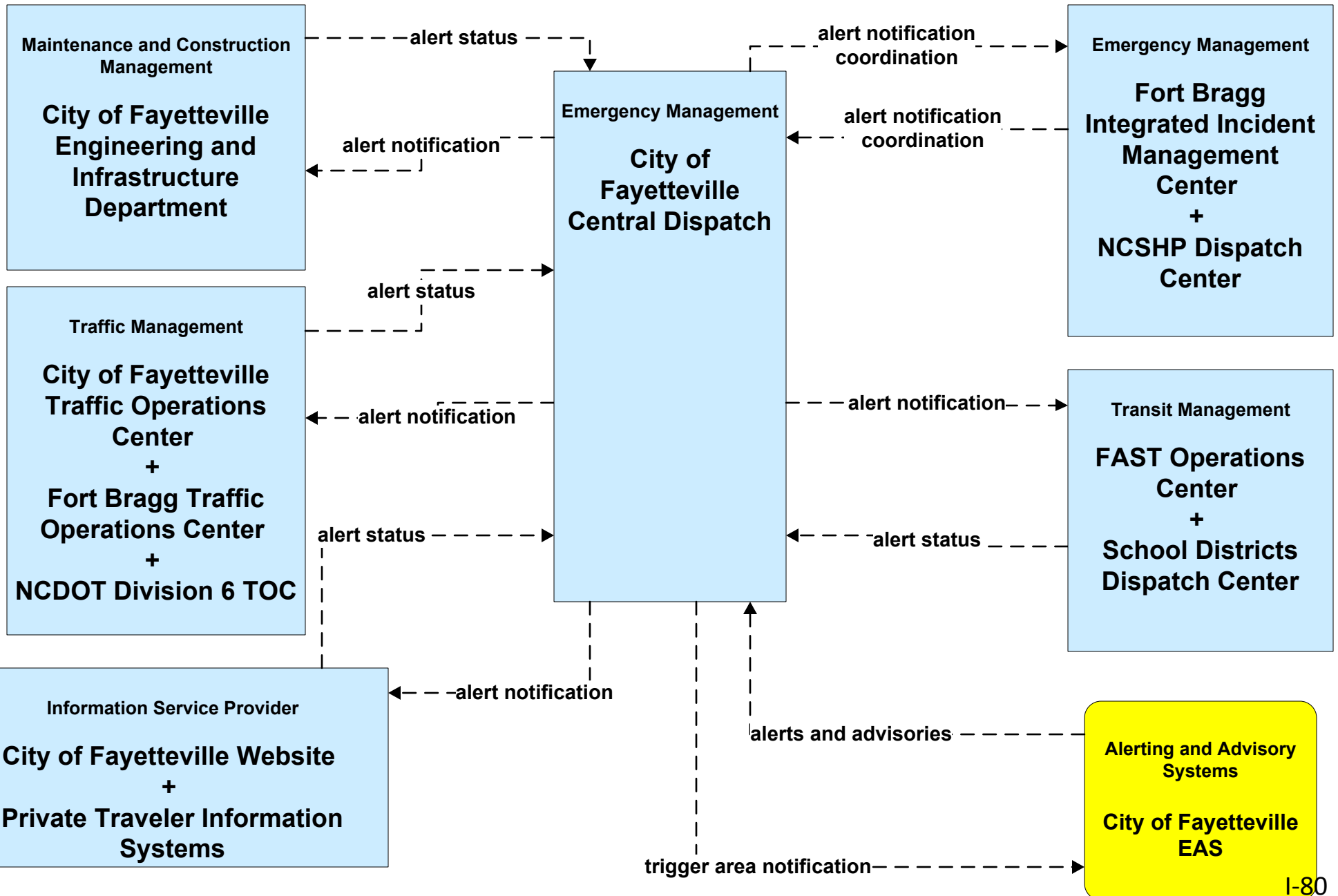
EM06 - Wide Area Alert Harnett County EOC



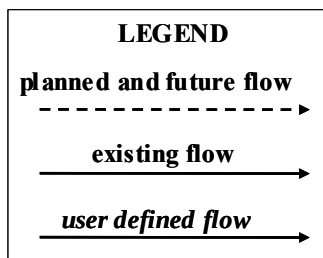
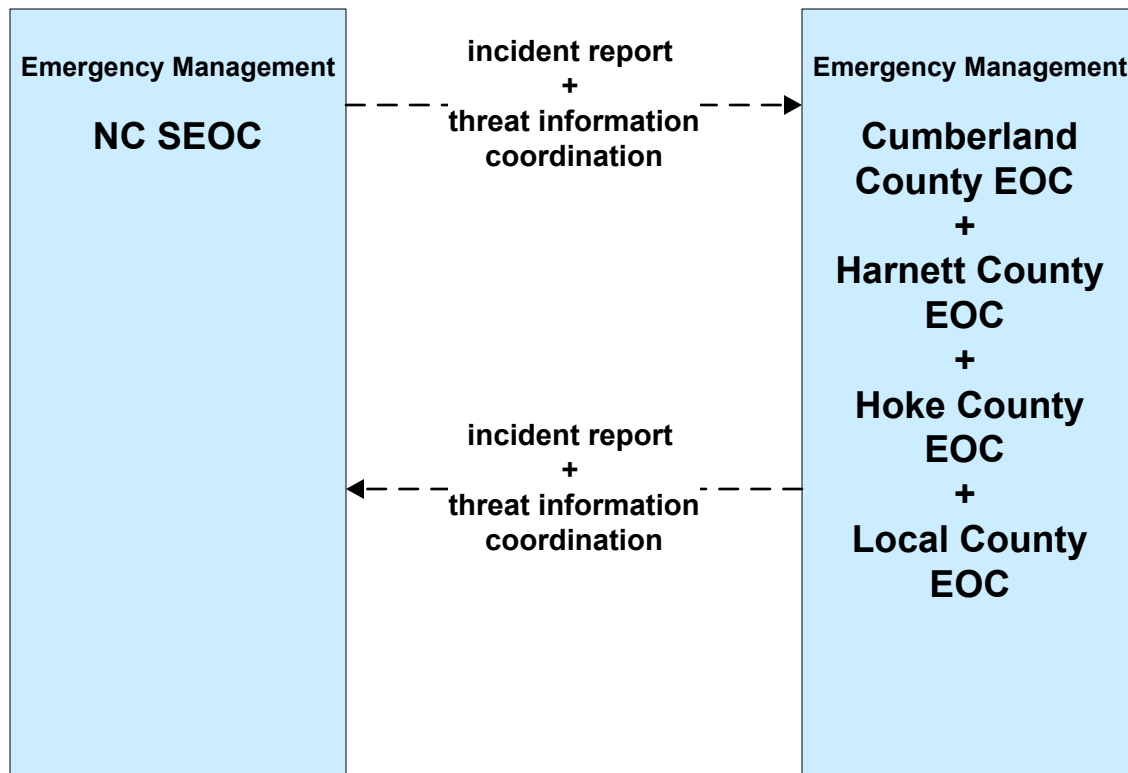
**EM06 - Wide Area Alert
Amber / Silver Alert**



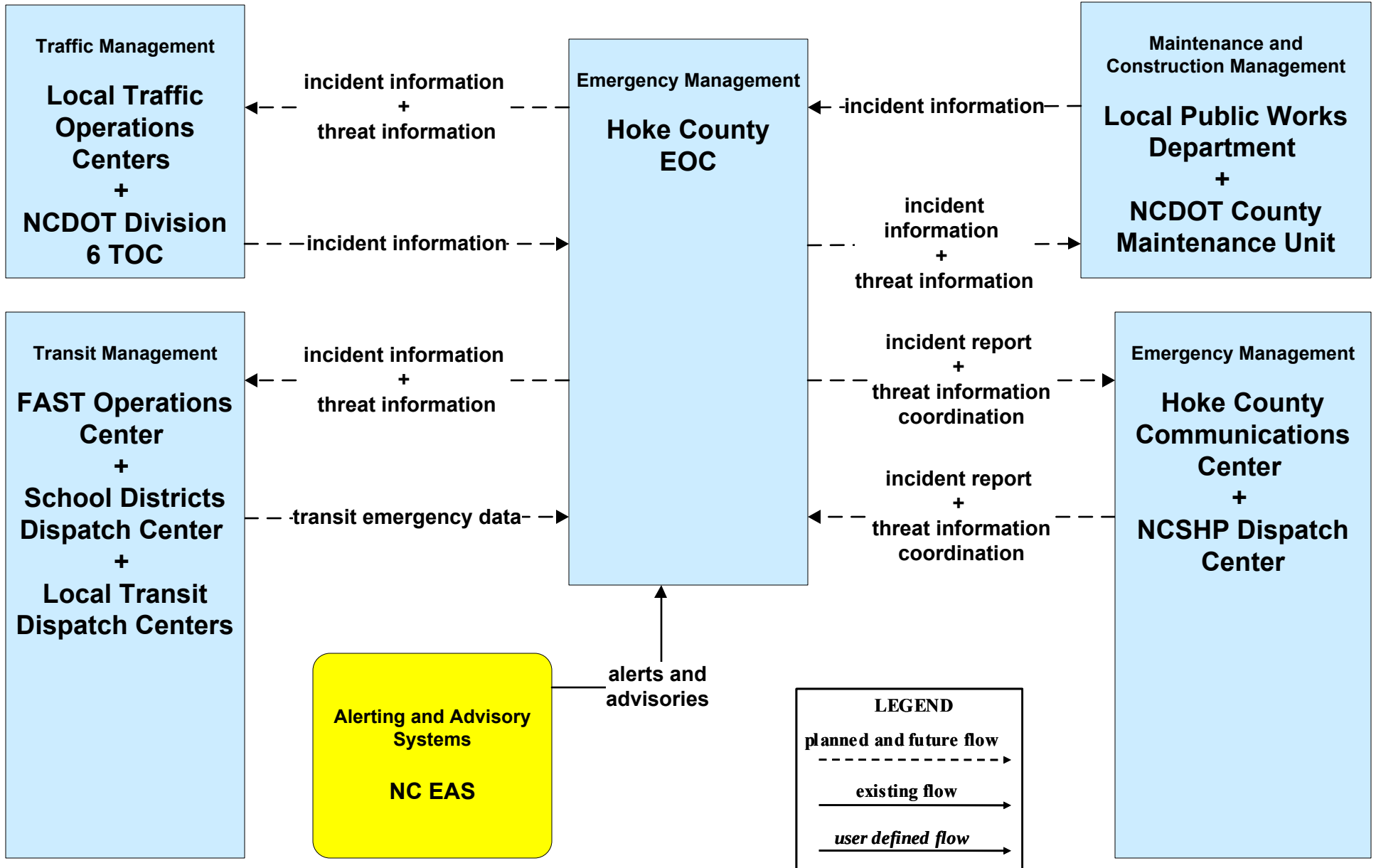
EM06 - Wide Area Alert
City of Fayetteville Reverse 911 System



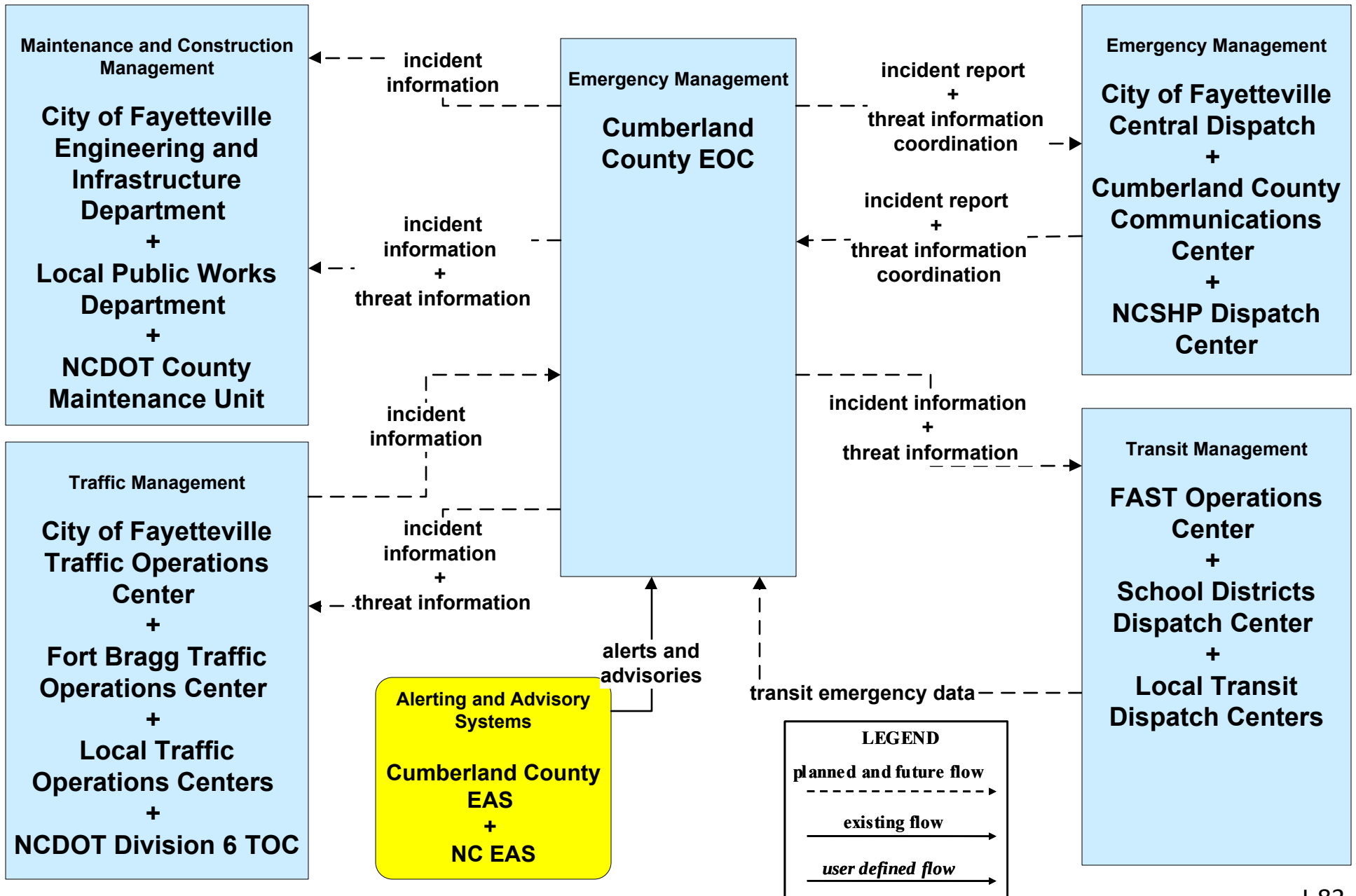
EM07 - Early Warning System
NC State Emergency Operations Center



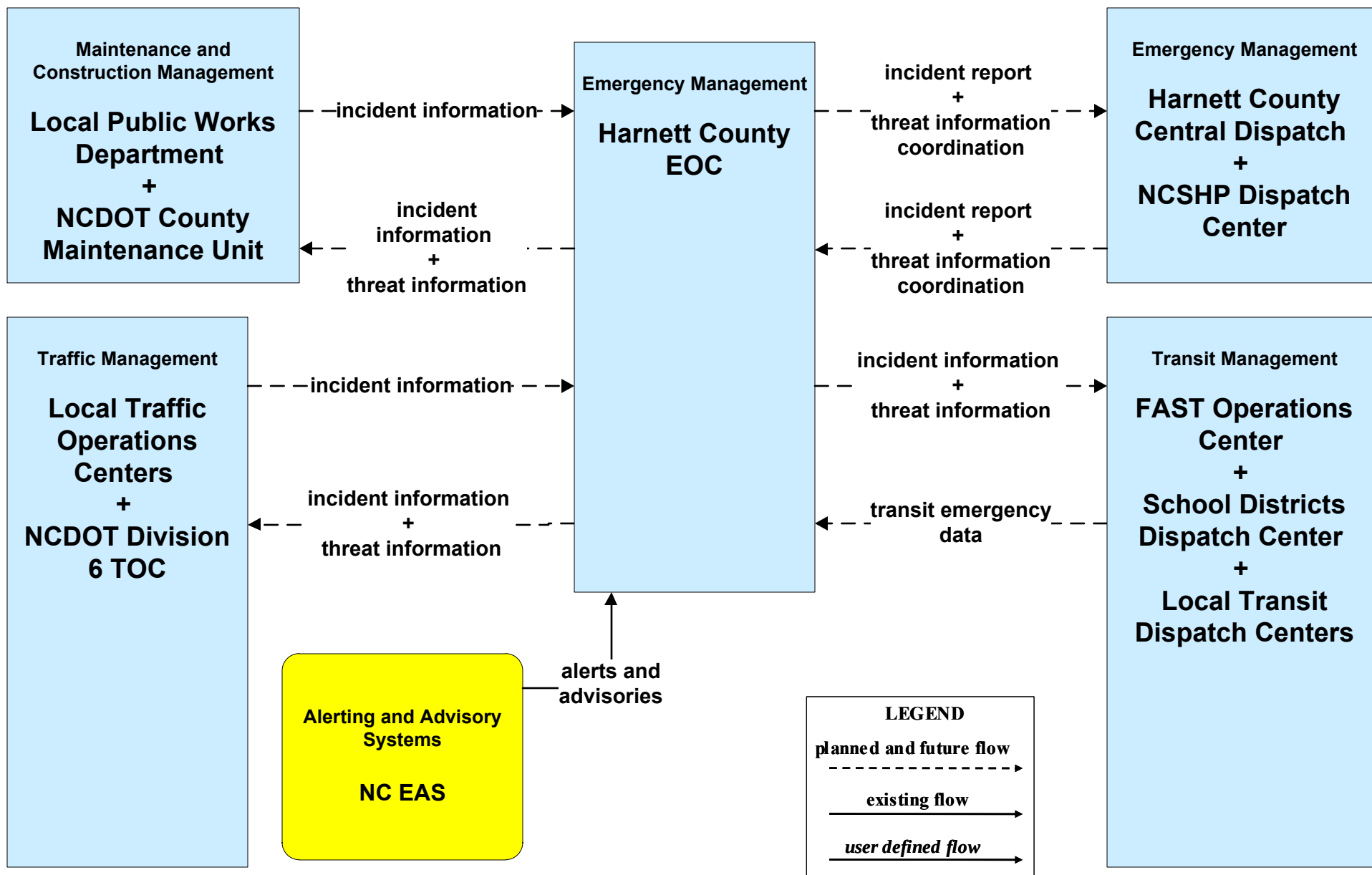
EM07 - Early Warning System Hoke County EOC



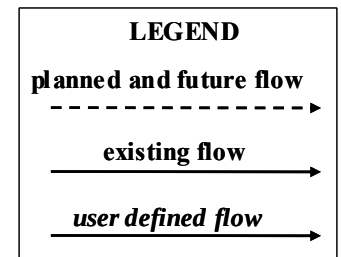
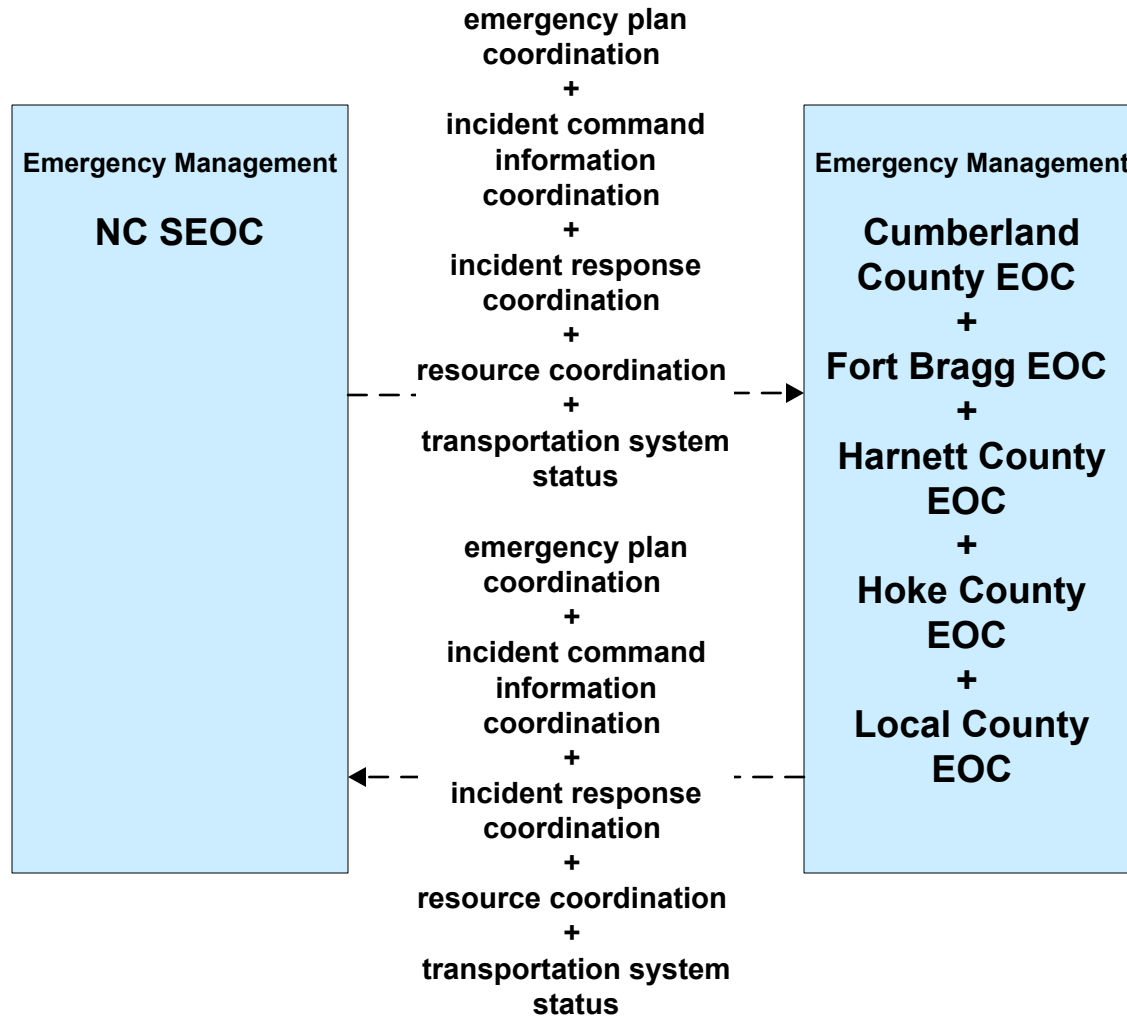
EM07 - Early Warning System Cumberland County EOC



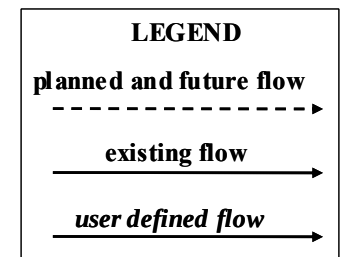
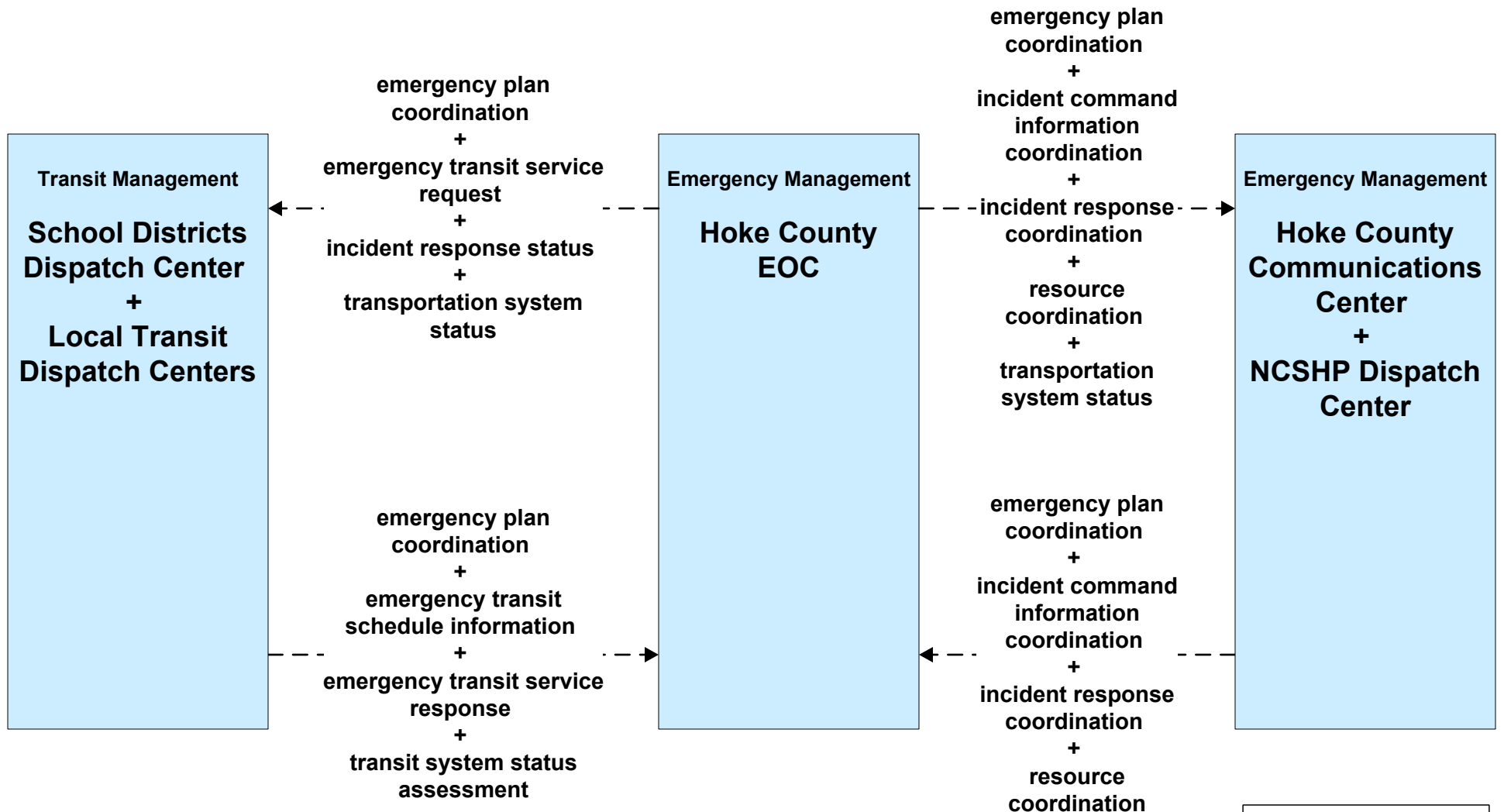
EM07 - Early Warning System Harnett County EOC



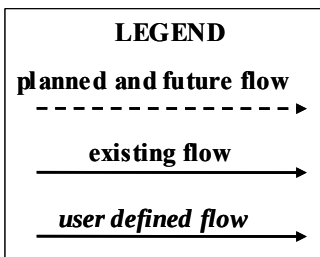
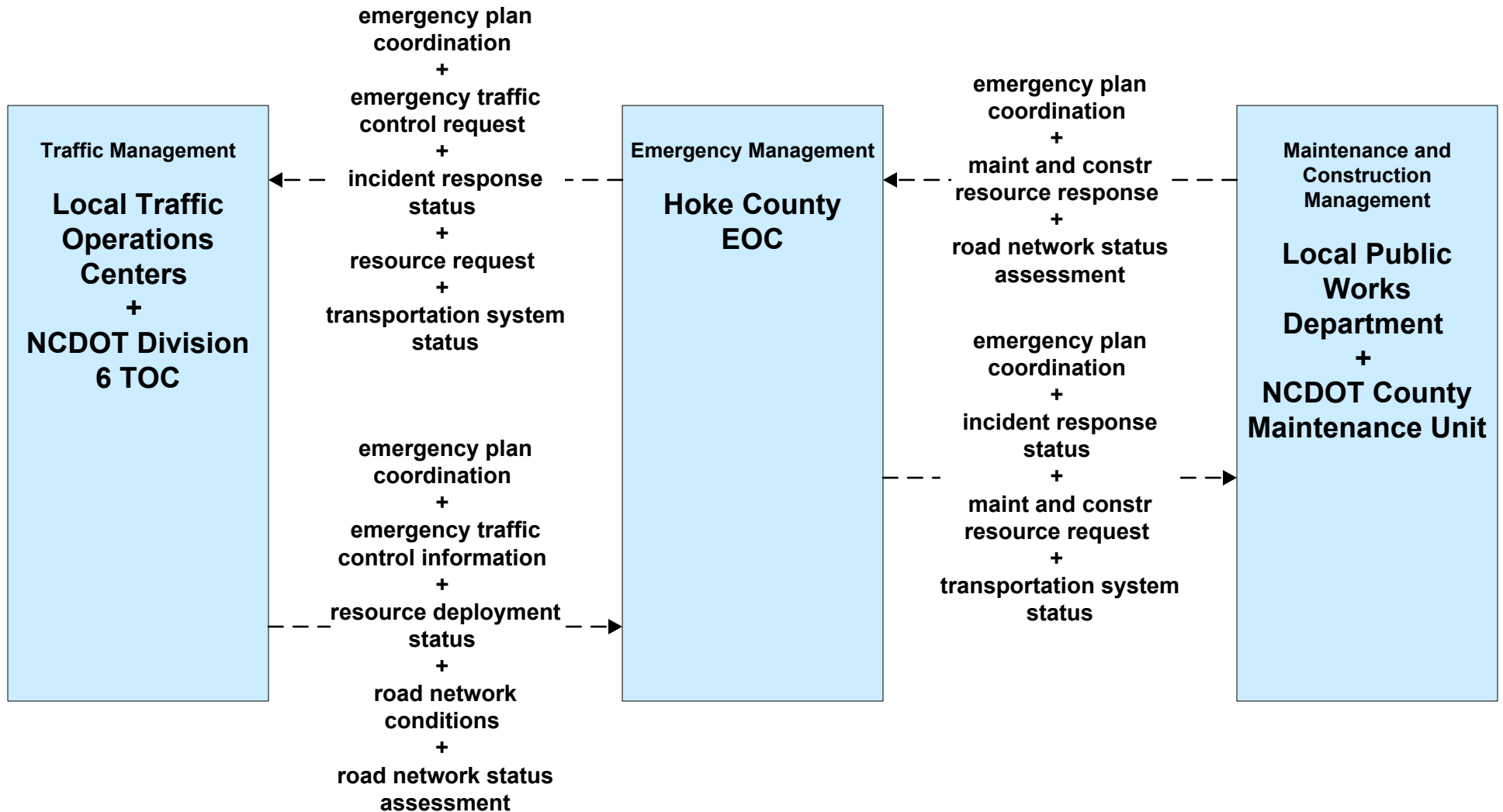
EM08 - Disaster Response and Recovery NC State Emergency Operations Center



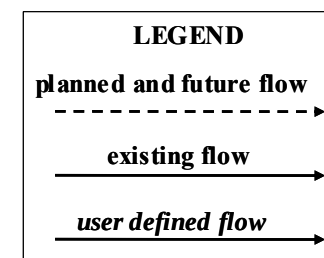
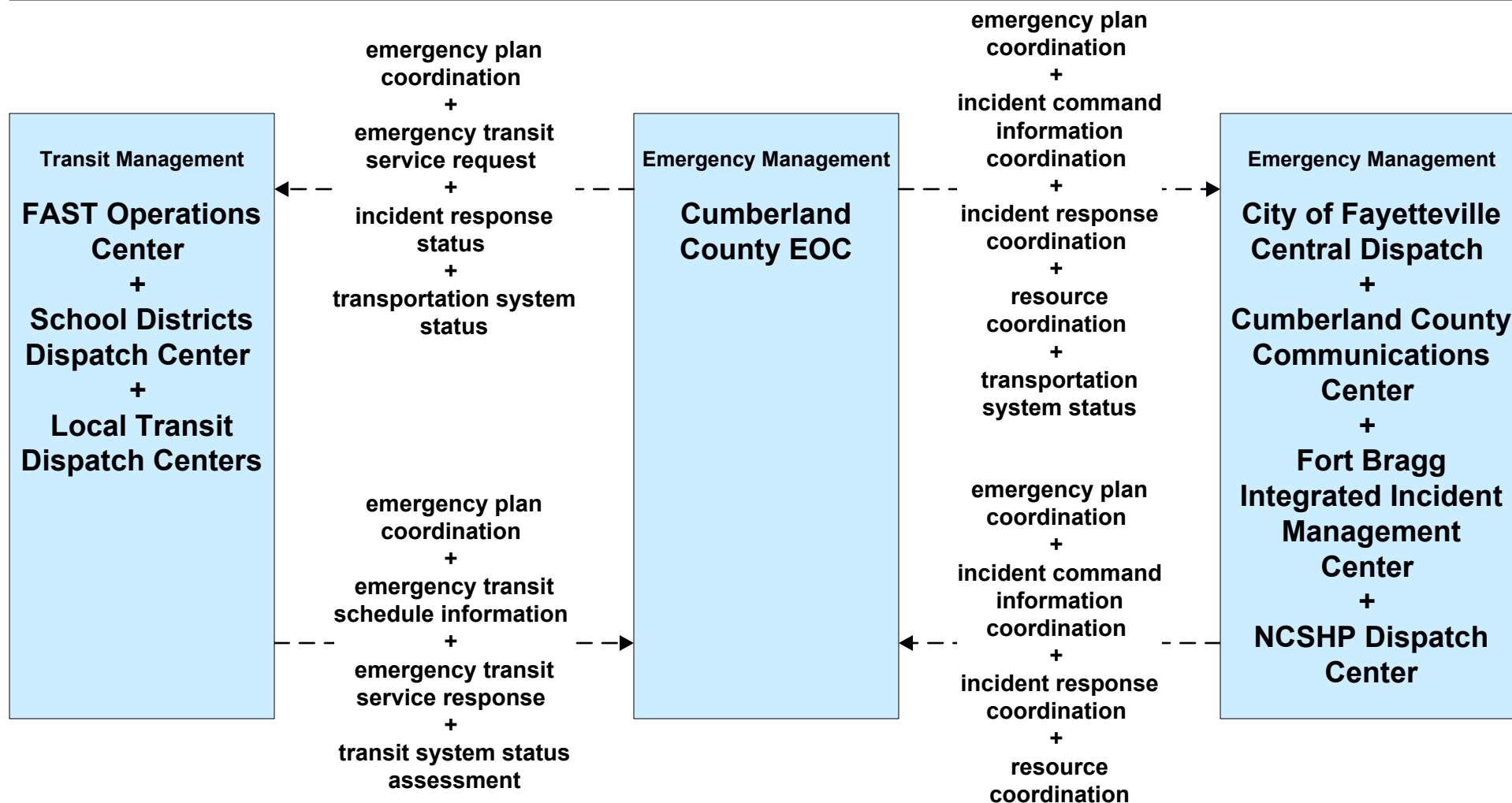
EM08 - Disaster Response and Recovery Hoke County EOC (1 of 2)



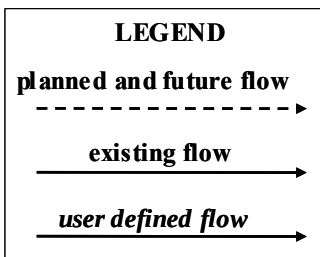
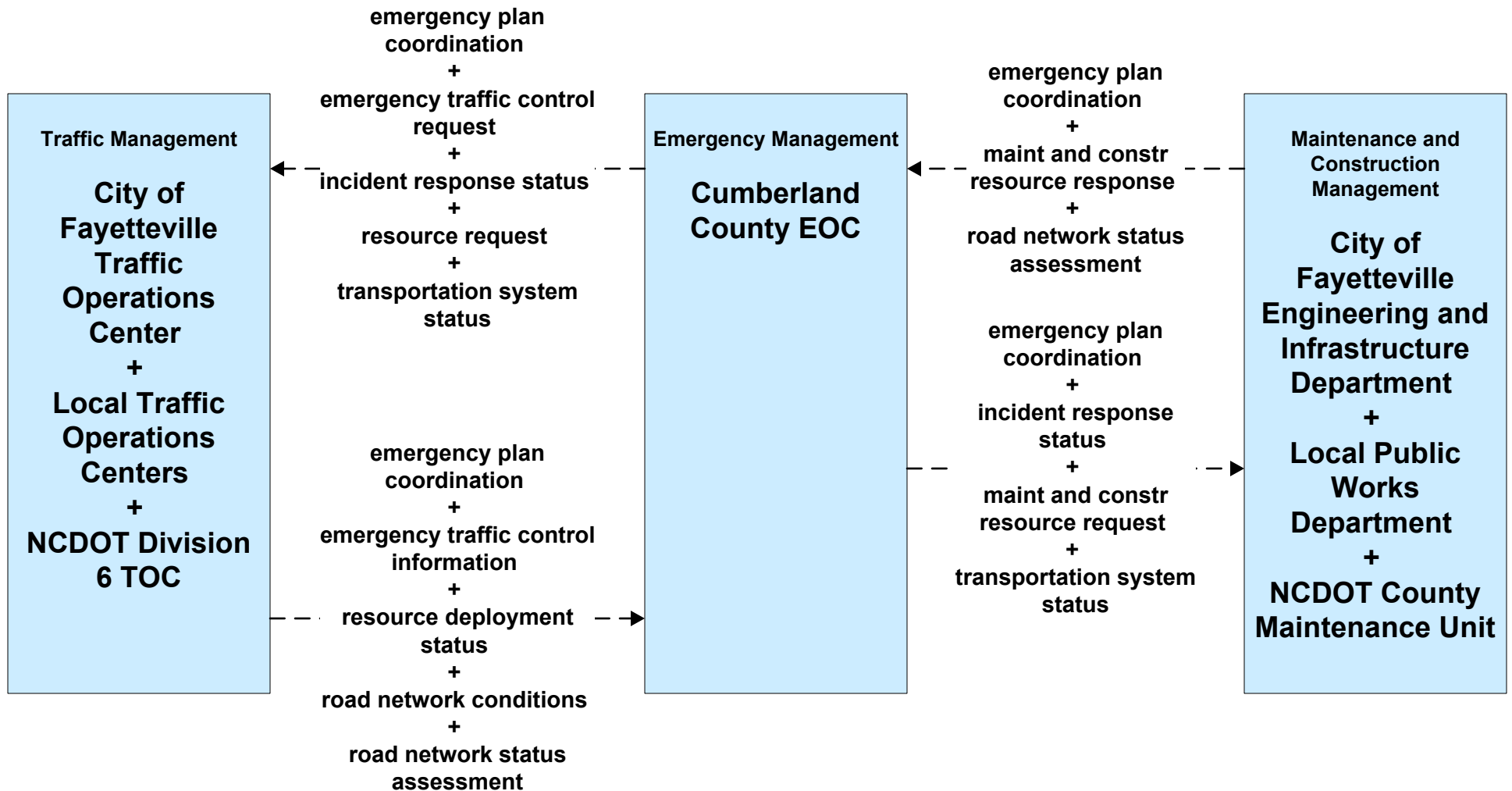
EM08 - Disaster Response and Recovery Hoke County EOC (2 of 2)



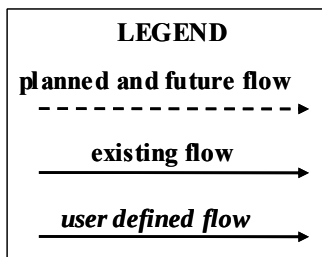
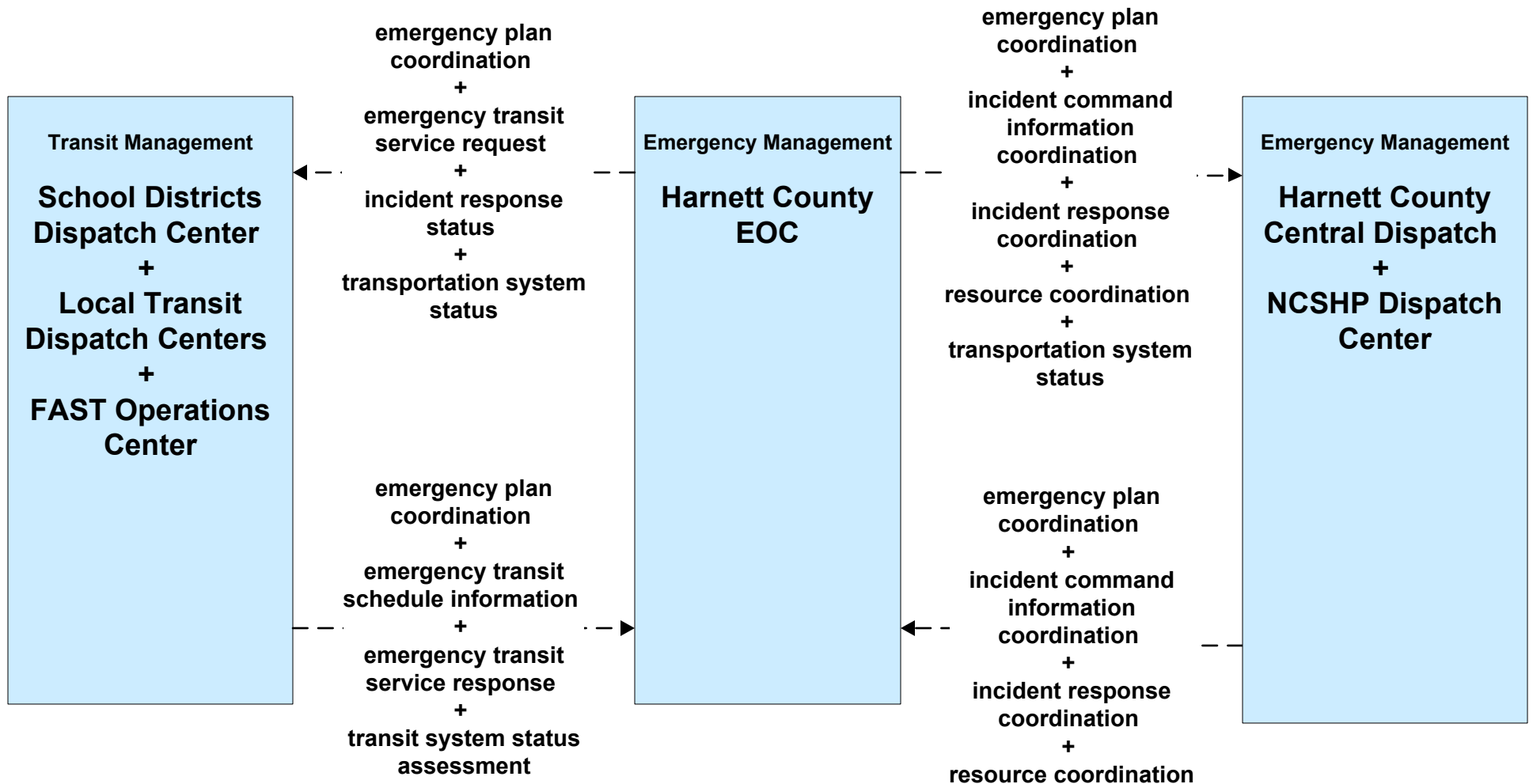
EM08 - Disaster Response and Recovery Cumberland County EOC (1 of 2)



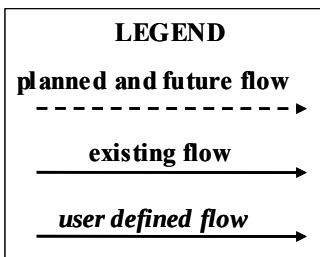
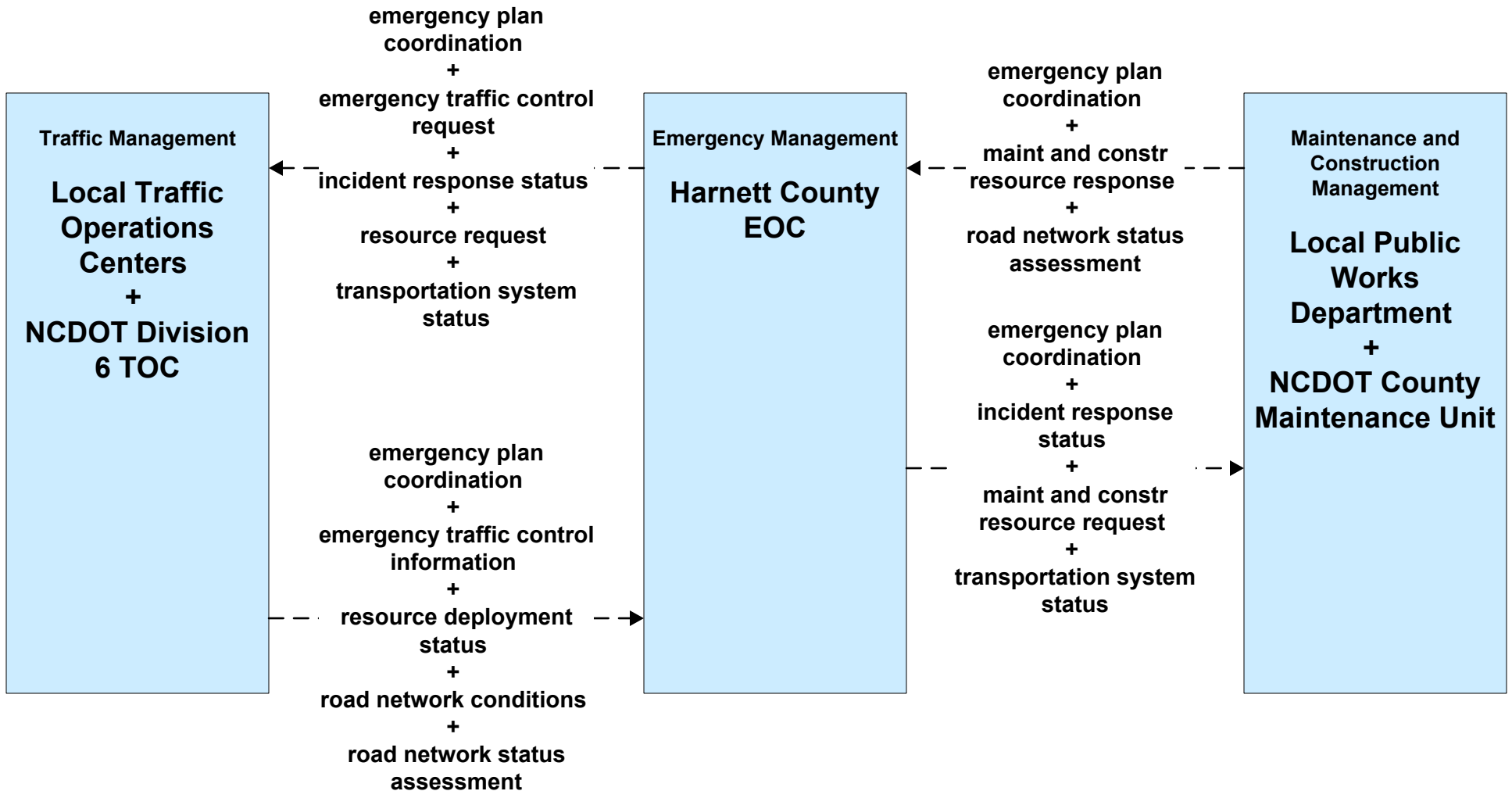
EM08 - Disaster Response and Recovery **Cumberland County EOC (2 of 2)**



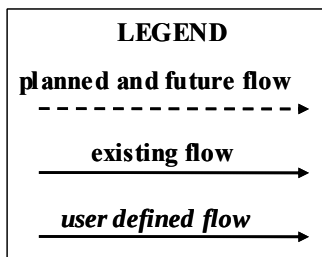
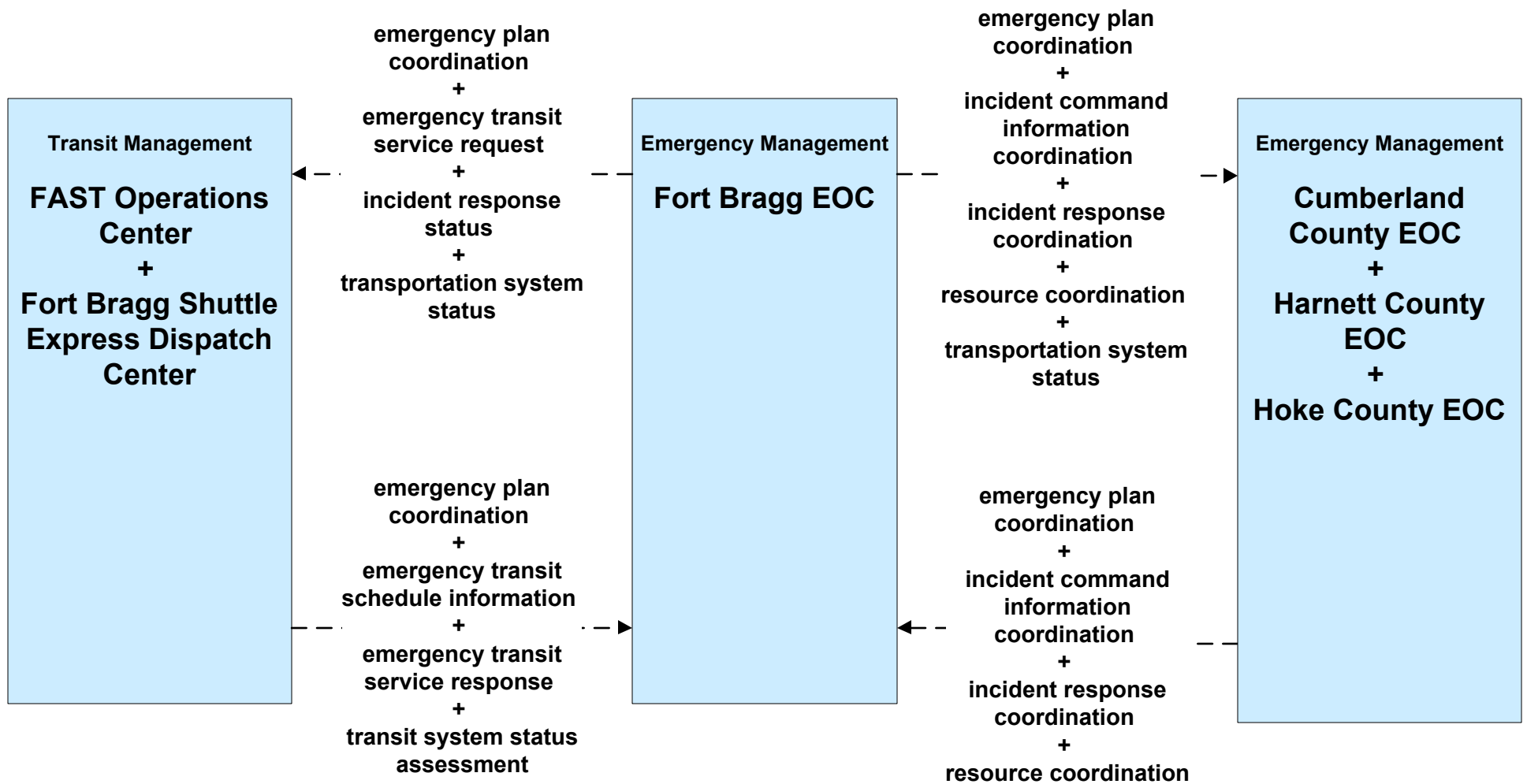
EM08 - Disaster Response and Recovery Harnett County EOC (1 of 2)



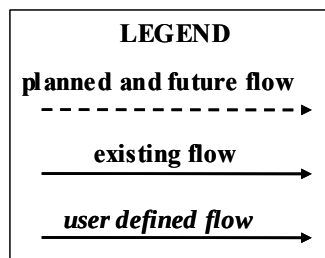
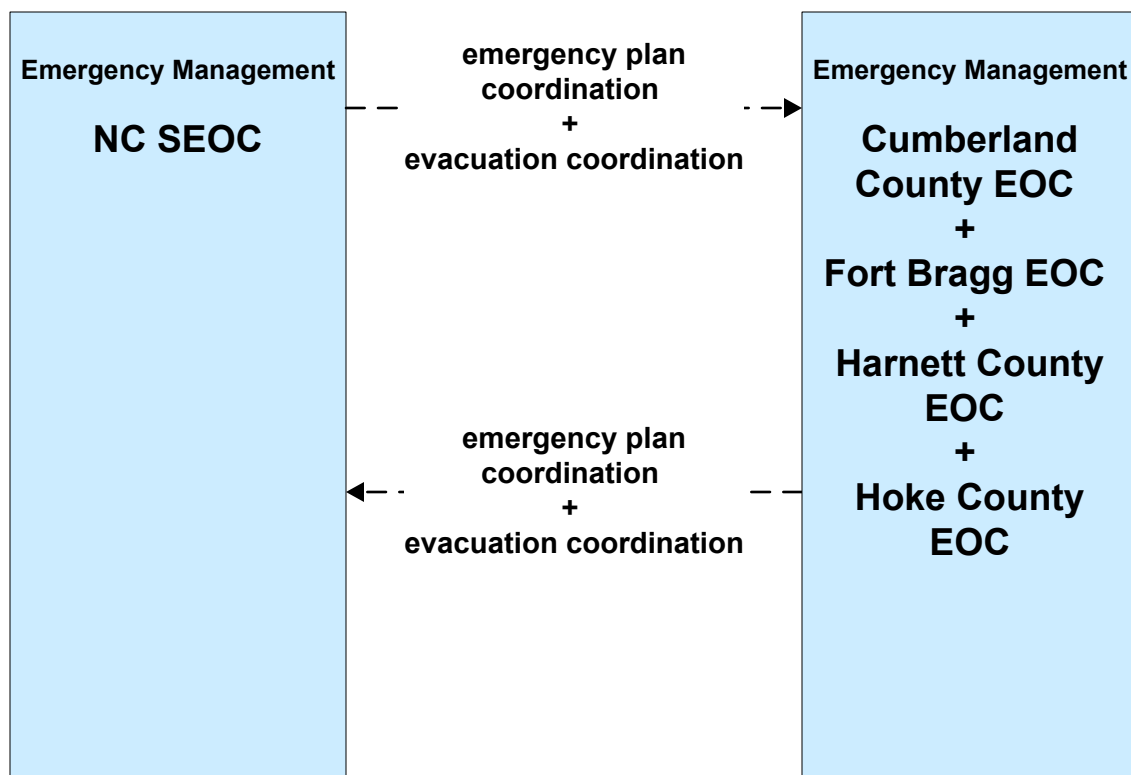
EM08 - Disaster Response and Recovery Harnett County EOC (2 of 2)



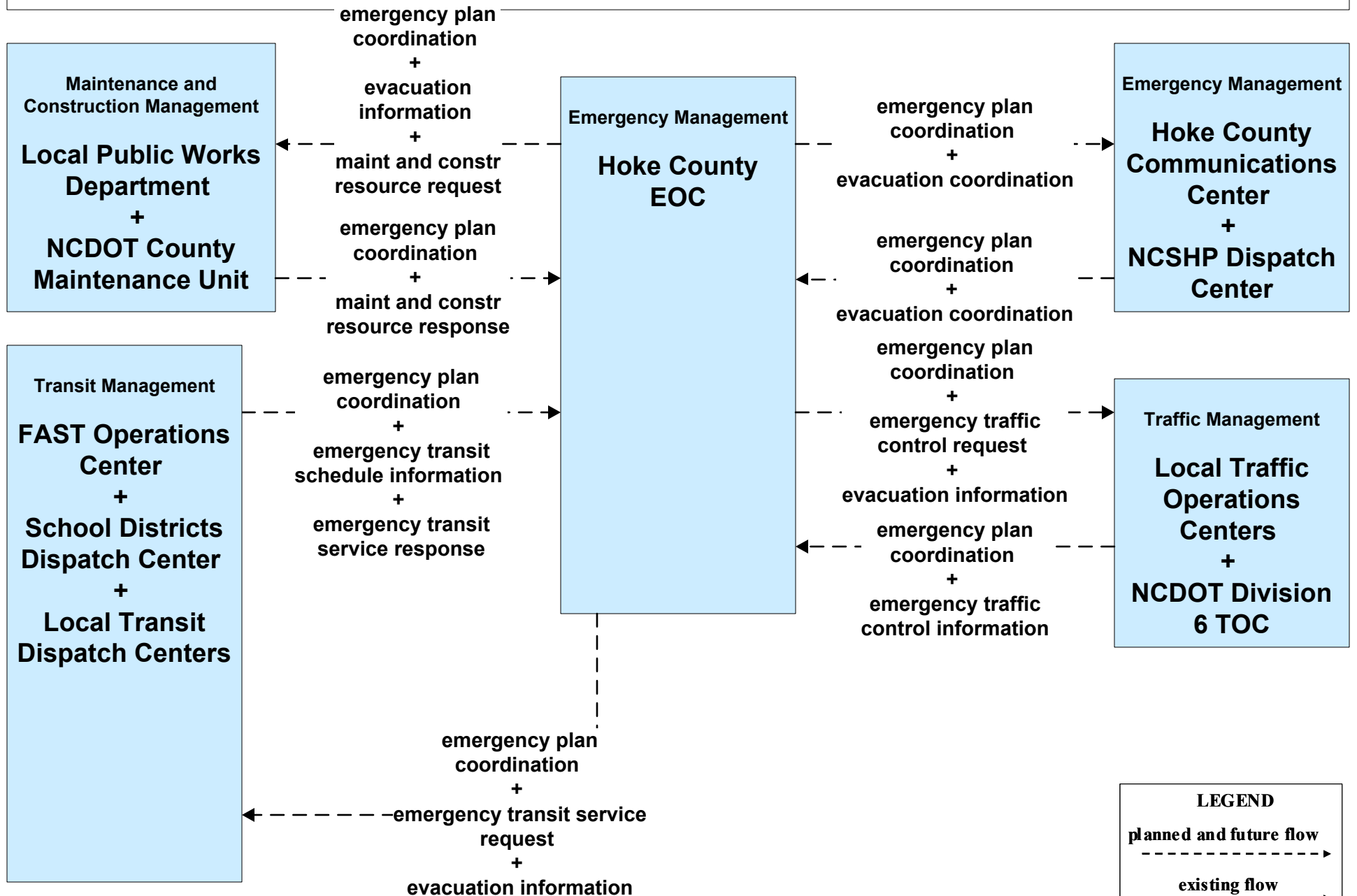
EM08 - Disaster Response and Recovery Fort Bragg EOC



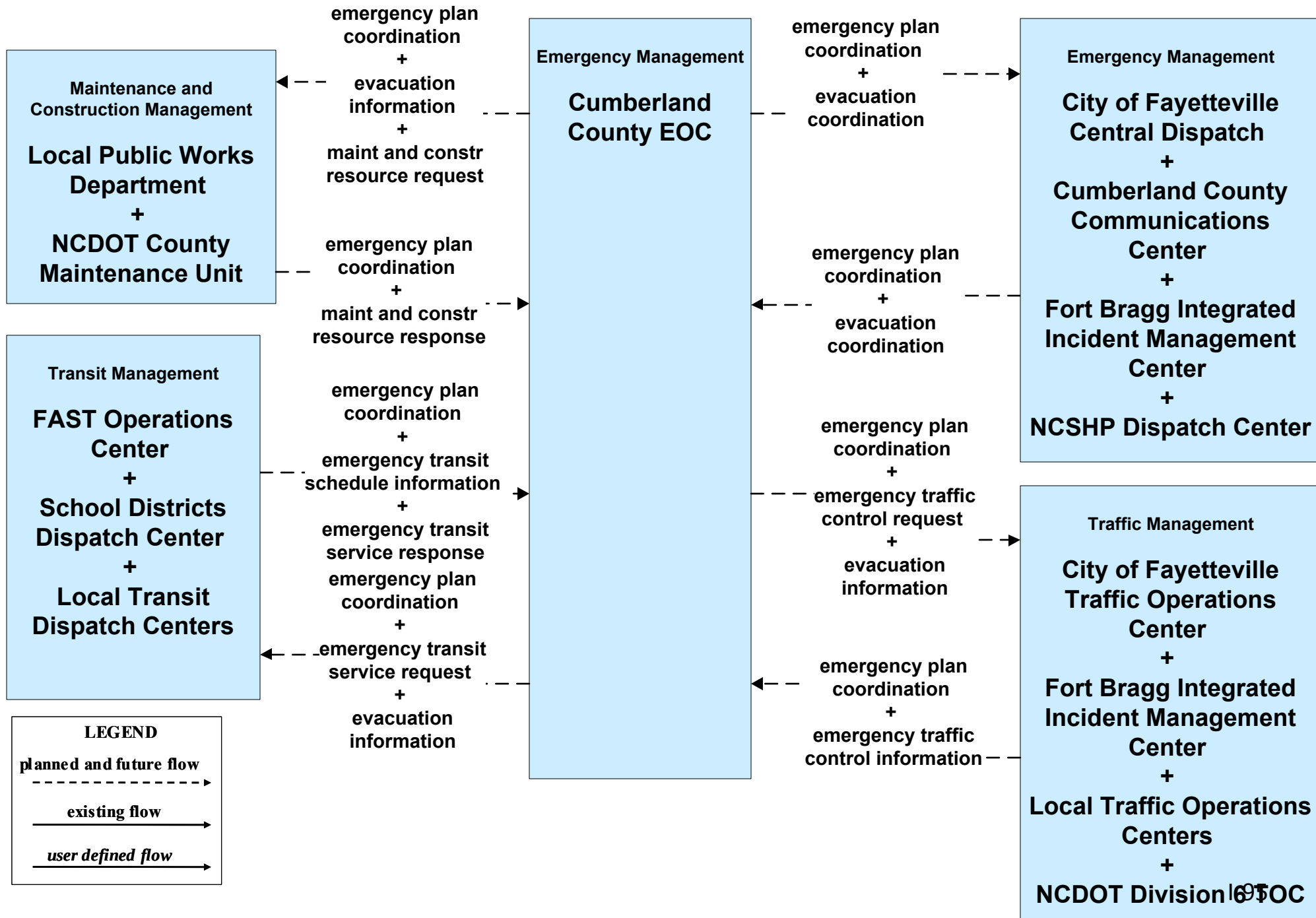
EM09 – Evacuation and Reentry Management NC State Emergency Operations Center



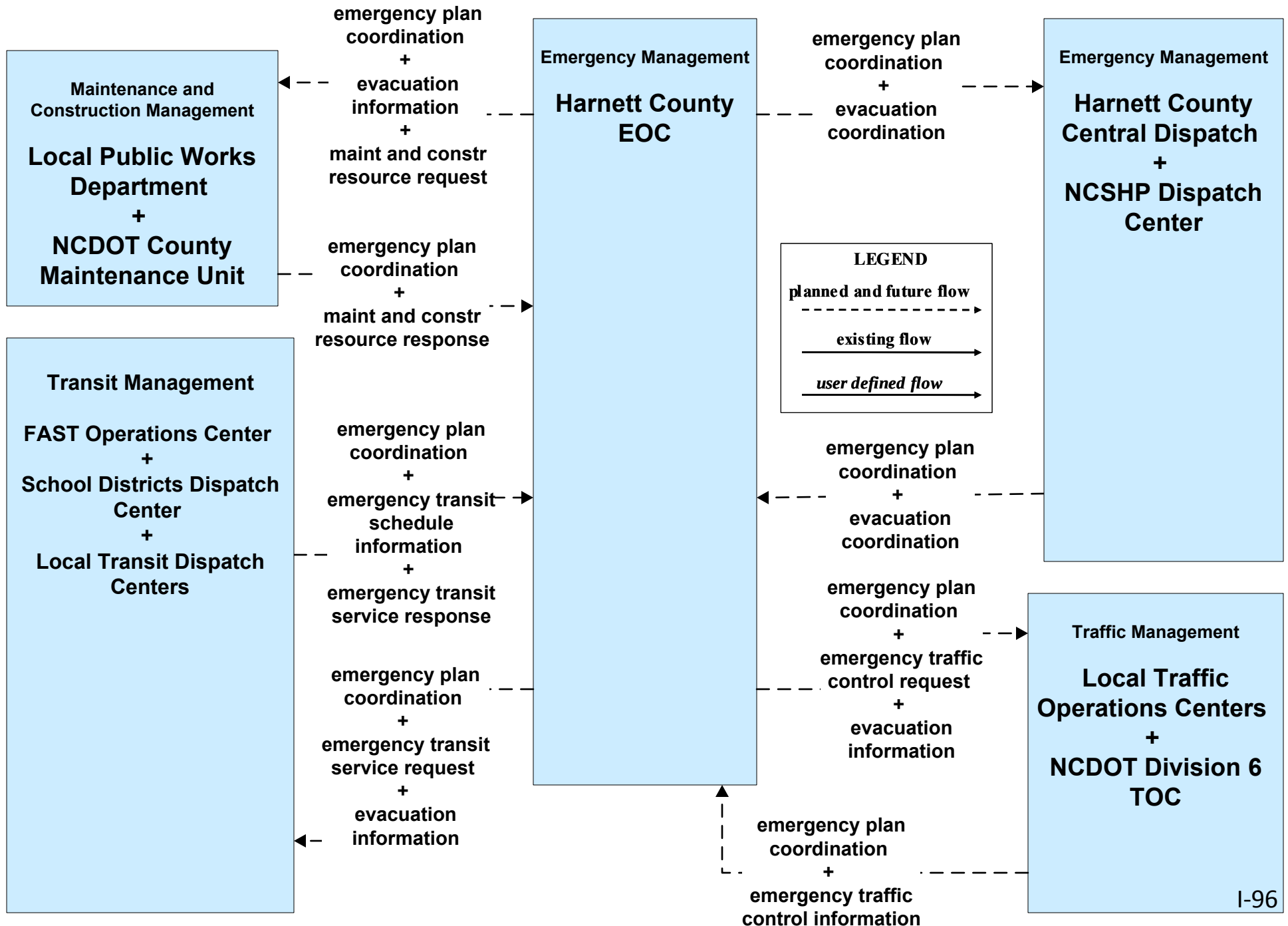
EM09 – Evacuation and Reentry Management Hoke County EOC



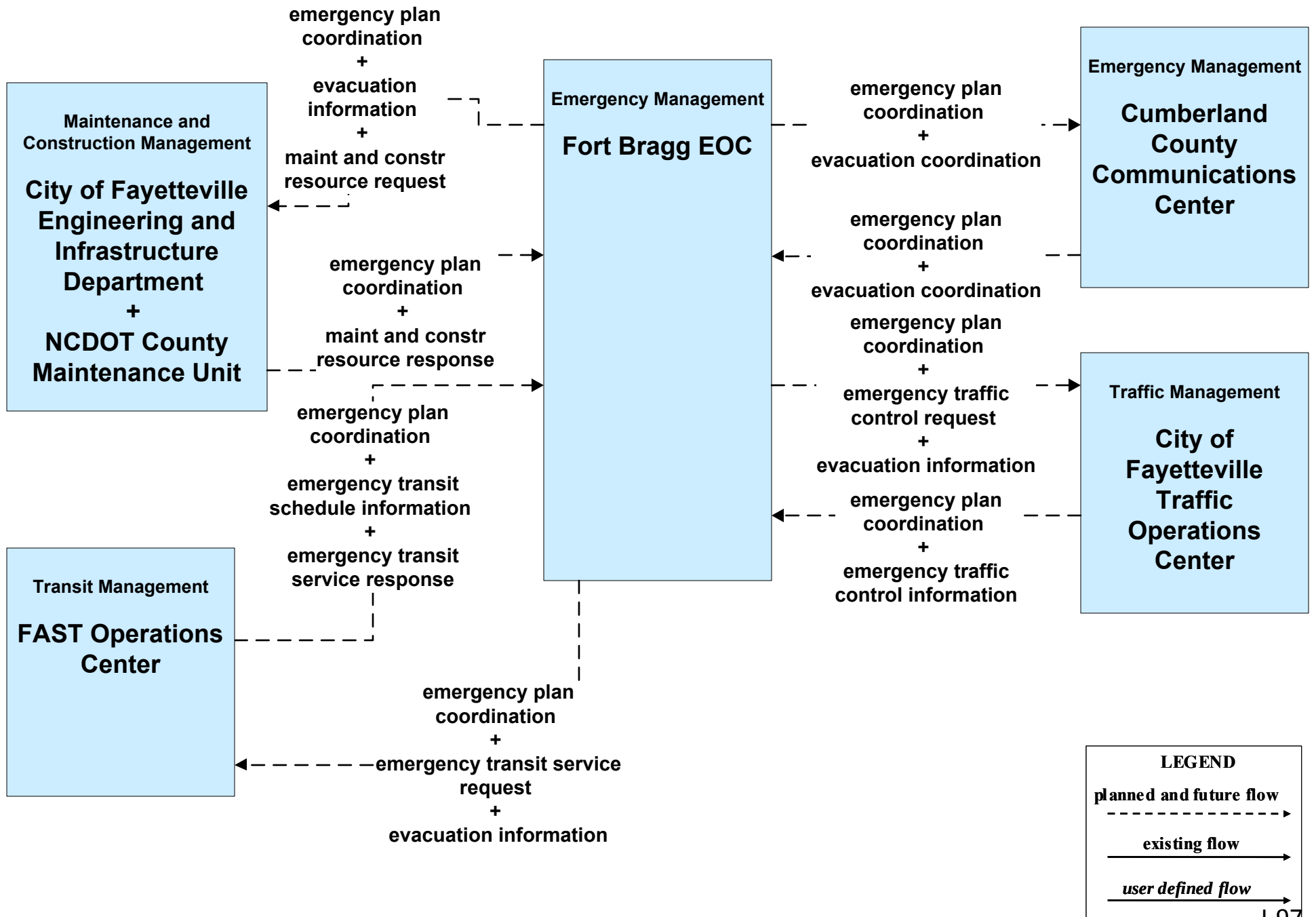
EM09 – Evacuation and Reentry Management Cumberland County EOC



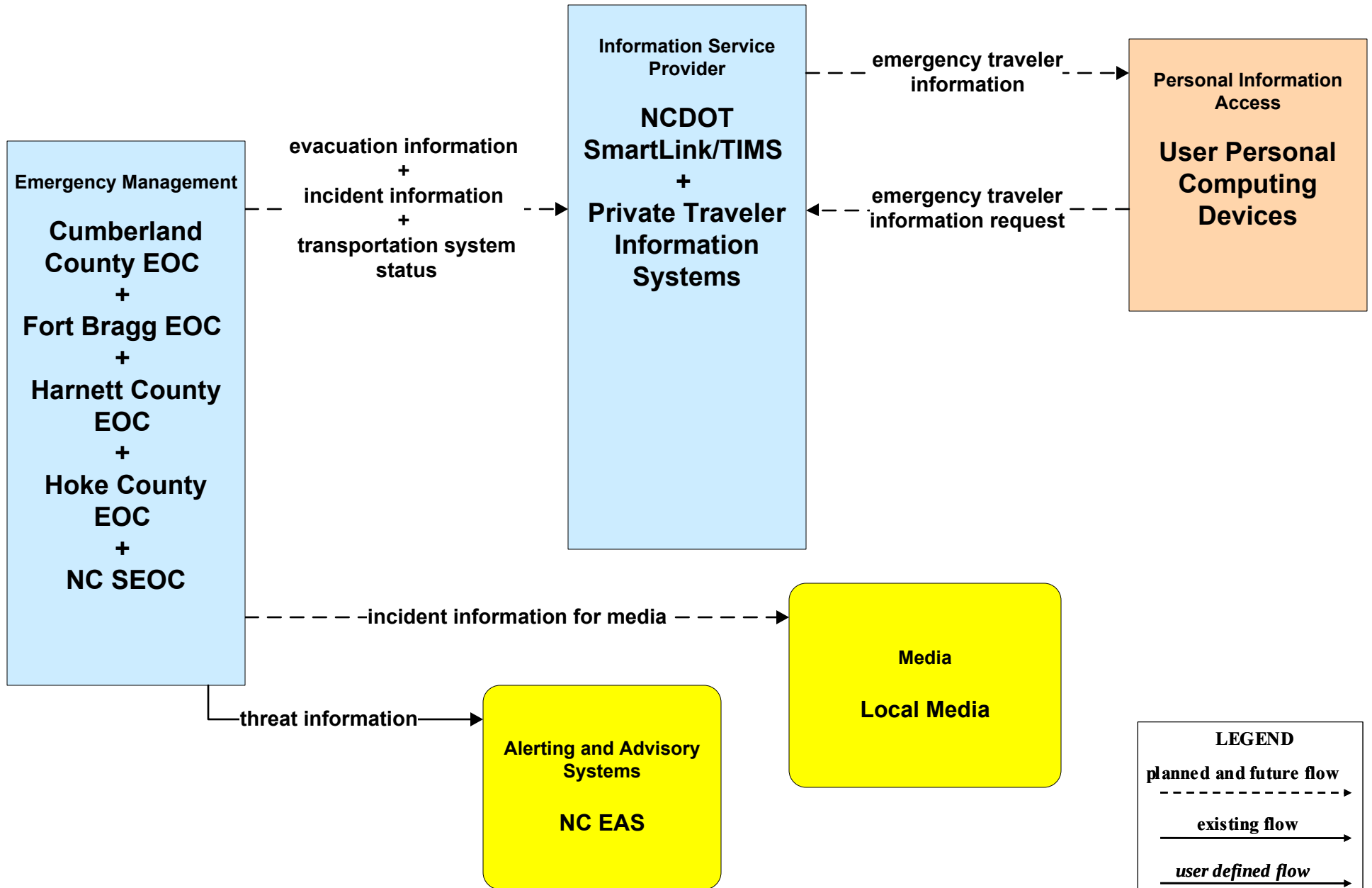
EM09 – Evacuation and Reentry Management Harnett County EOC



EM09 – Evacuation and Reentry Management Fort Bragg EOC



EM10 - Disaster Traveler Information NCDOT SmartLink

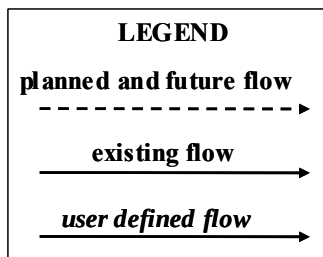
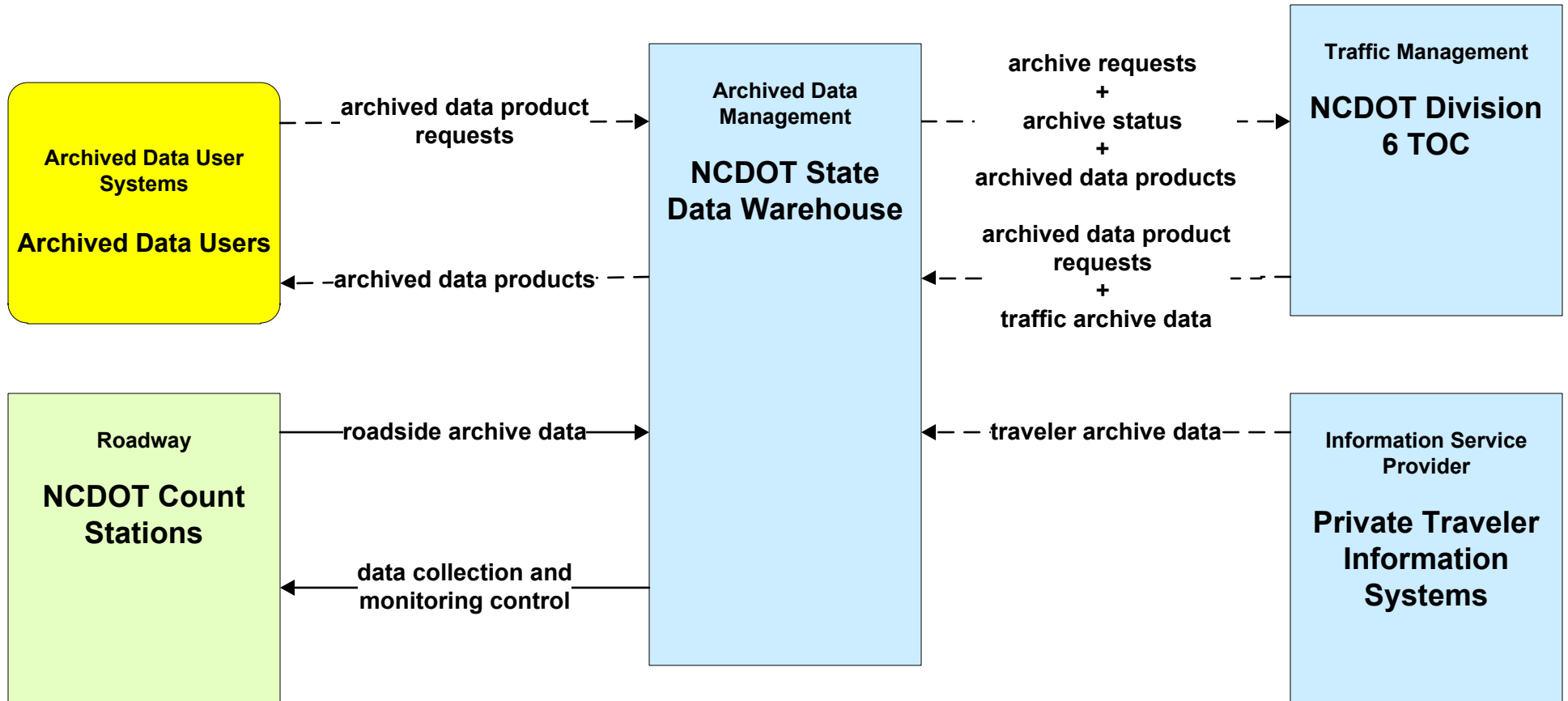


FAMPO Regional ITS Architecture

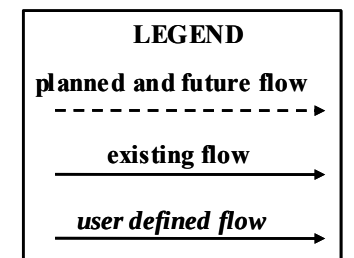
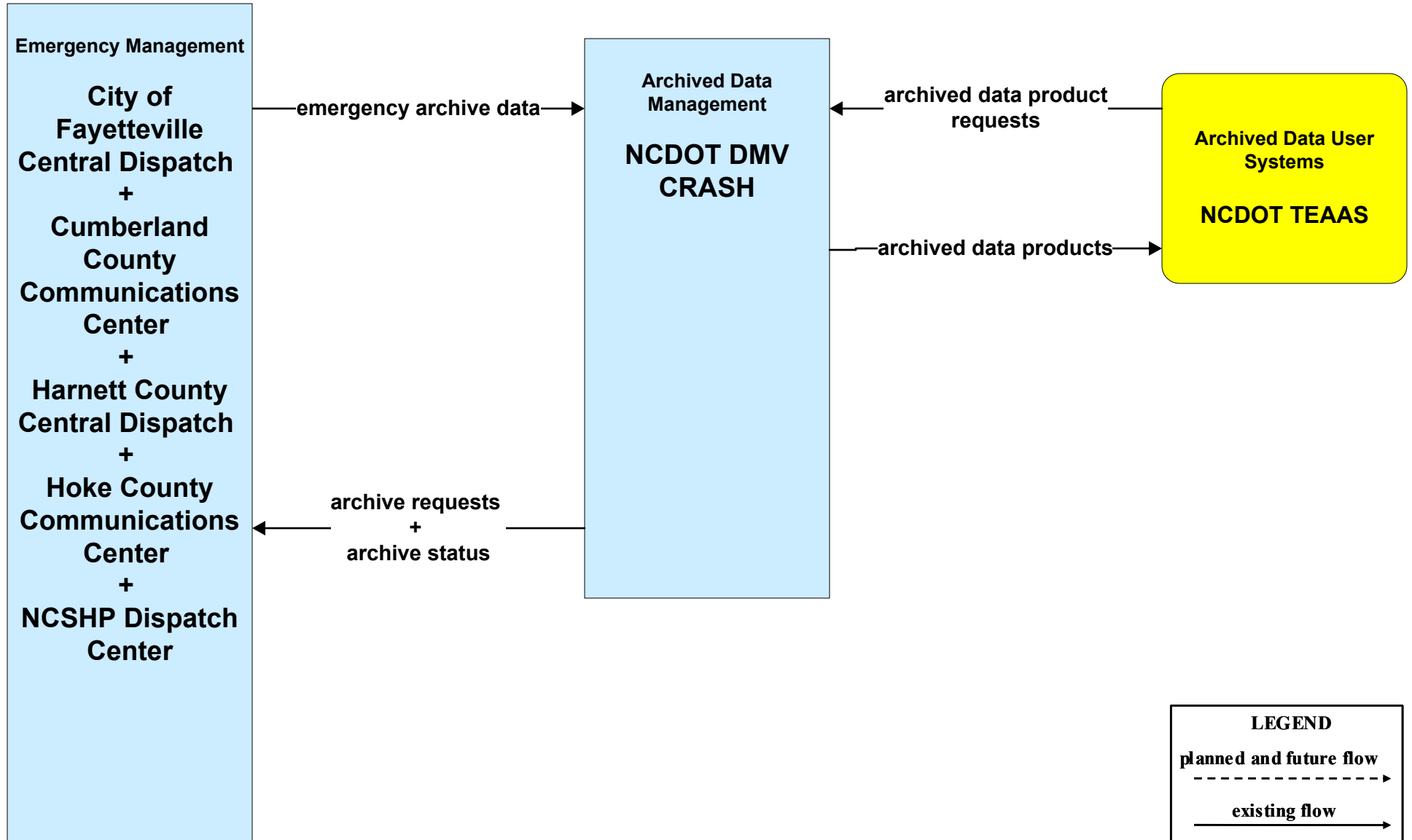
Customized Service Package Diagrams

Archived Data (AD)

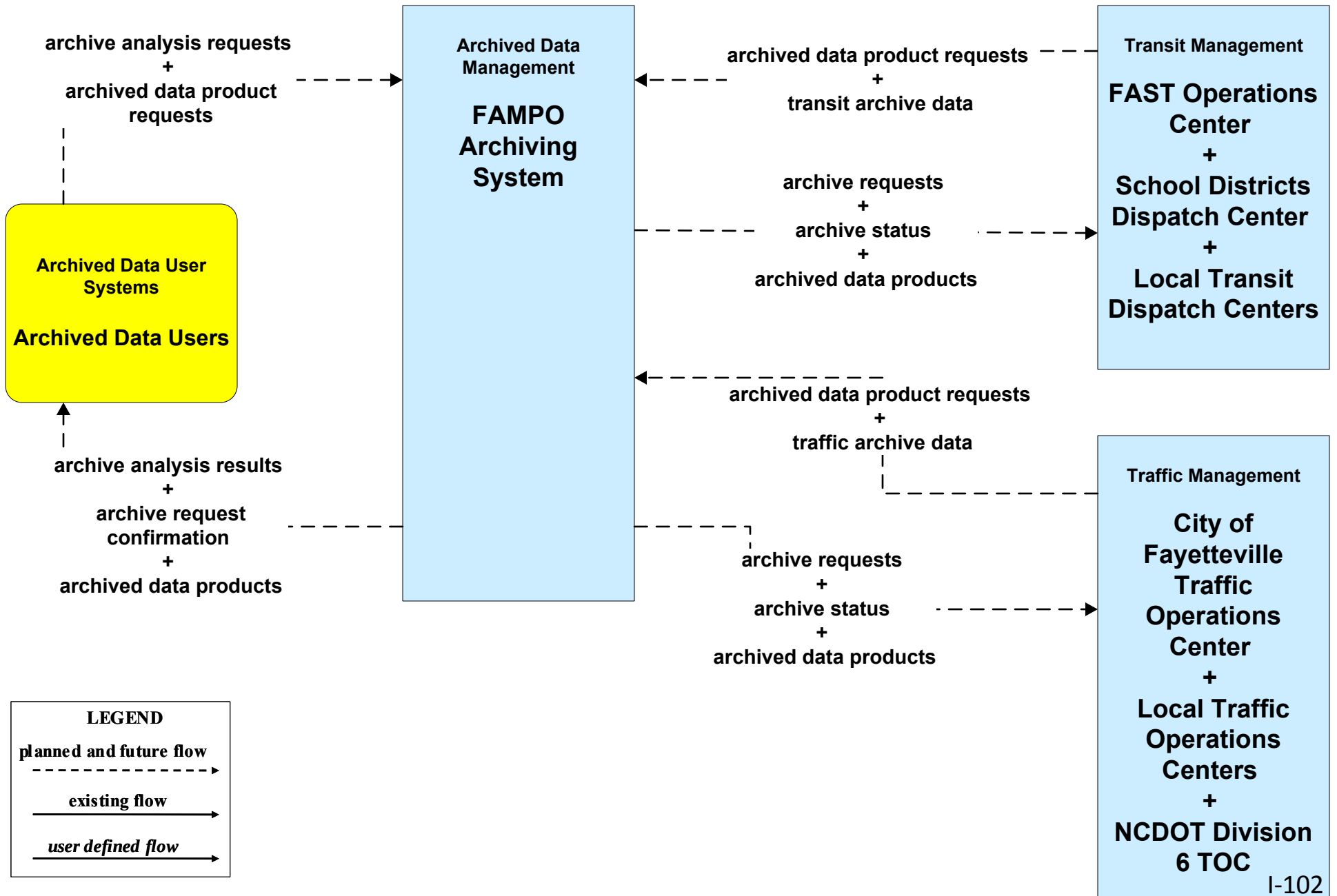
AD1 - ITS Data Mart NCDOT



**AD1 - ITS Data Mart
NCDOT DMV CRS**



AD2 - ITS Data Warehouse FAMPO Archiving System

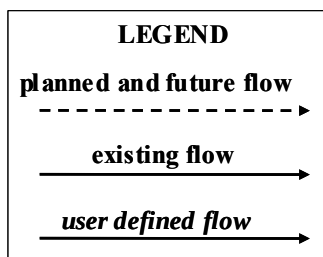
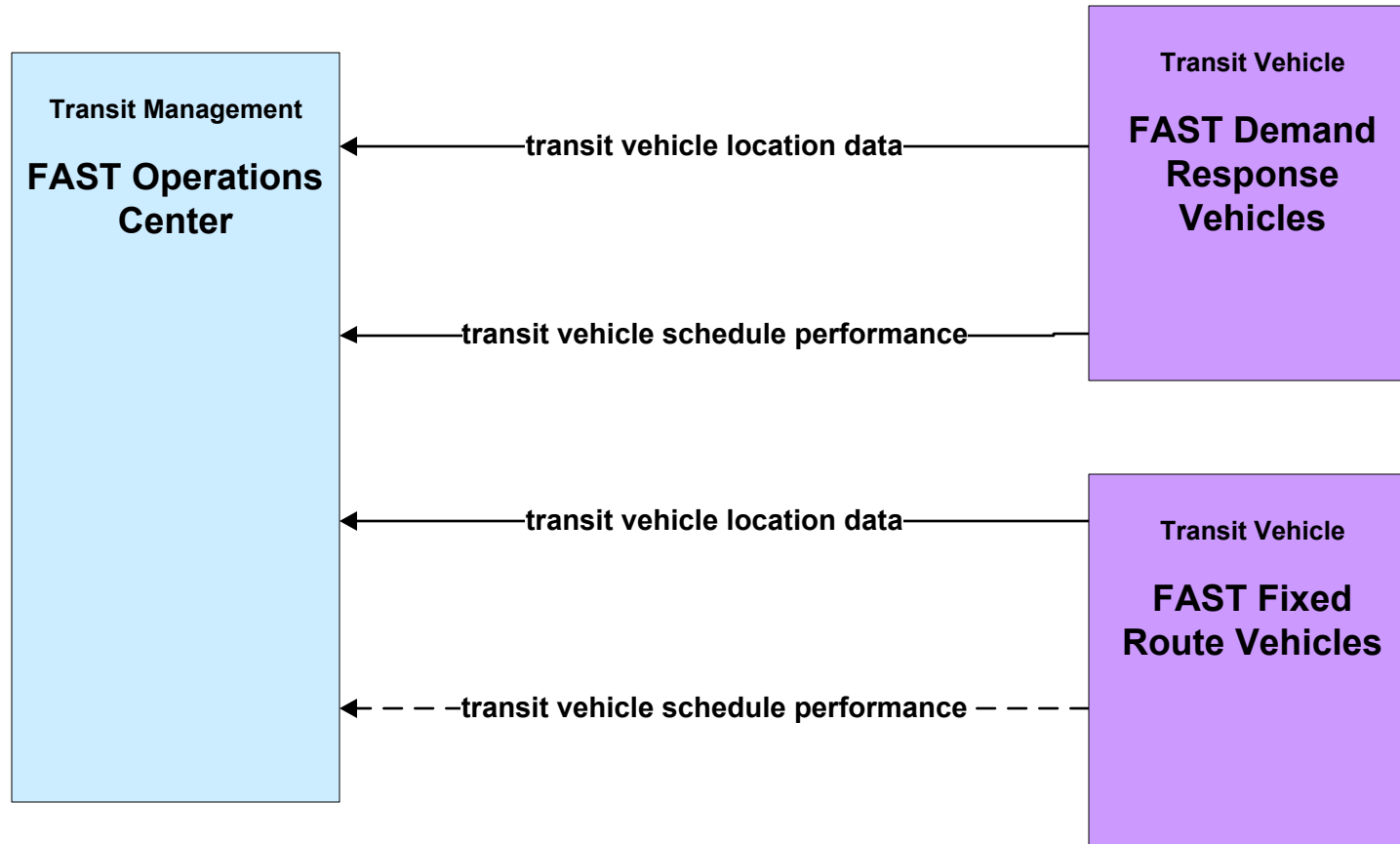


FAMPO Regional ITS Architecture

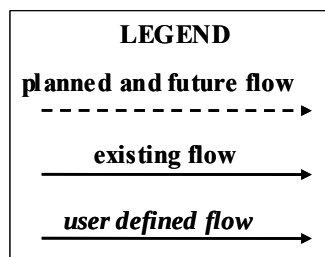
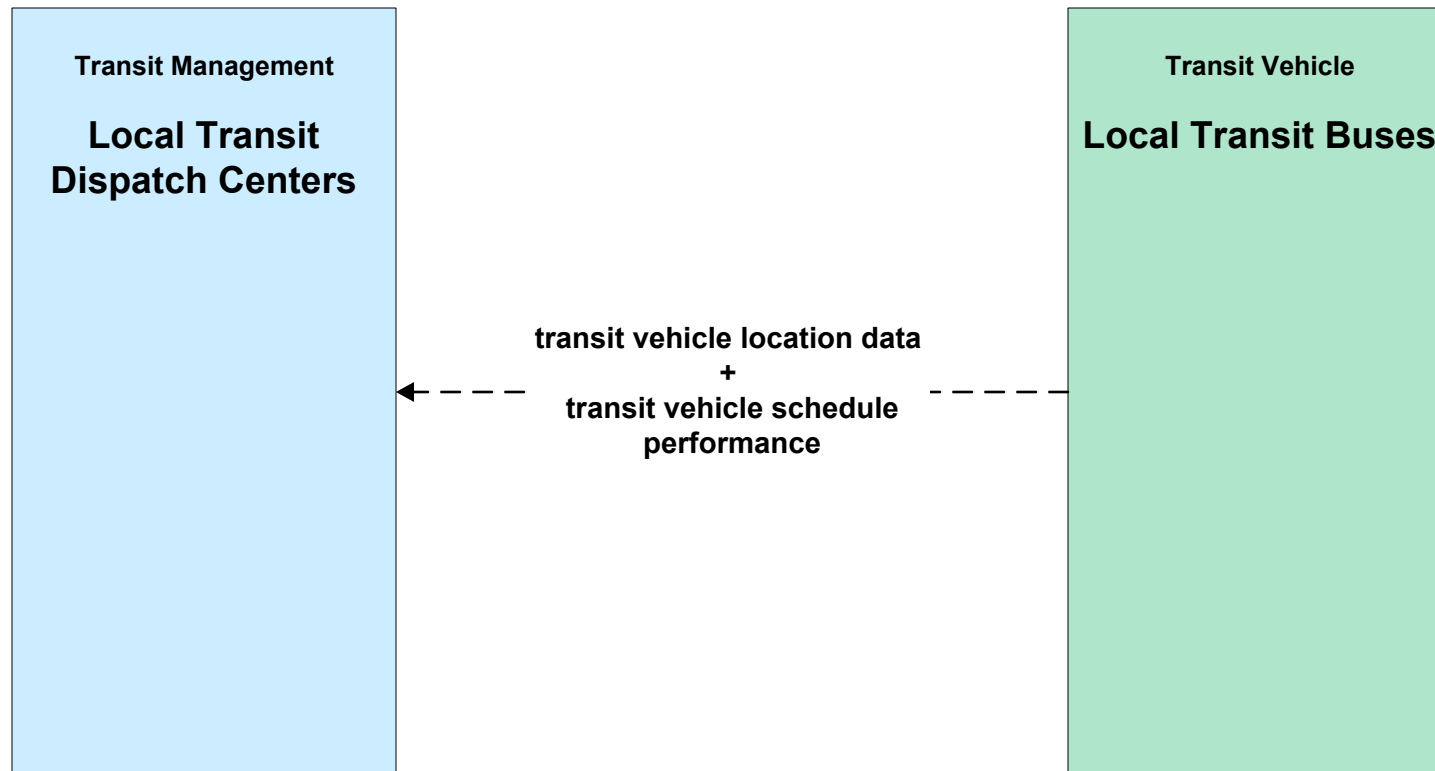
Customized Service Package Diagrams

**Advanced Public Transportation Systems
(APTS)**

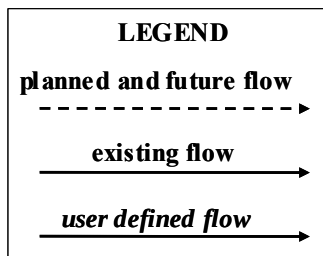
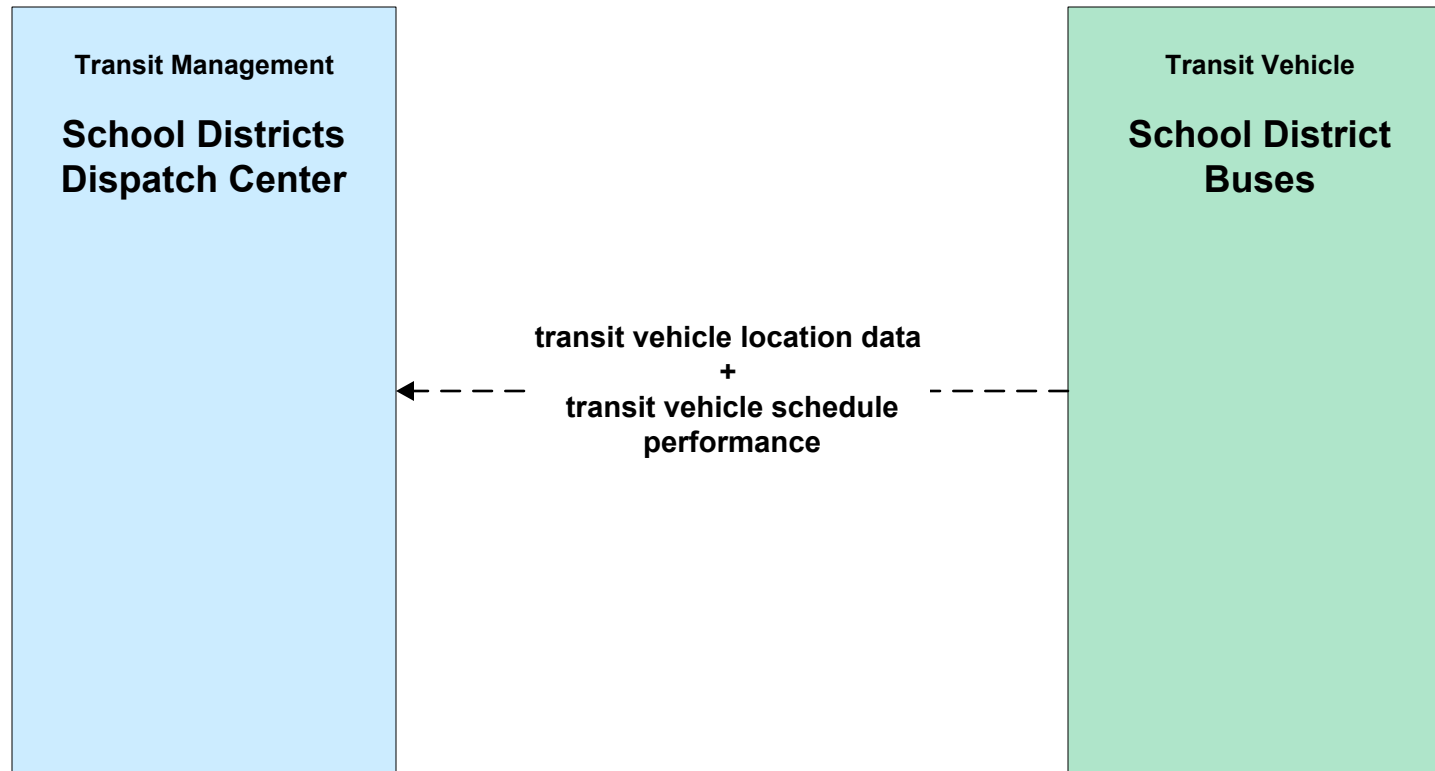
APTS01 - Transit Vehicle Tracking FAST



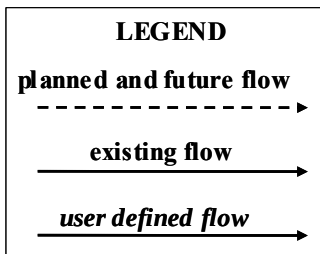
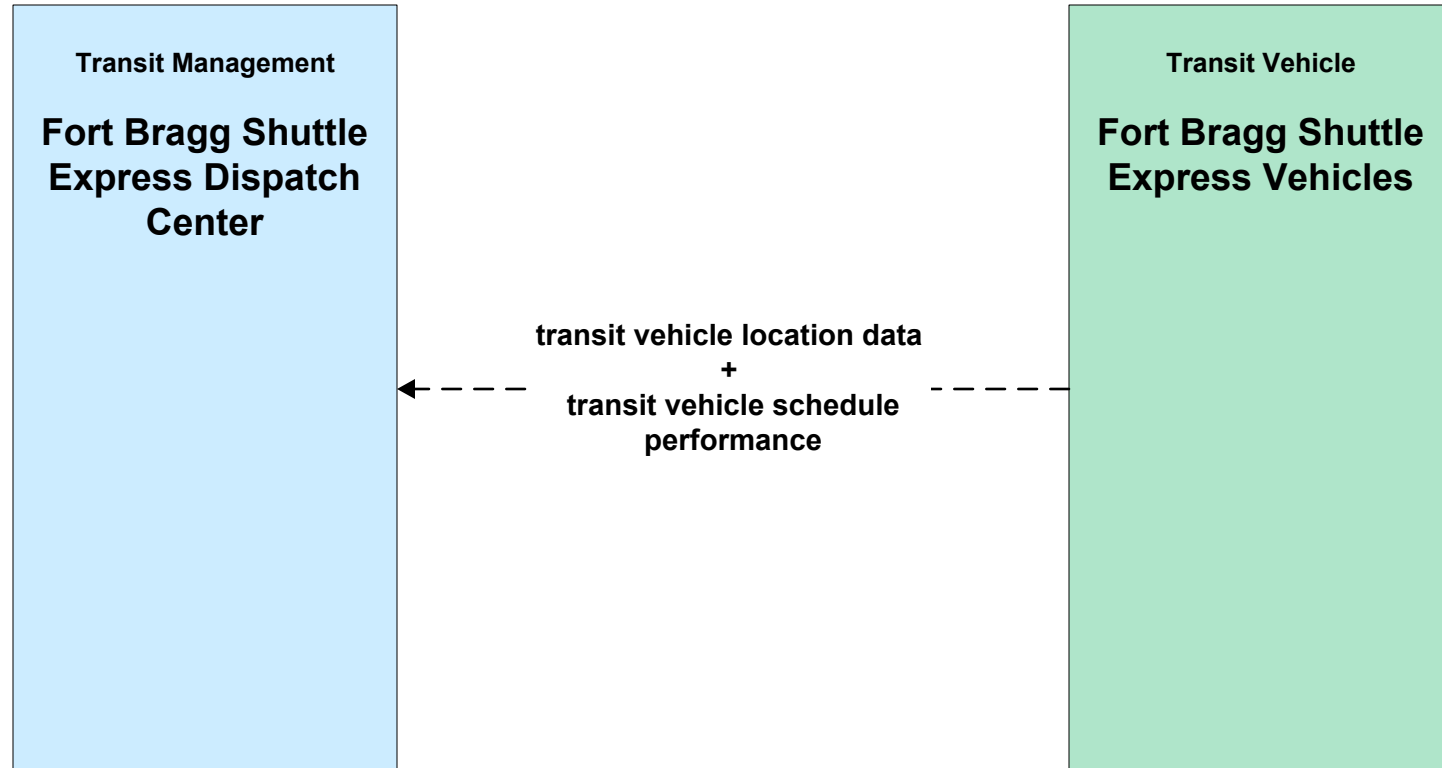
APTS01 - Transit Vehicle Tracking Local Transit Systems



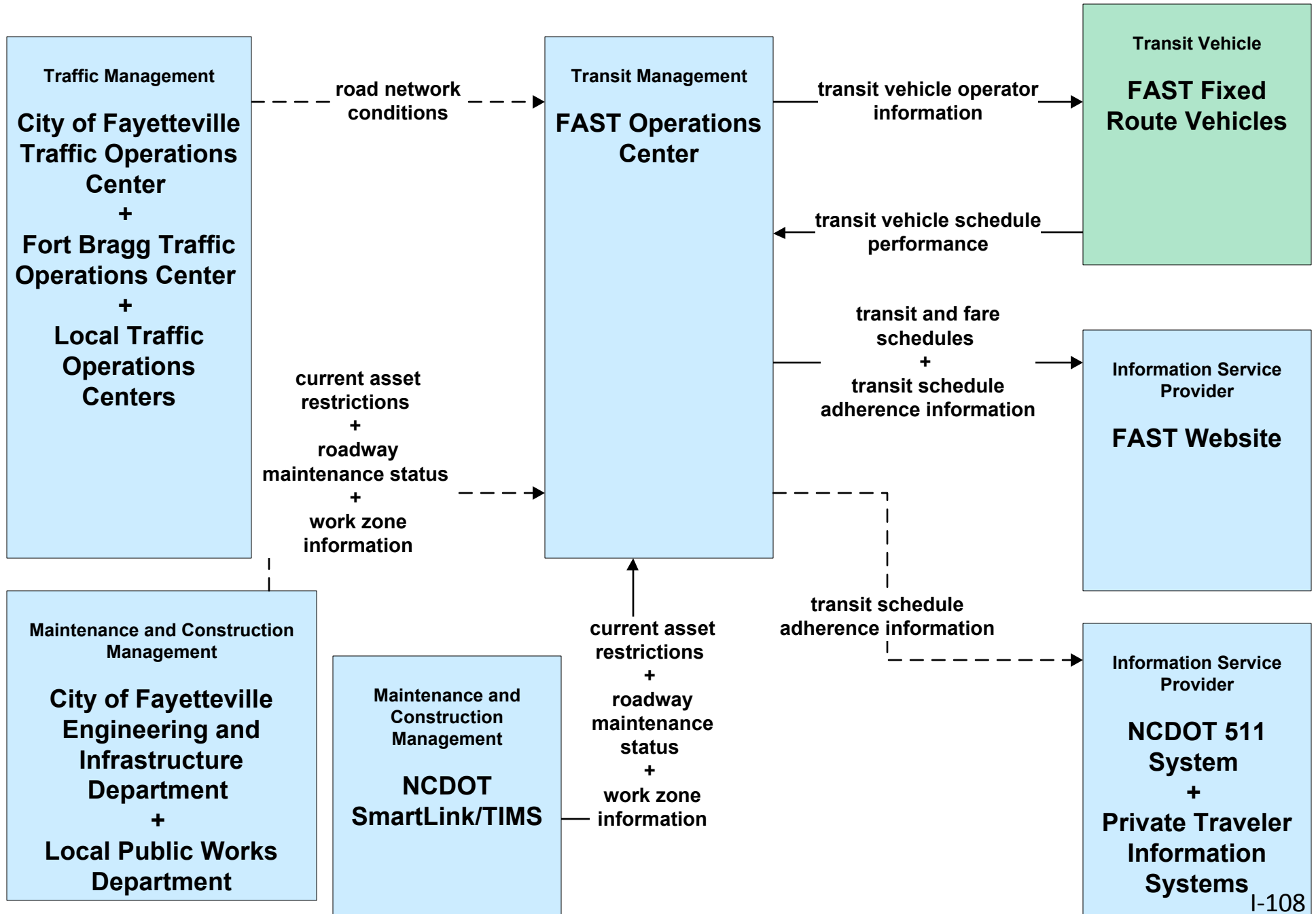
APTS01 - Transit Vehicle Tracking Independent School Districts



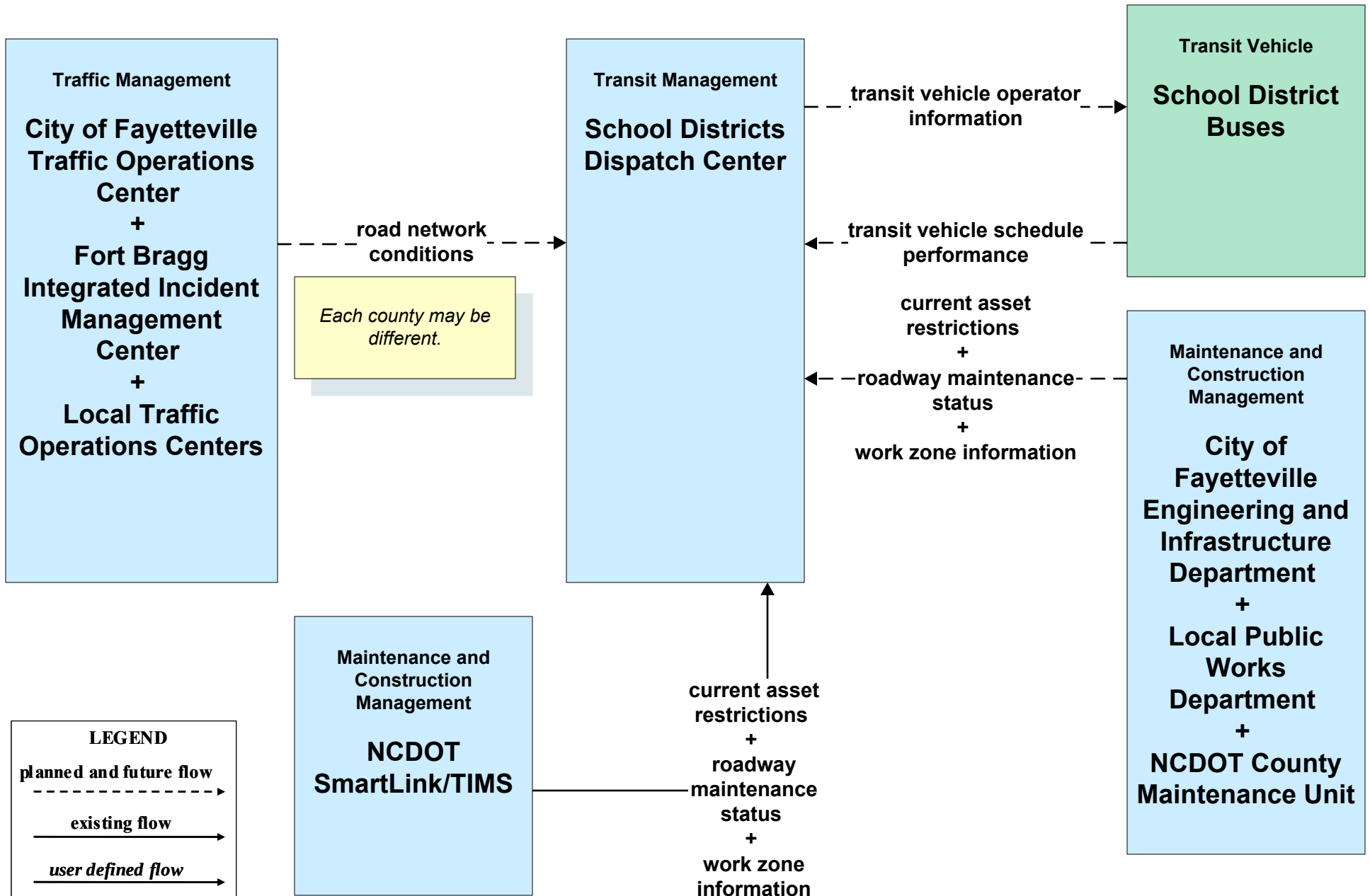
APTS01 - Transit Vehicle Tracking Fort Bragg Shuttle Express



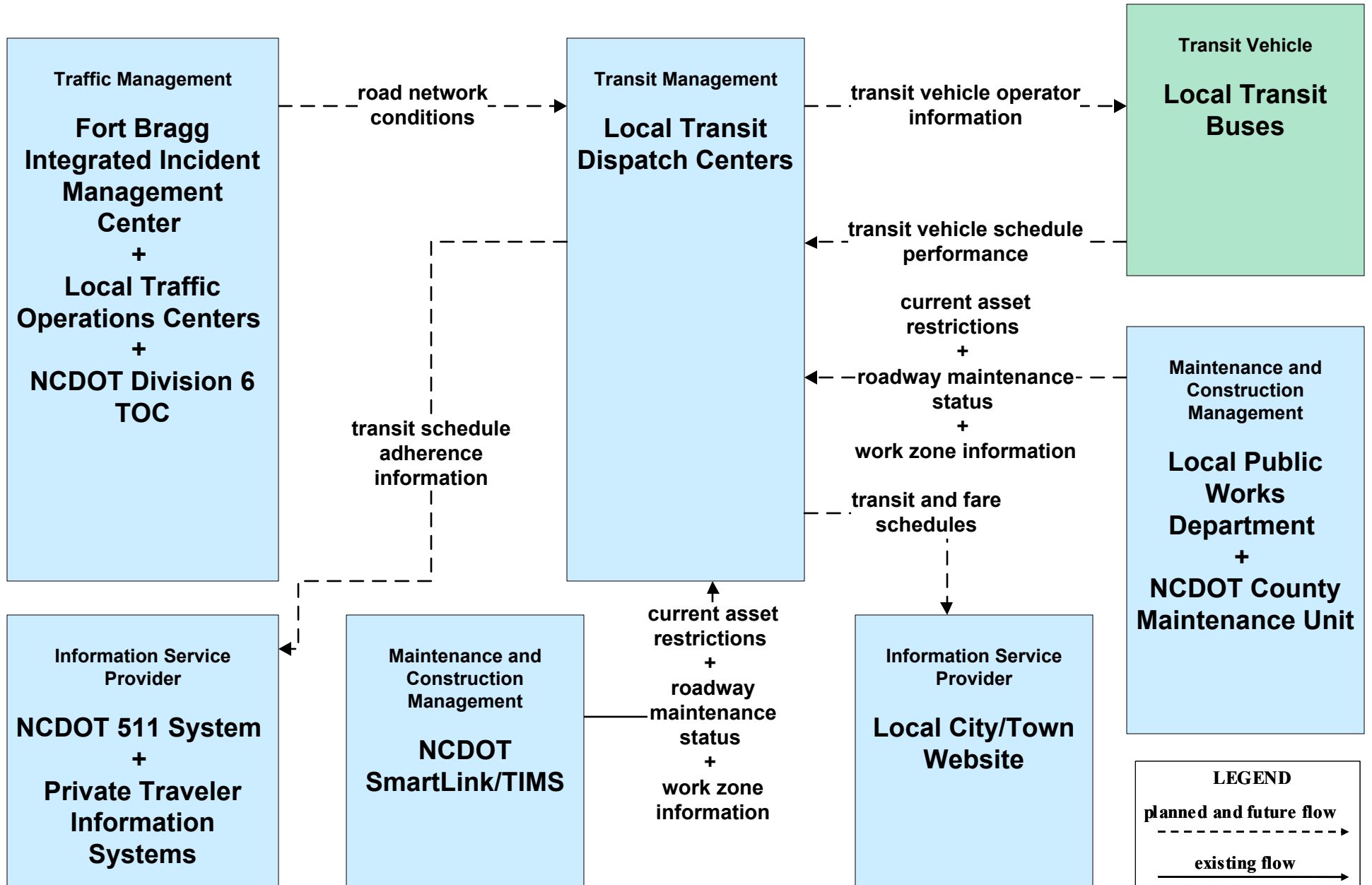
APTS02 - Transit Fixed-Route Operations FAST



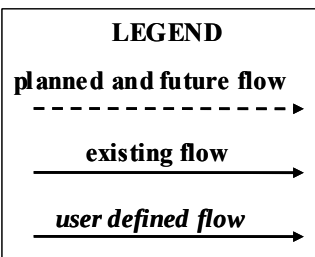
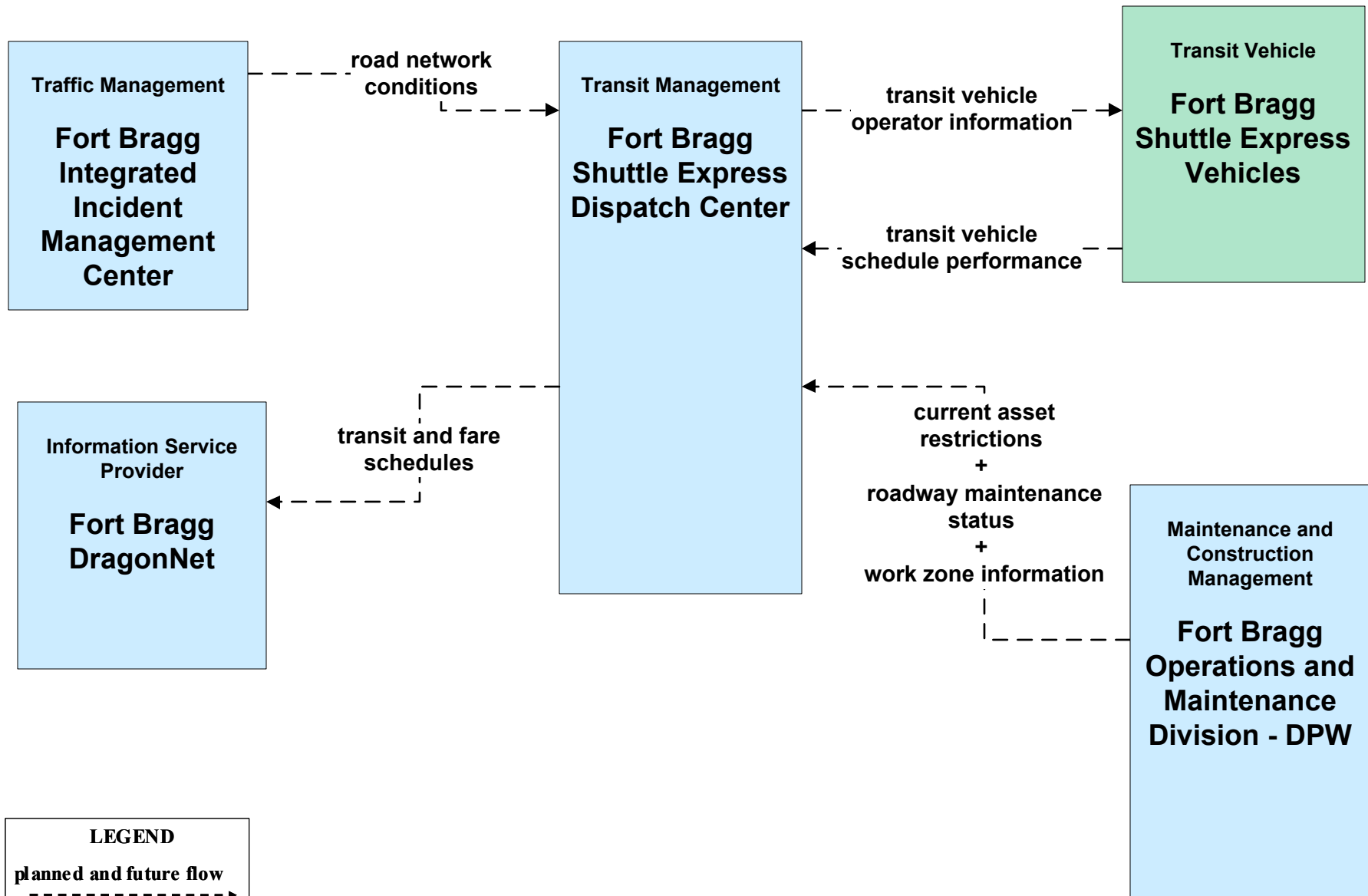
APTS02 - Transit Fixed-Route Operations Independent School Districts



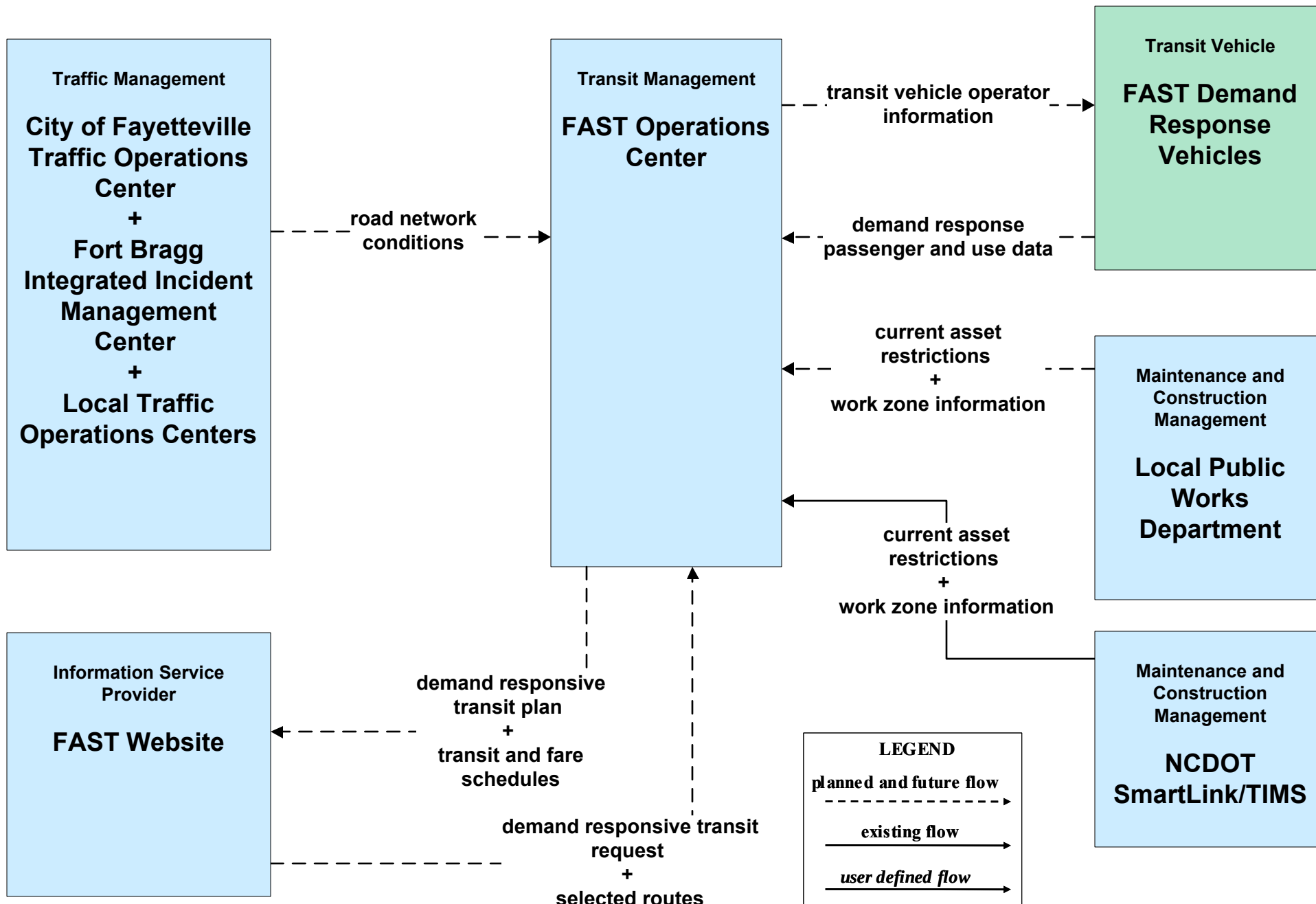
APTS02 - Transit Fixed-Route Operations Local Transit Systems



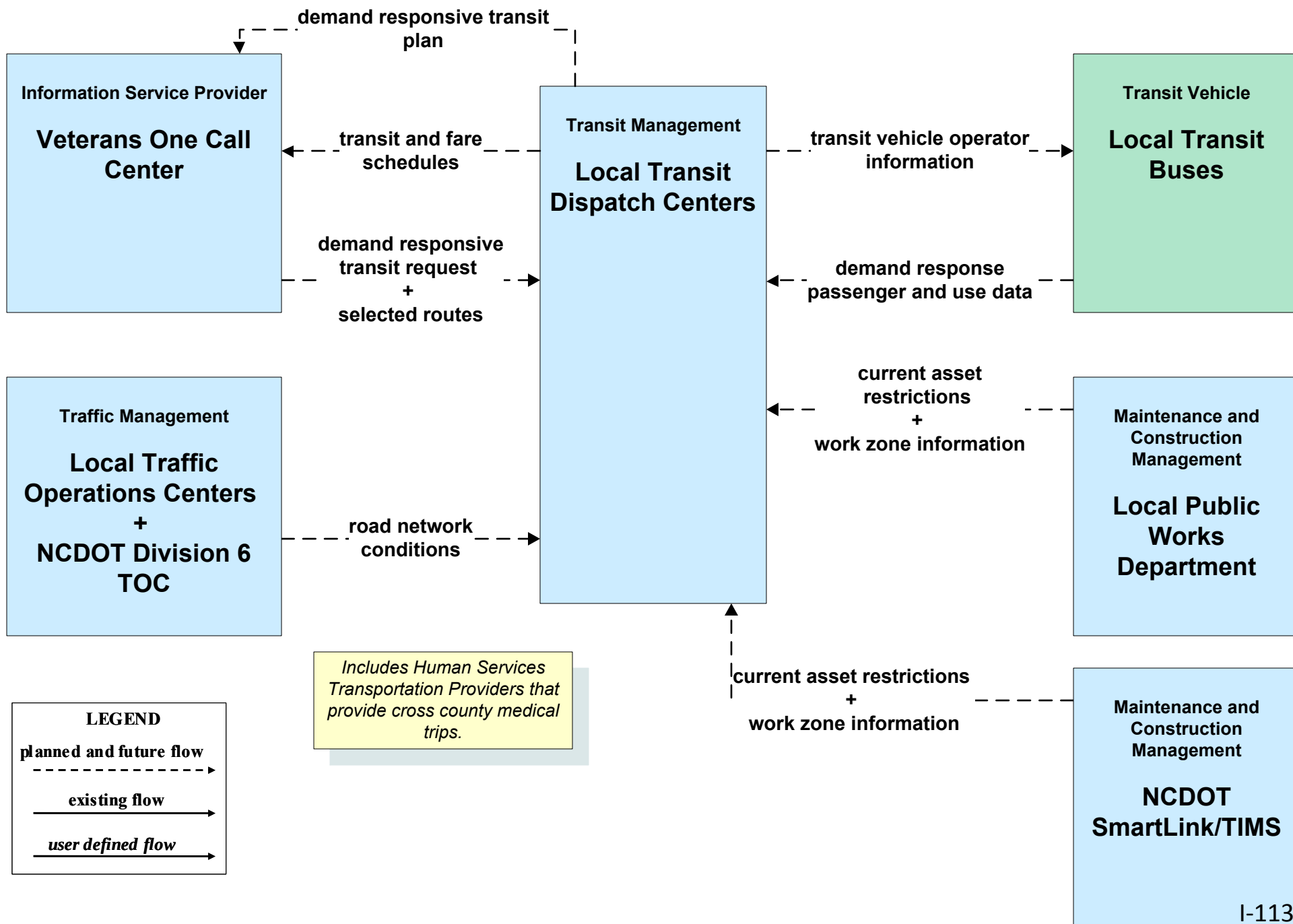
APTS02 - Transit Fixed-Route Operations Fort Bragg Shuttle Express



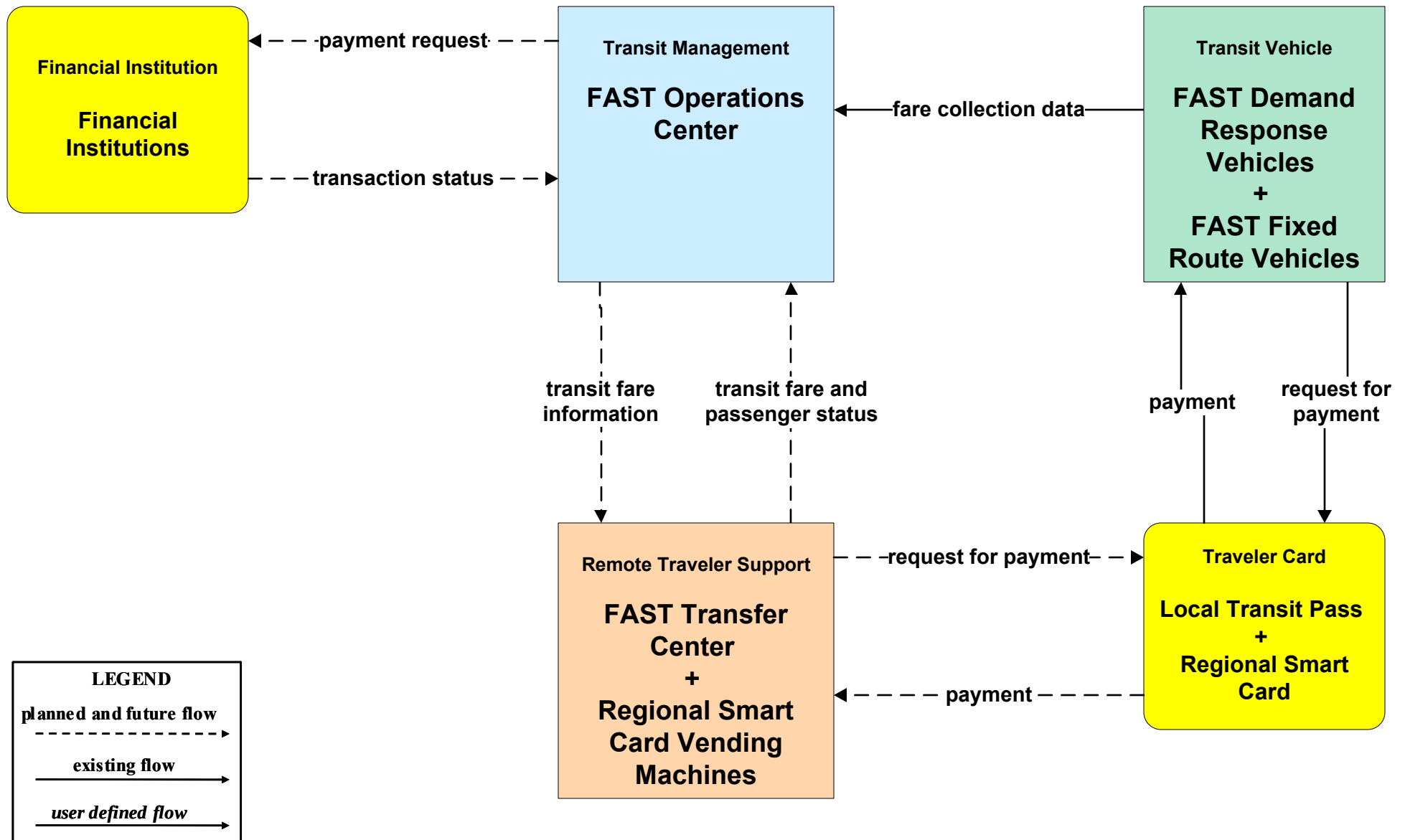
APTS03 - Demand Response FAST



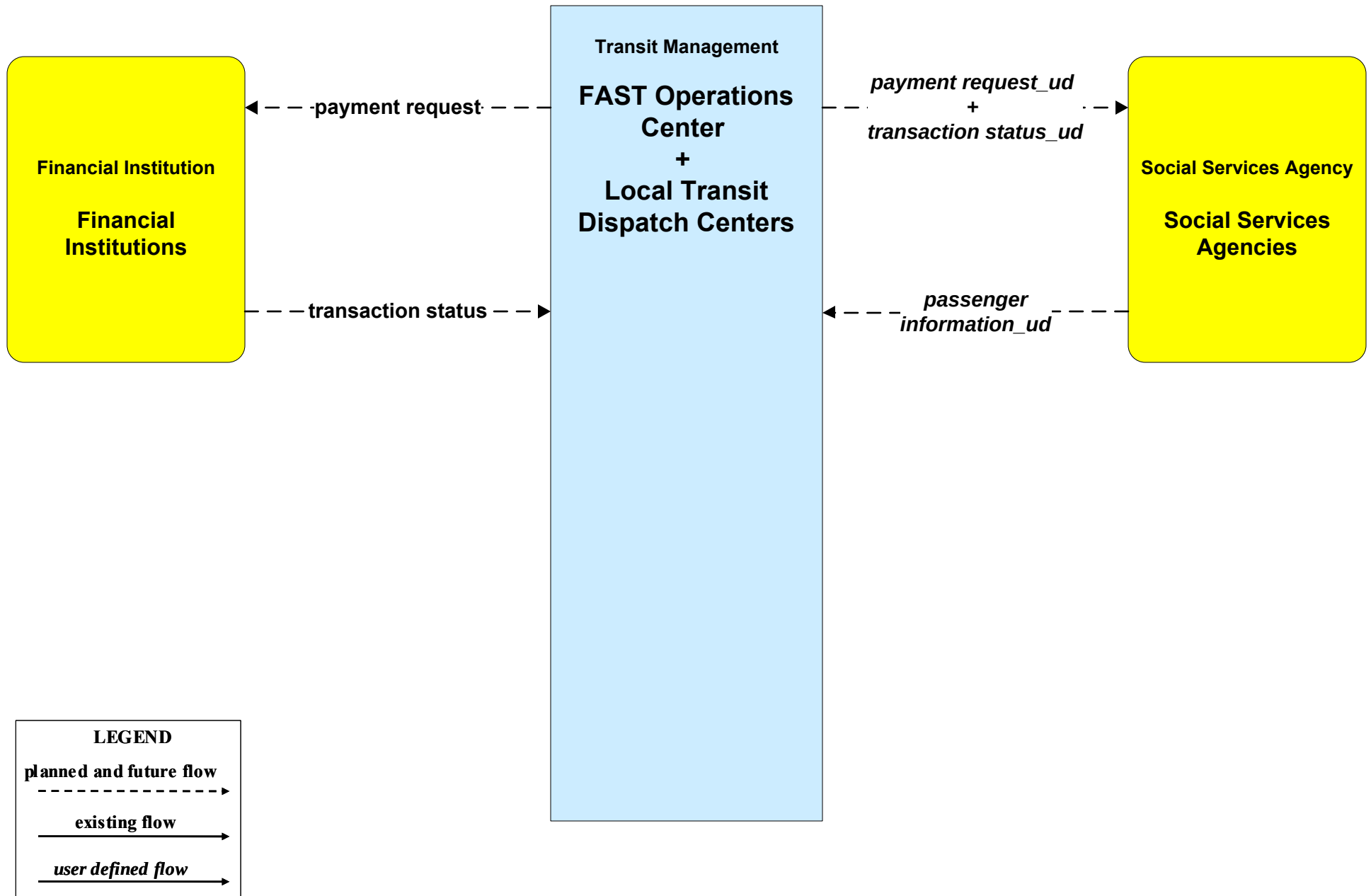
APTS03 - Demand Response Local Transit Systems



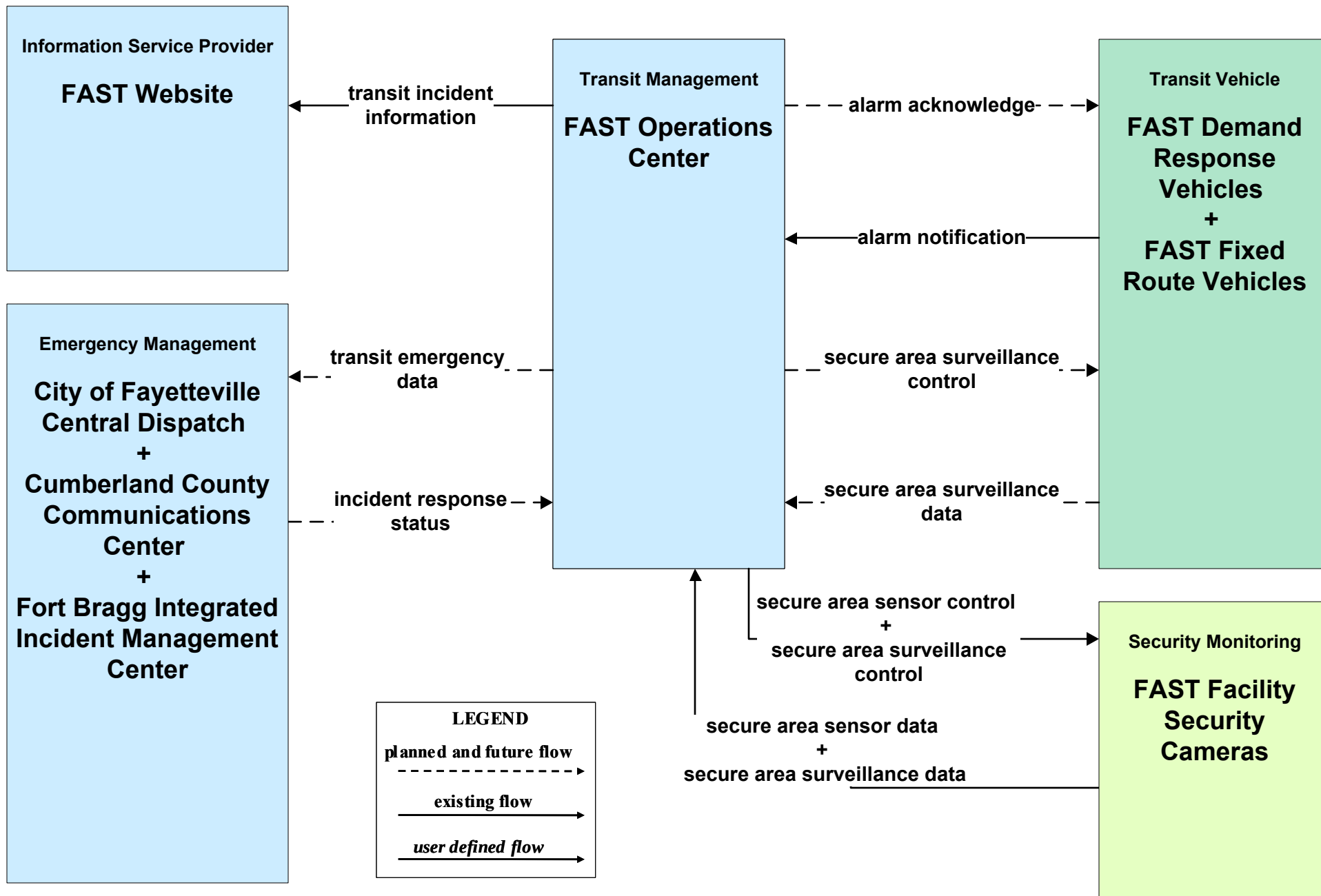
APTS04 - Transit Passenger and Fare Management FAST



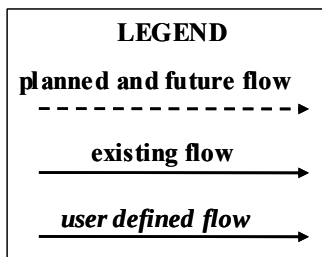
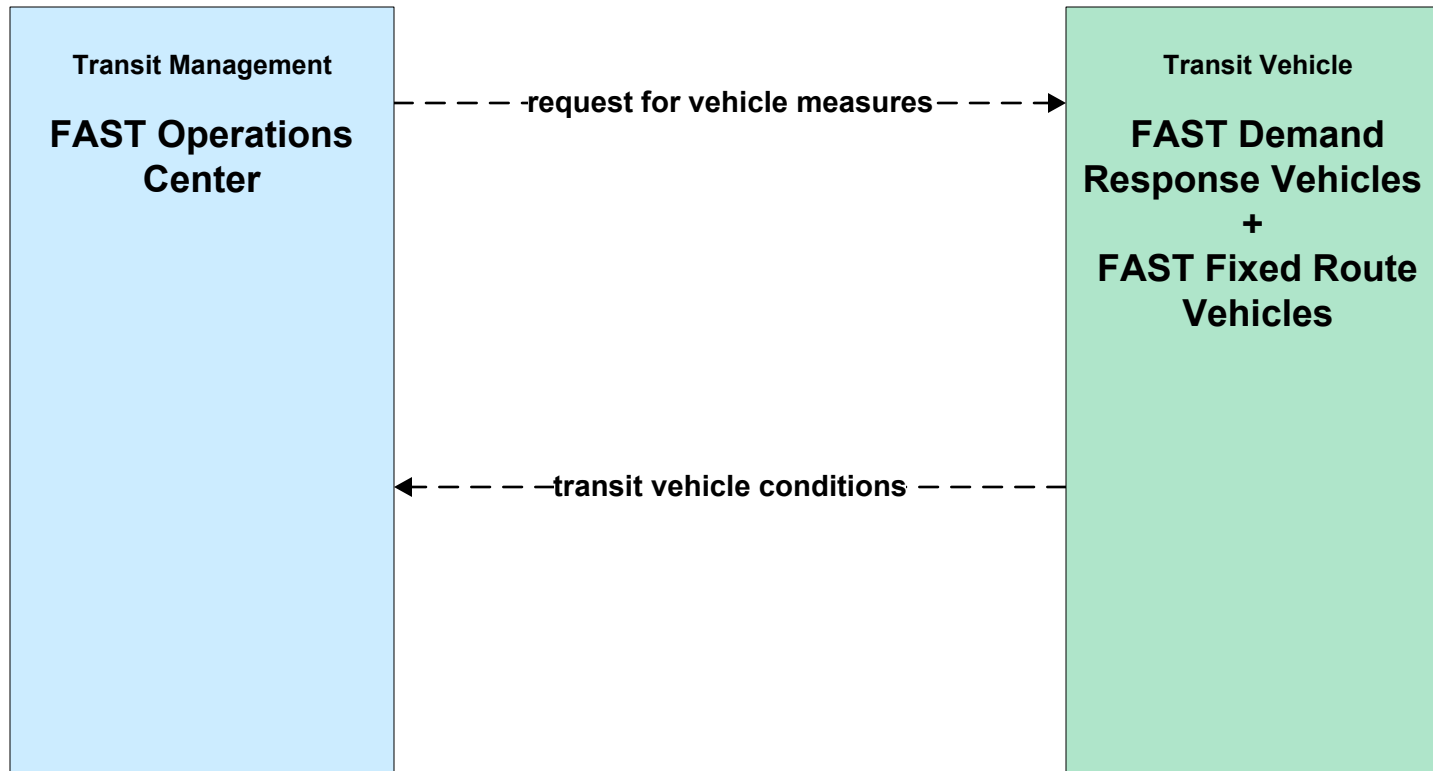
APTS04 - Transit Passenger and Fare Management Demand Responsive and Paratransit Agencies



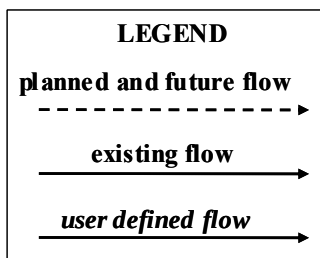
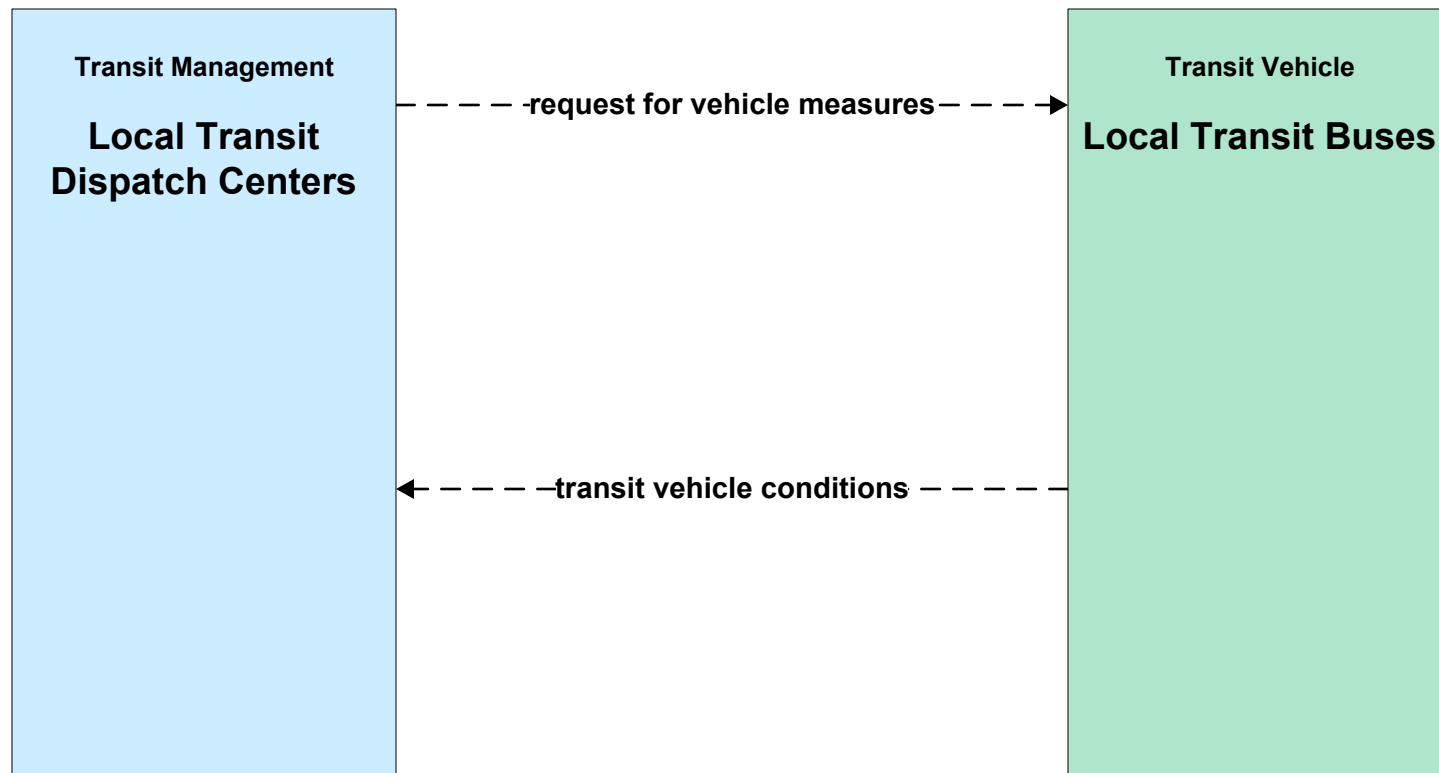
APTS05 - Transit Security FAST



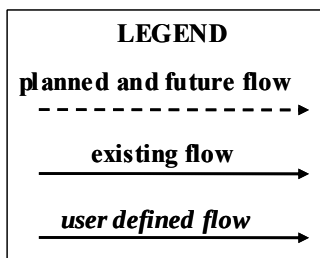
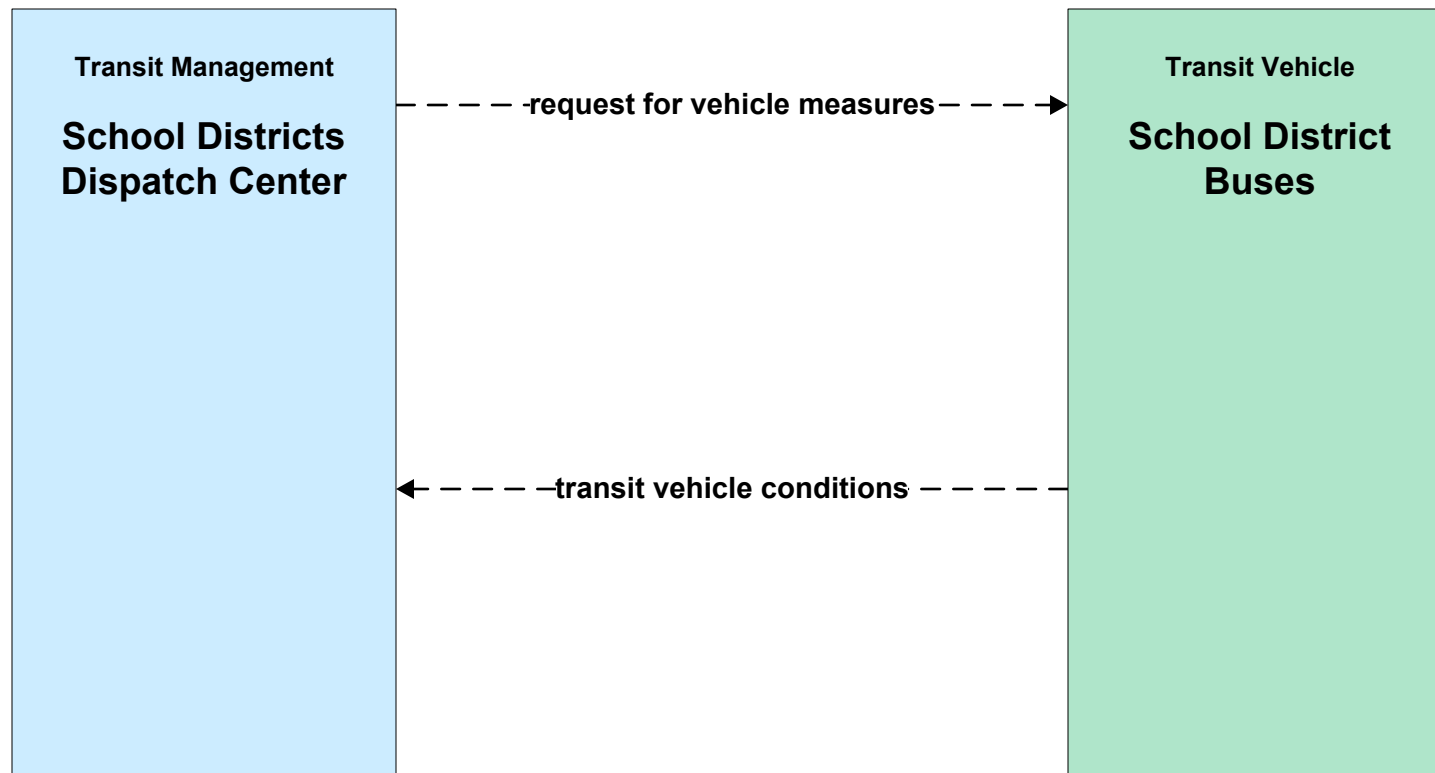
APTS06 - Transit Maintenance FAST



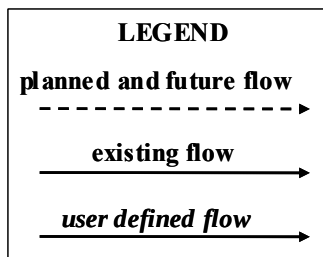
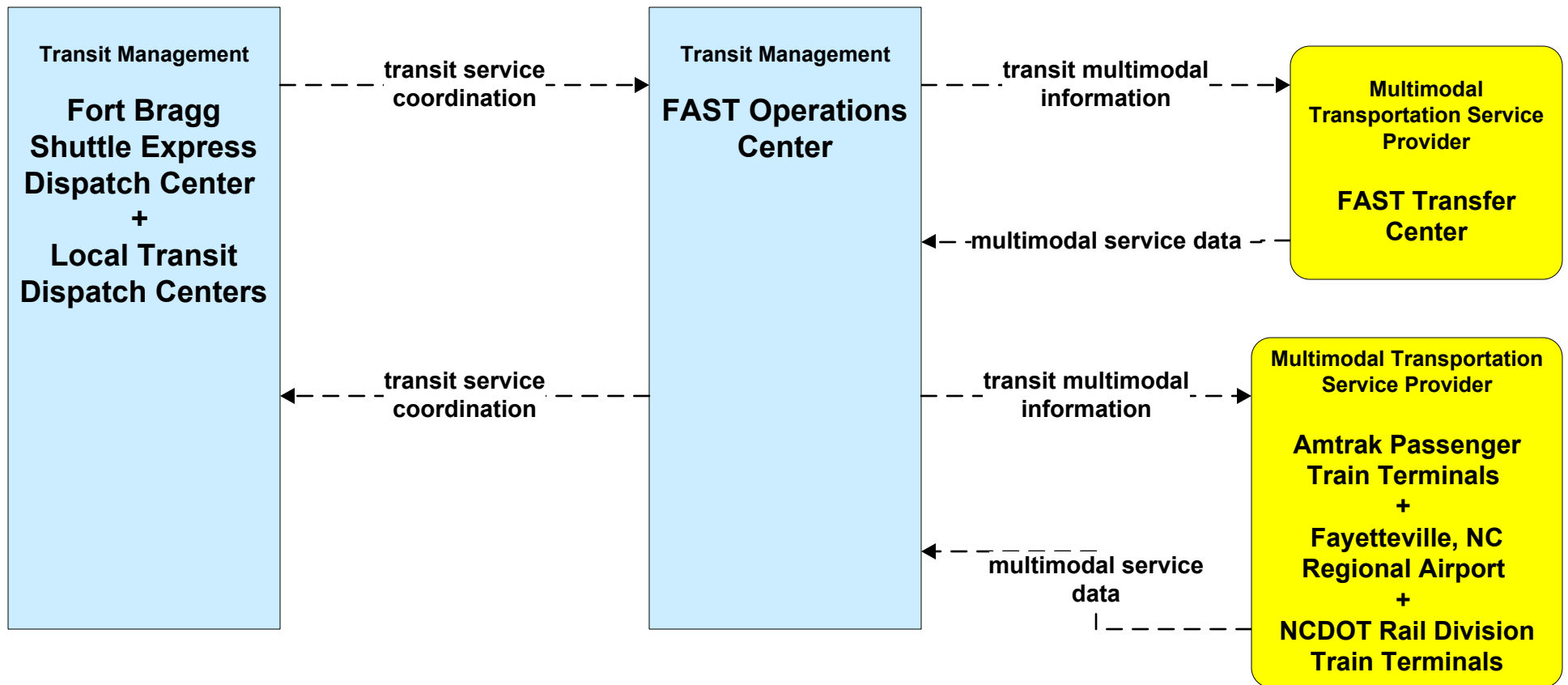
APTS06 - Transit Maintenance Local Transit Systems



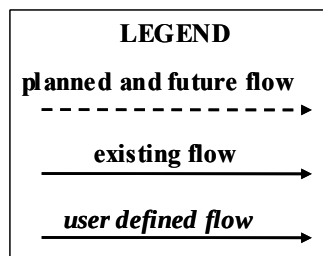
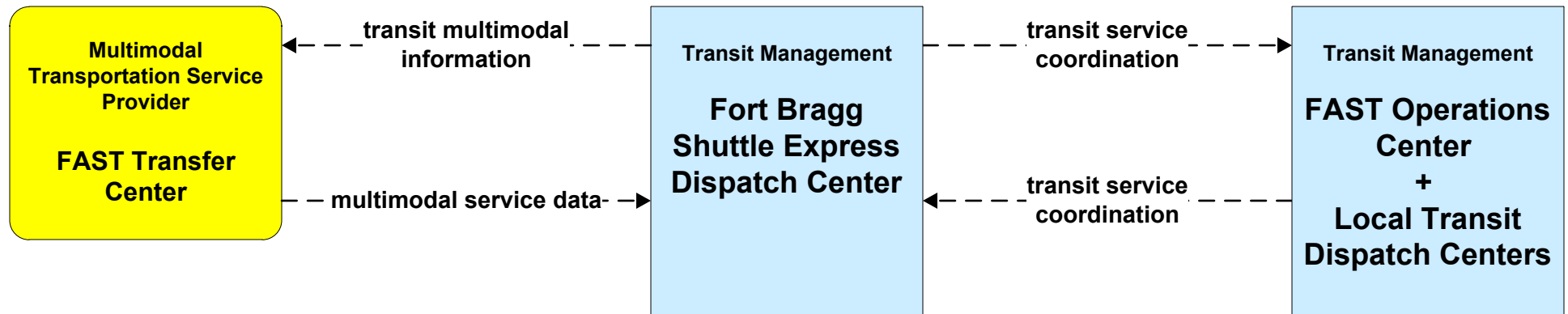
APTS06 - Transit Maintenance Independent School Districts



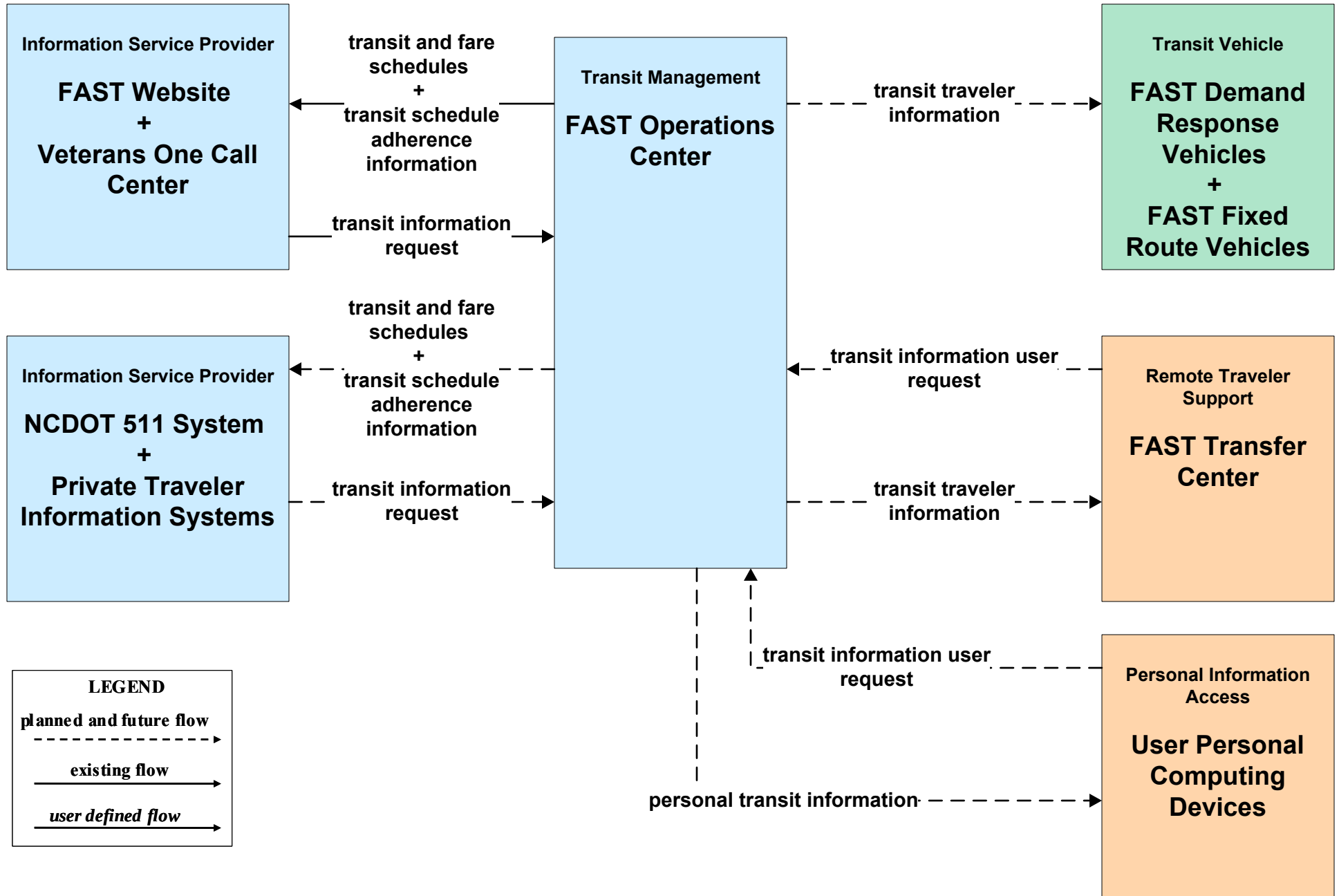
APTS07 - Multi-modal Coordination FAST



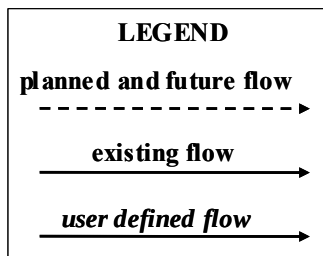
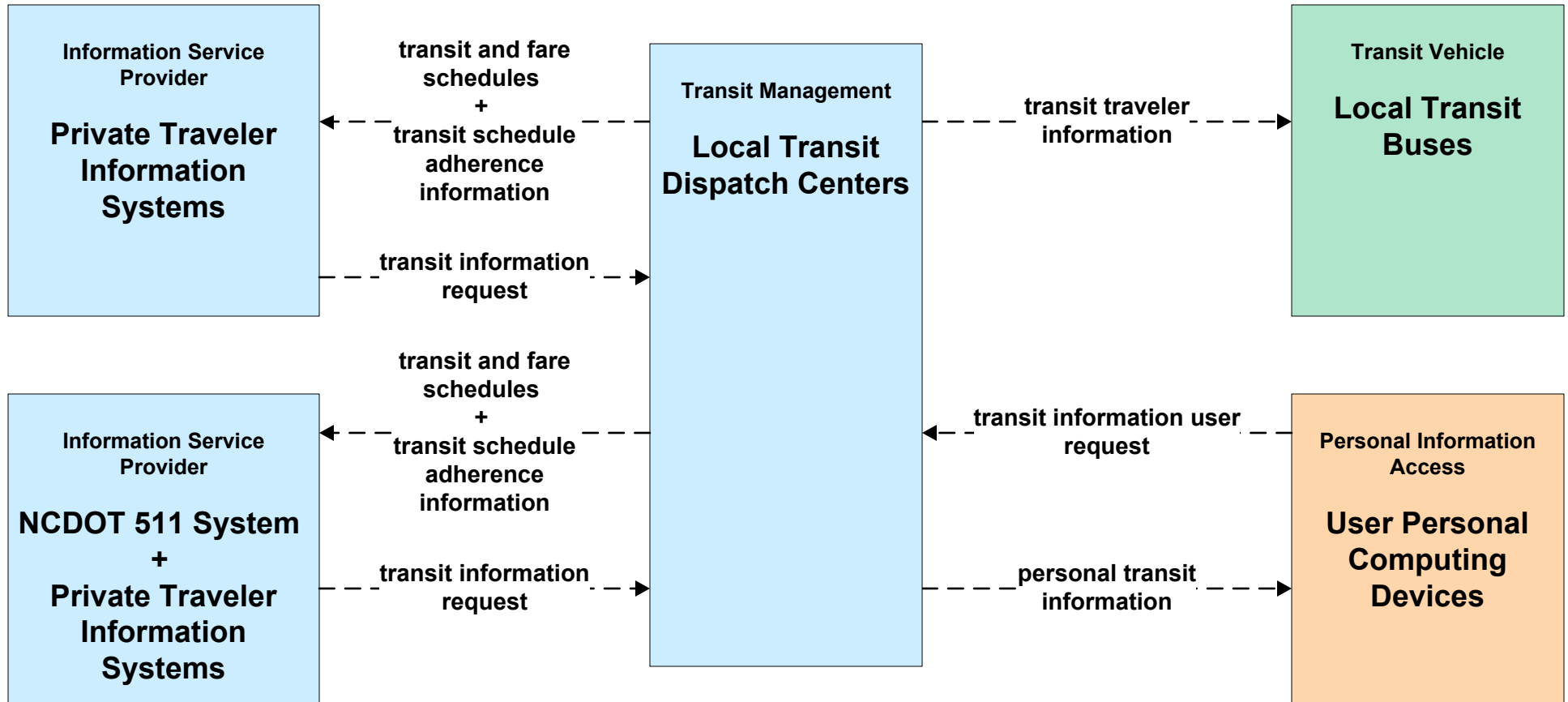
APTS07 - Multimodal Coordination Fort Bragg Shuttle Express



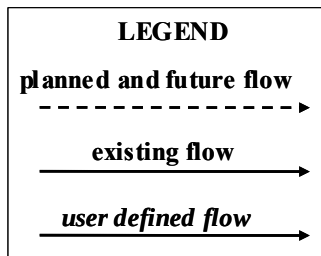
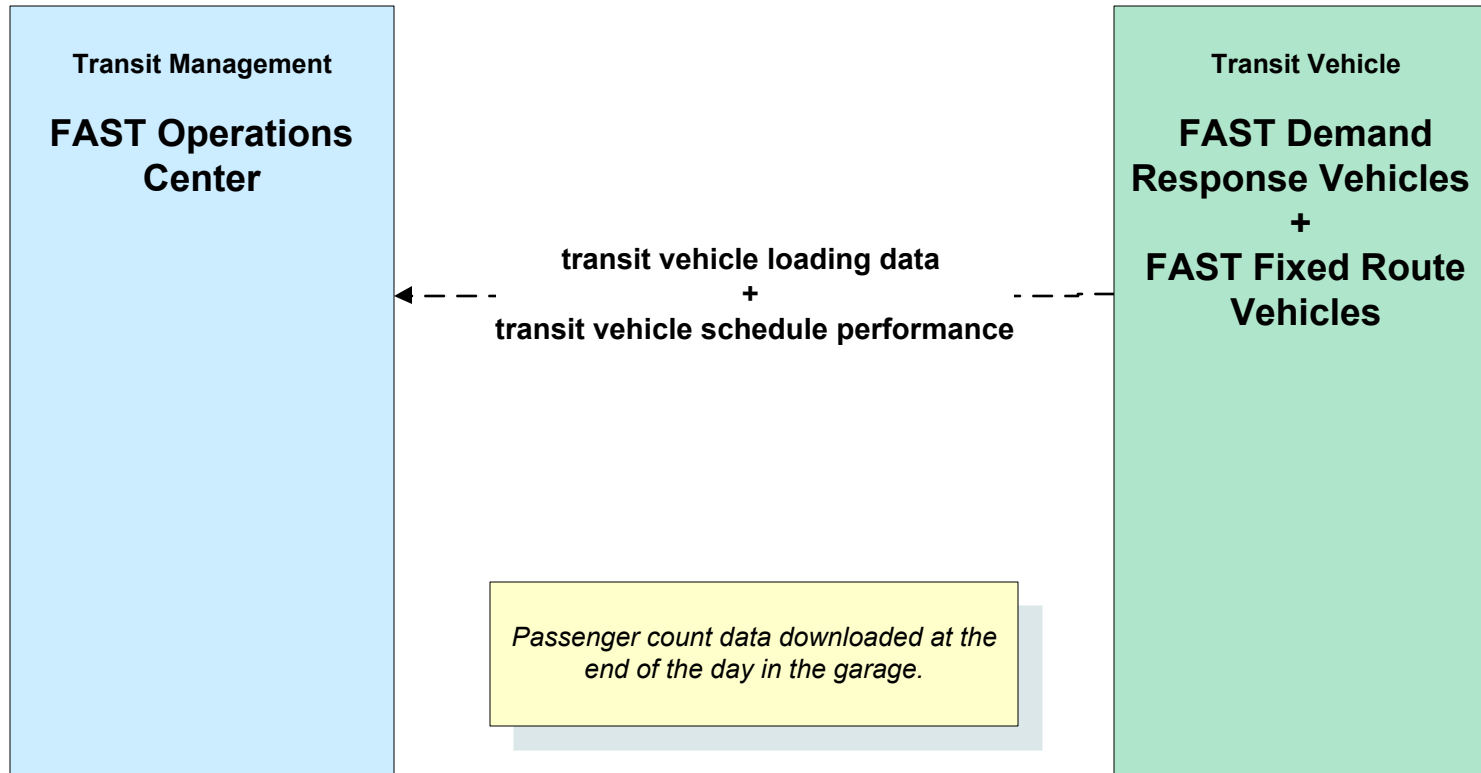
APTS08 - Transit Traveler Information FAST



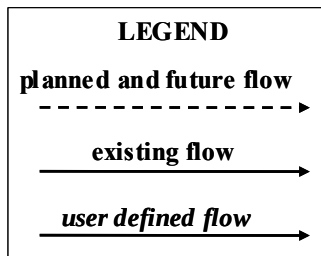
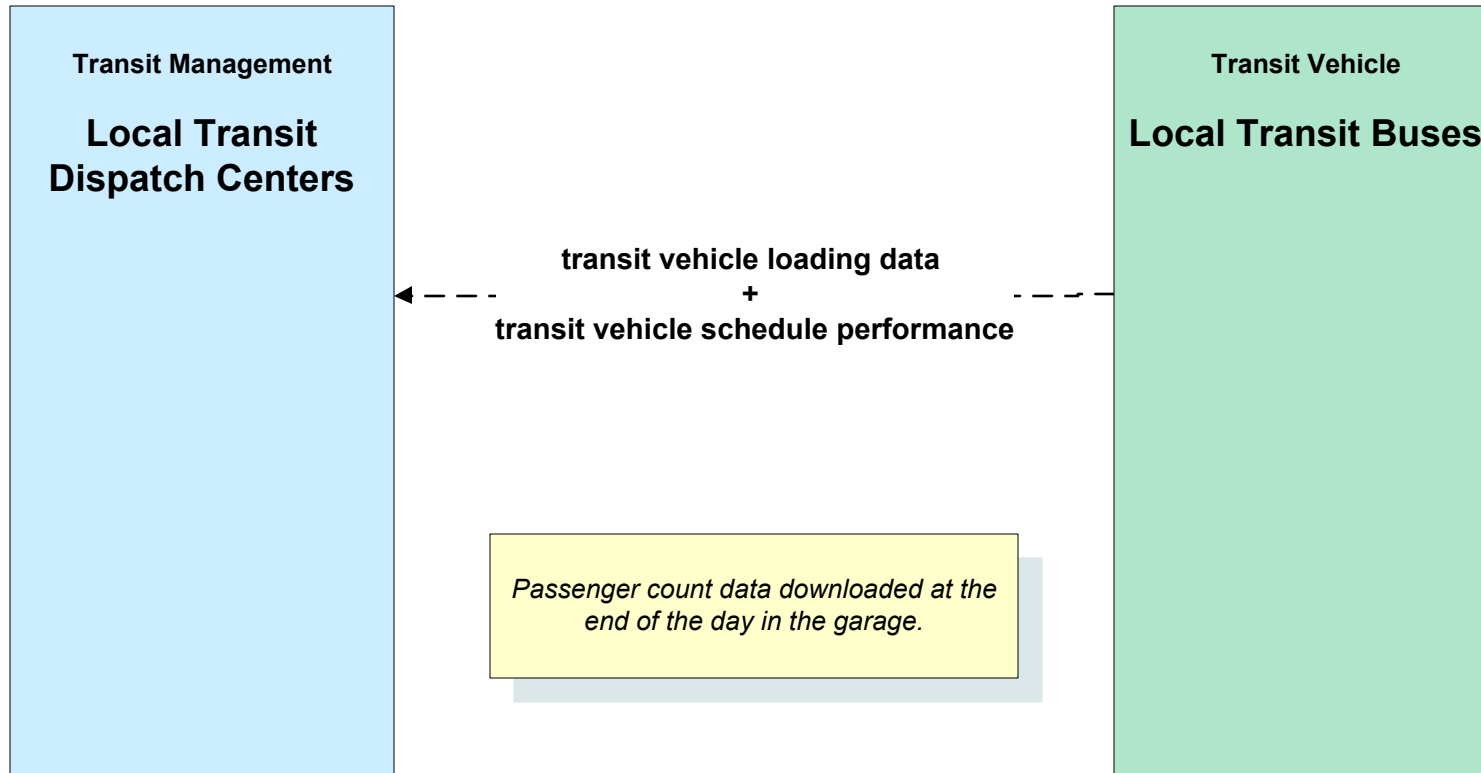
APTS08 - Transit Traveler Information Local Transit Systems



APTS10 – Transit Passenger Counting FAST



APTS10 – Transit Passenger Counting Local Transit Systems

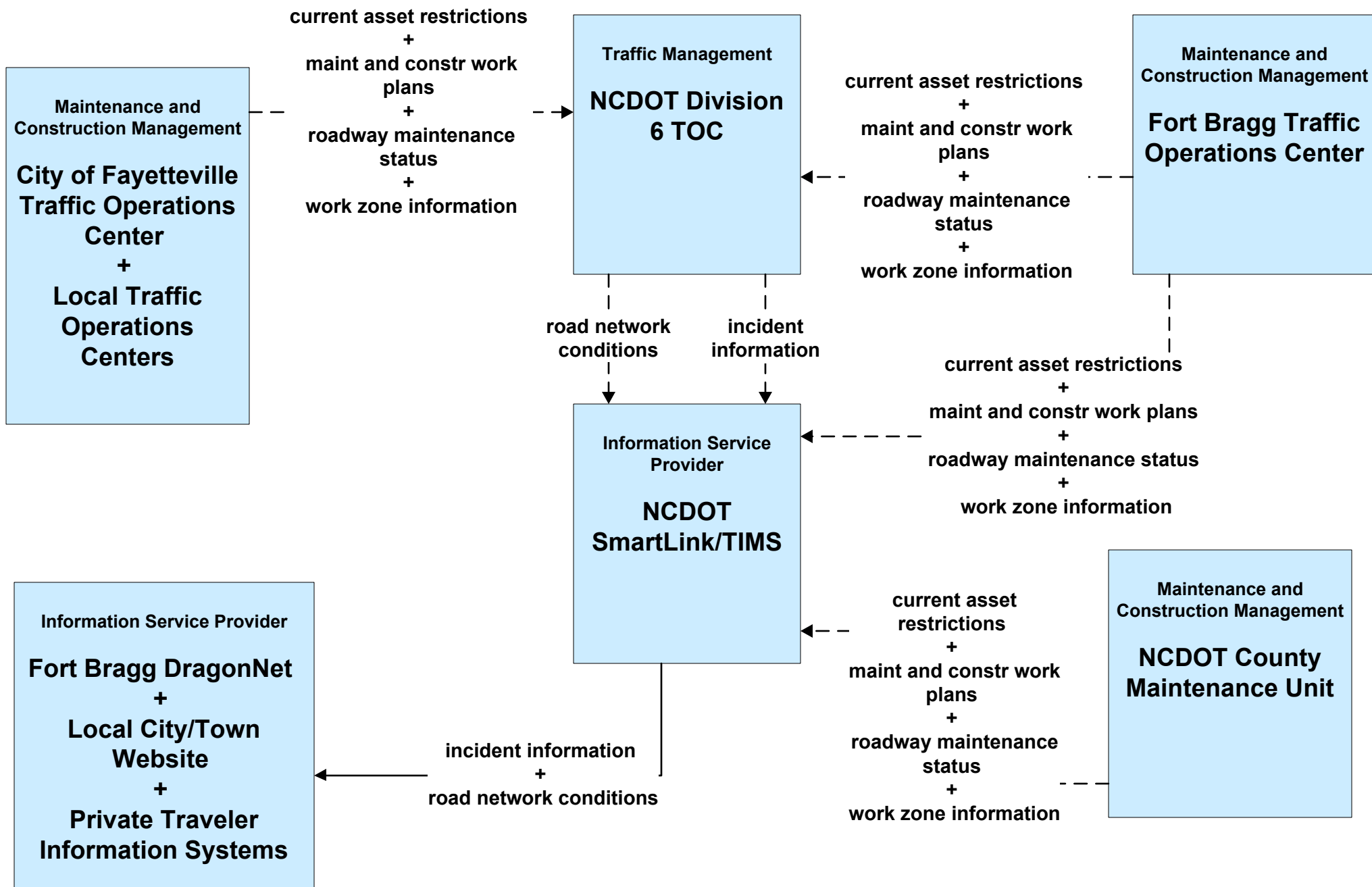


FAMPO Regional ITS Architecture

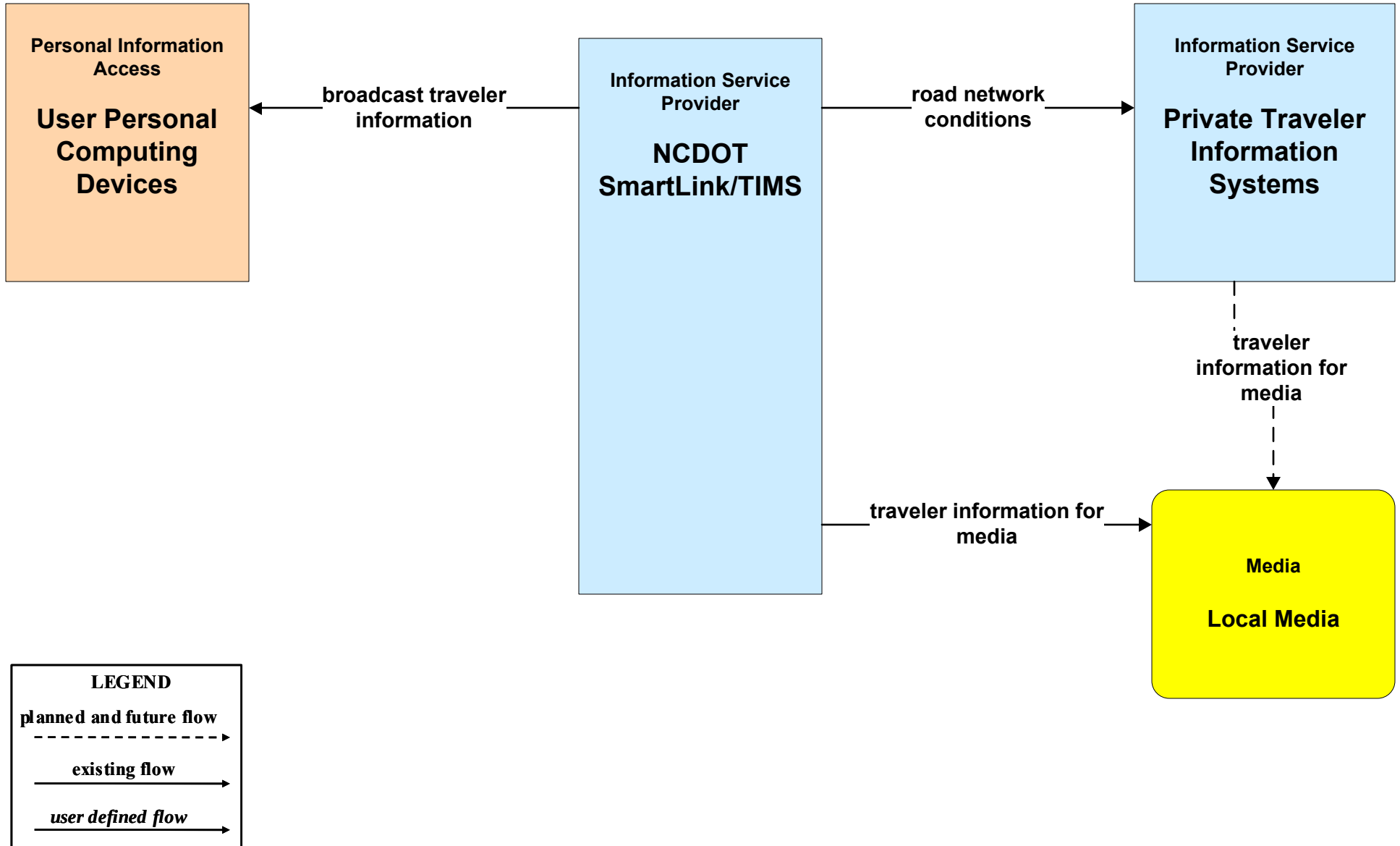
Customized Service Package Diagrams

Advanced Traveler Information Systems (ATIS)

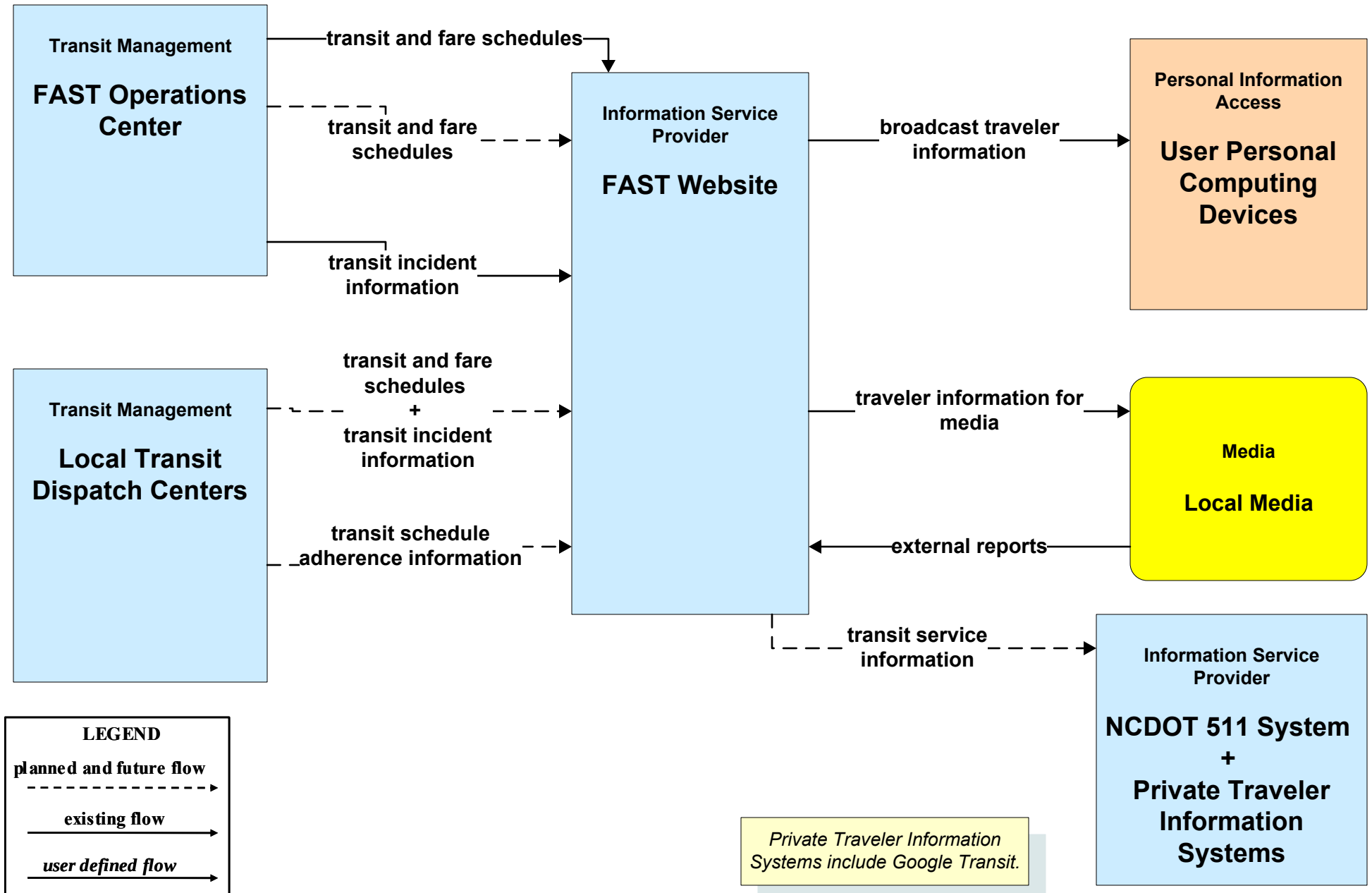
ATIS01 - Broadcast Traveler Information **NCDOT SmartLink/TIMS (1 of 2)**



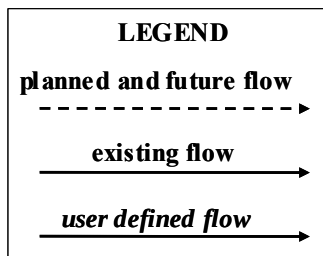
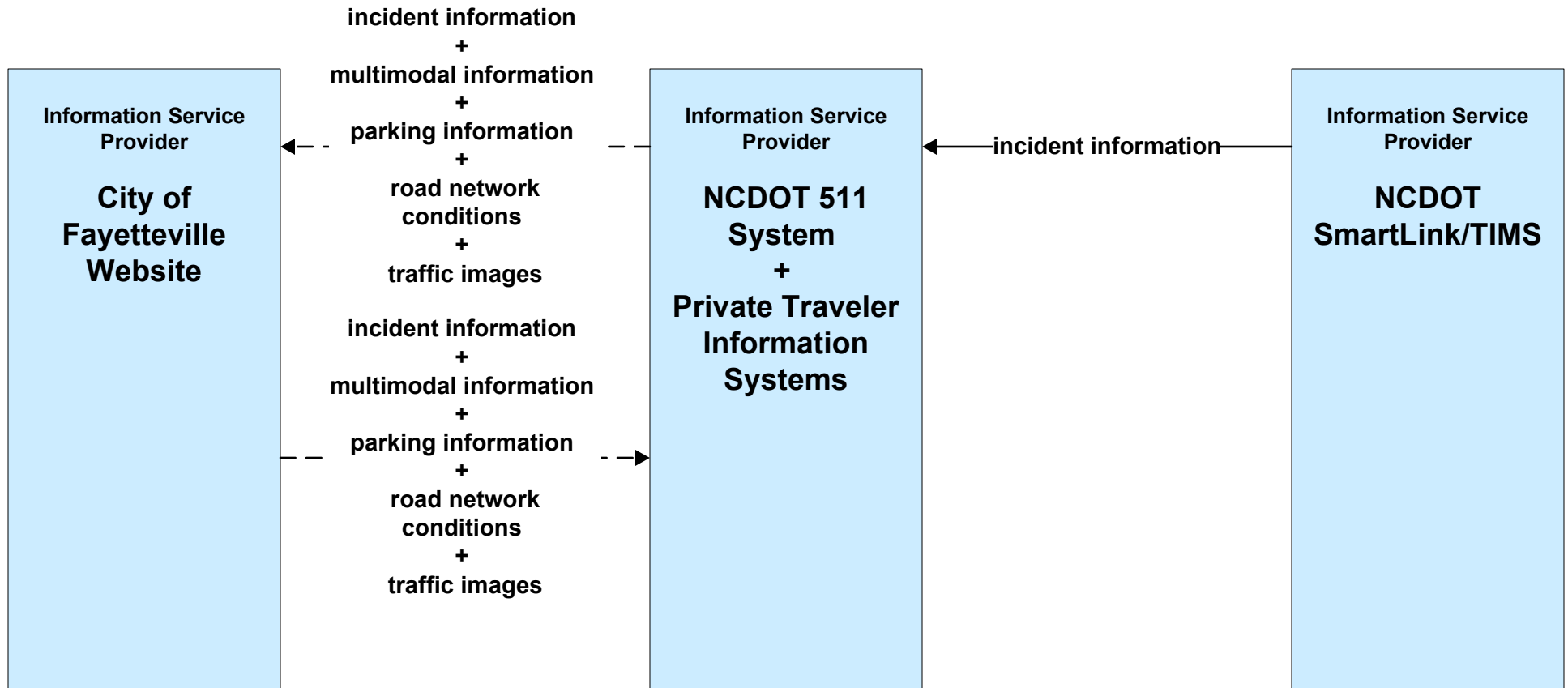
**ATIS01 - Broadcast Traveler Information
NCDOT SmartLink/TIMS (2 of 2)**



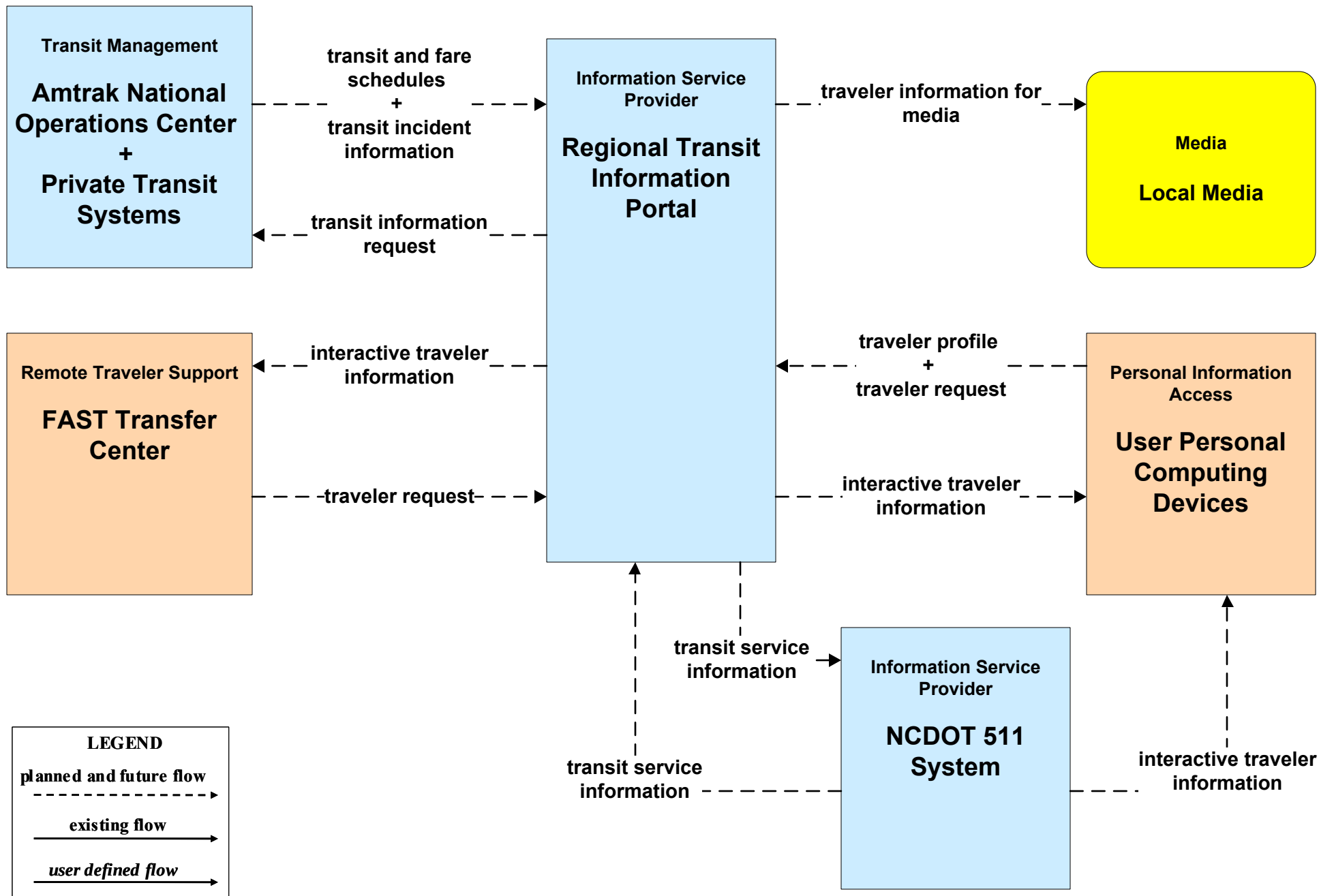
ATIS01 - Broadcast Traveler Information FAST



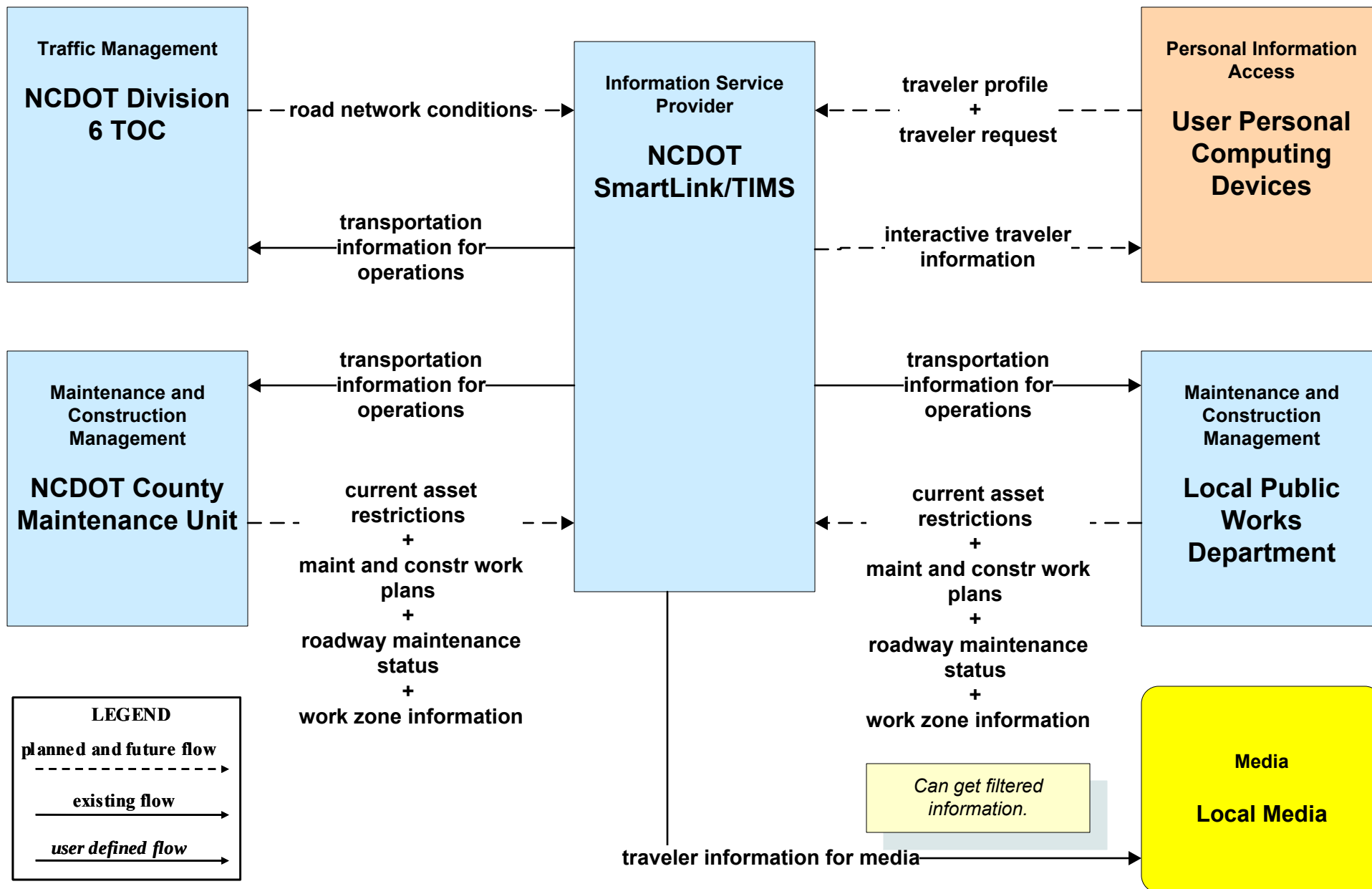
ATIS01 - Broadcast Traveler Information NC 511



ATIS02 - Interactive Traveler Information Regional Transit Information Portal



ATIS02 - Interactive Traveler Information NCDOT TIMS

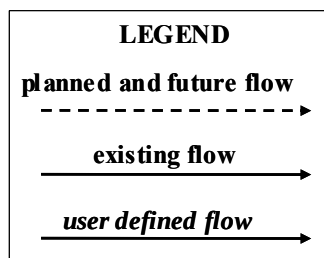
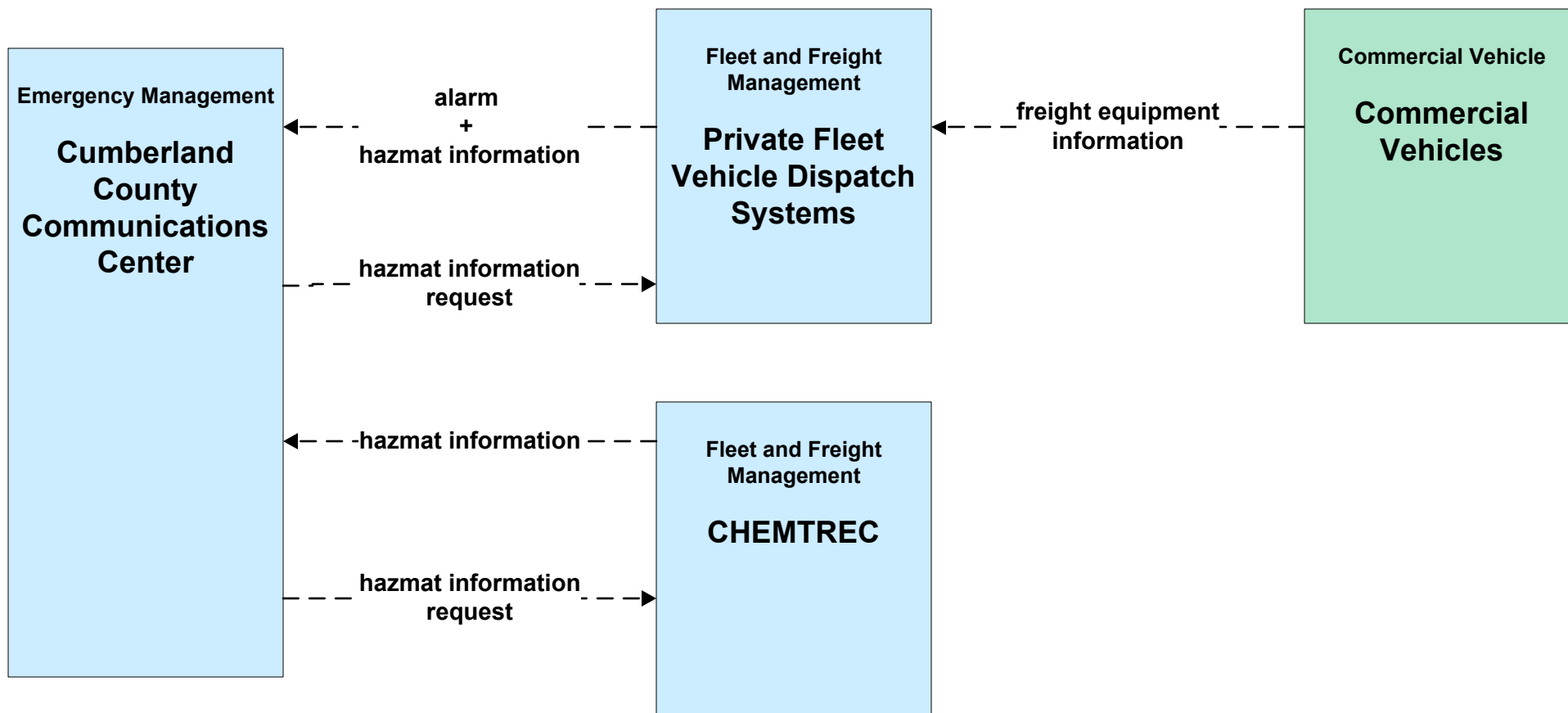


FAMPO Regional ITS Architecture

Customized Service Package Diagrams

Commercial Vehicles Operations (CVO)

**CVO10 - HAZMAT
HAZMAT Team**



Appendix I

FAMPO Regional ITS Architecture

Customized Service Package Diagrams

based on
National ITS Architecture Version 7.0

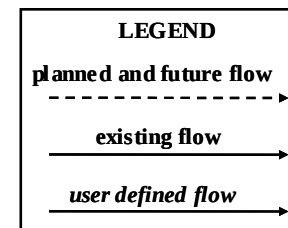
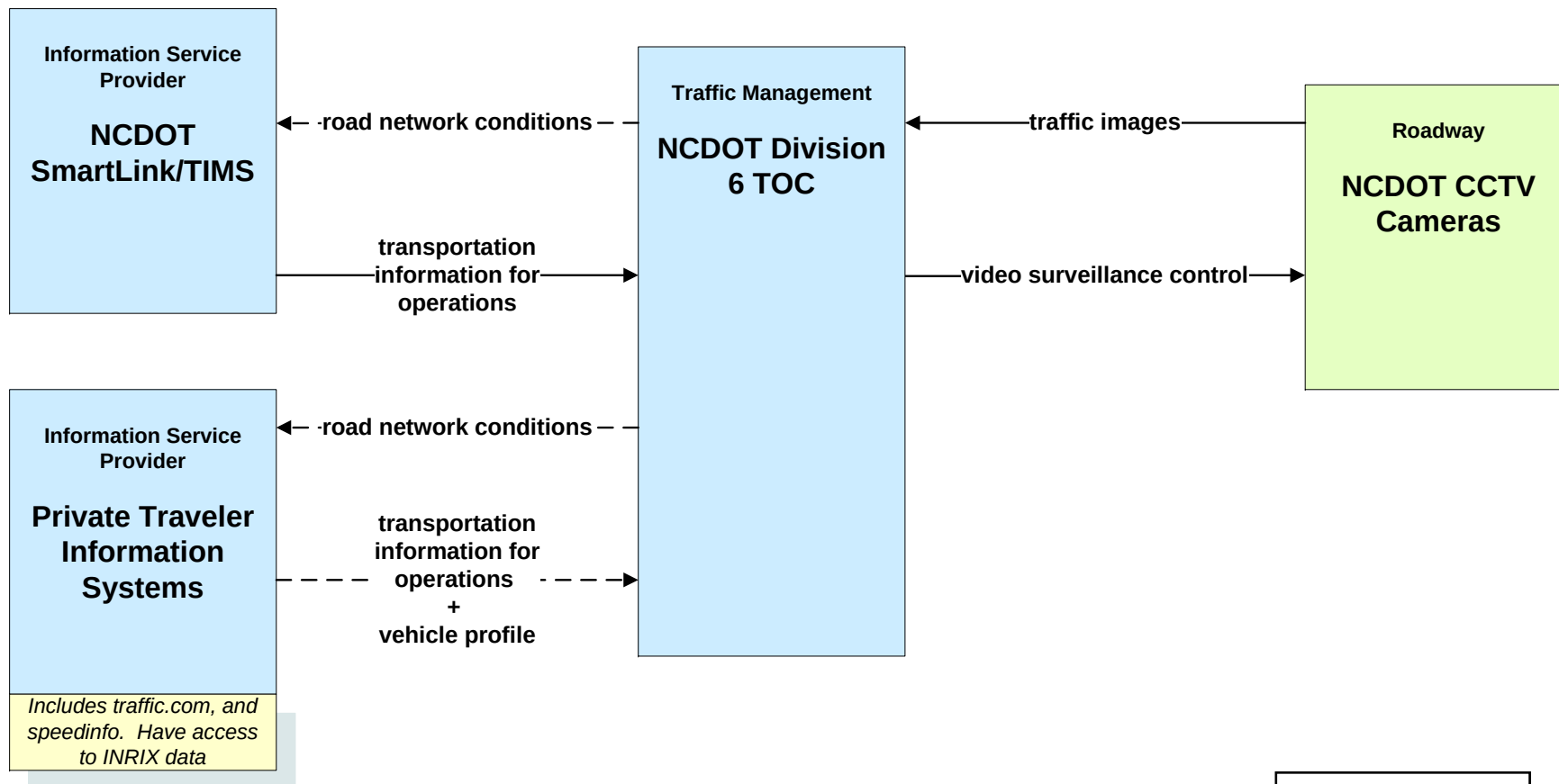
April 4, 2013

FAMPO Regional ITS Architecture

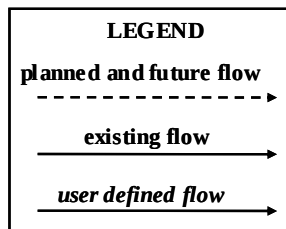
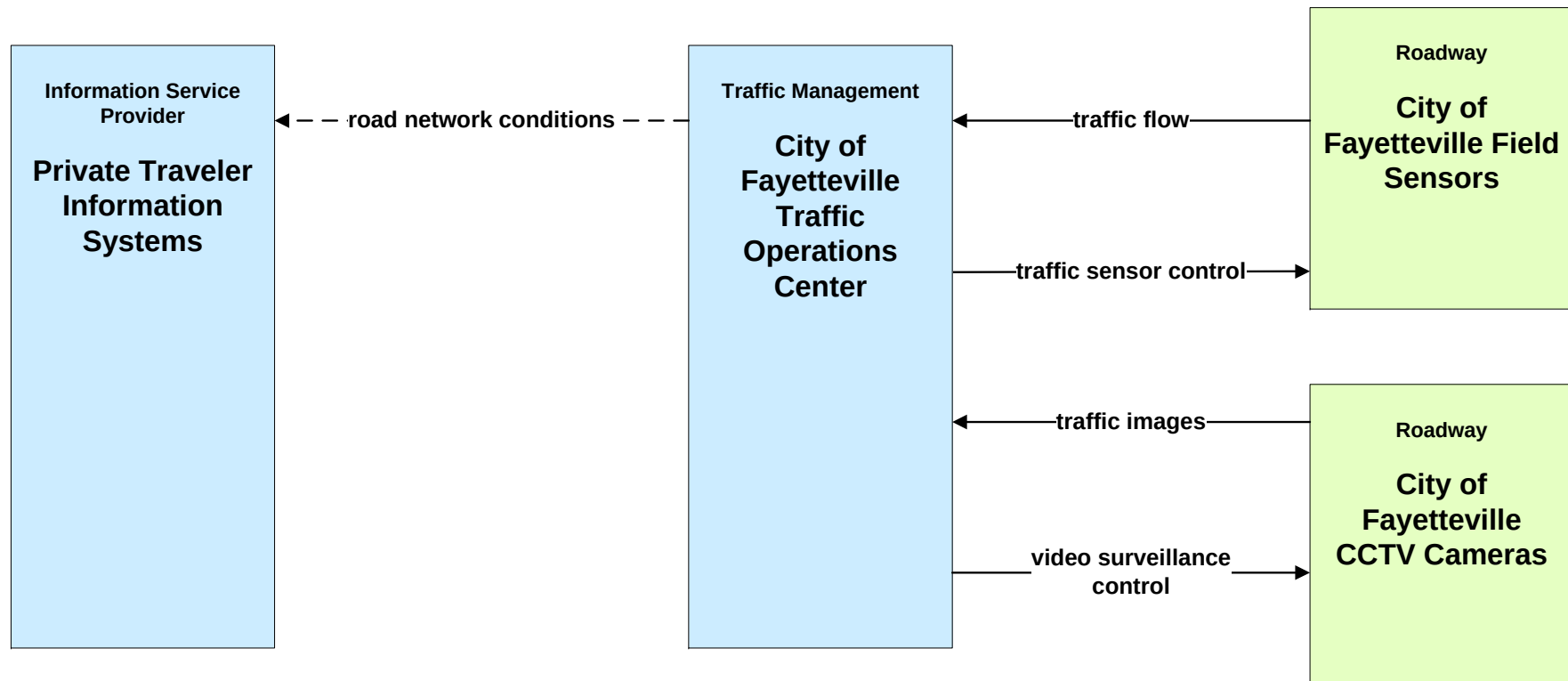
Customized Service Package Diagrams

**Advanced Traffic Management Systems
(ATMS)**

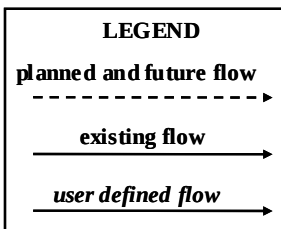
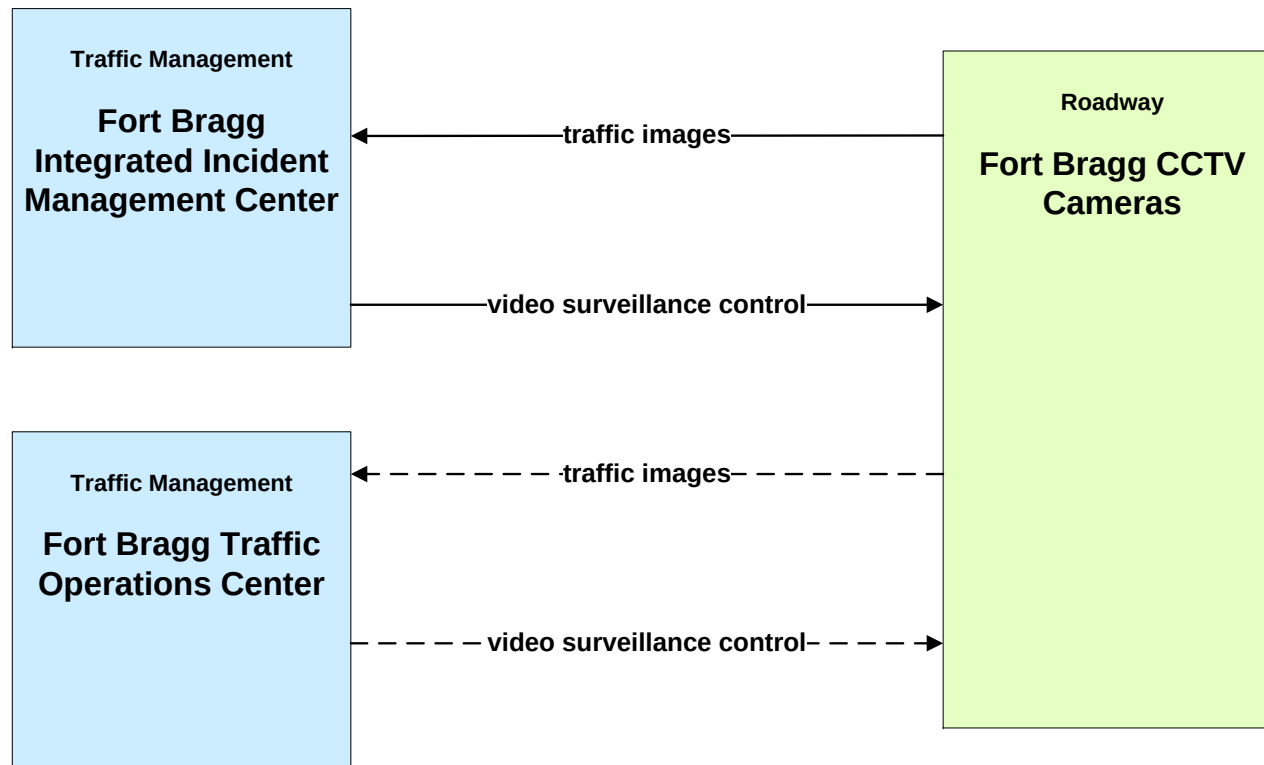
ATMS01 - Network Surveillance NCDOT



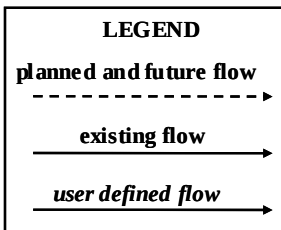
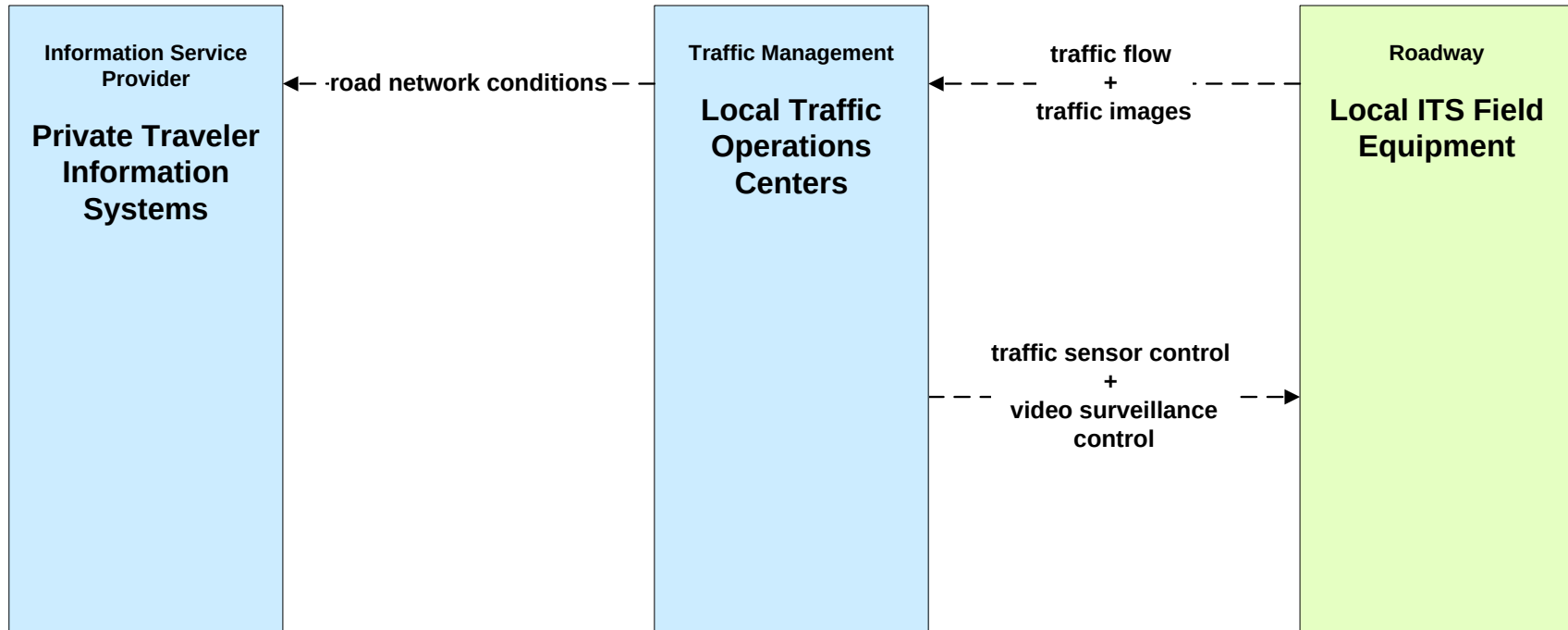
ATMS01 - Network Surveillance Fayetteville



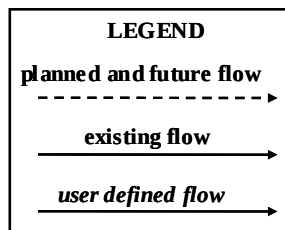
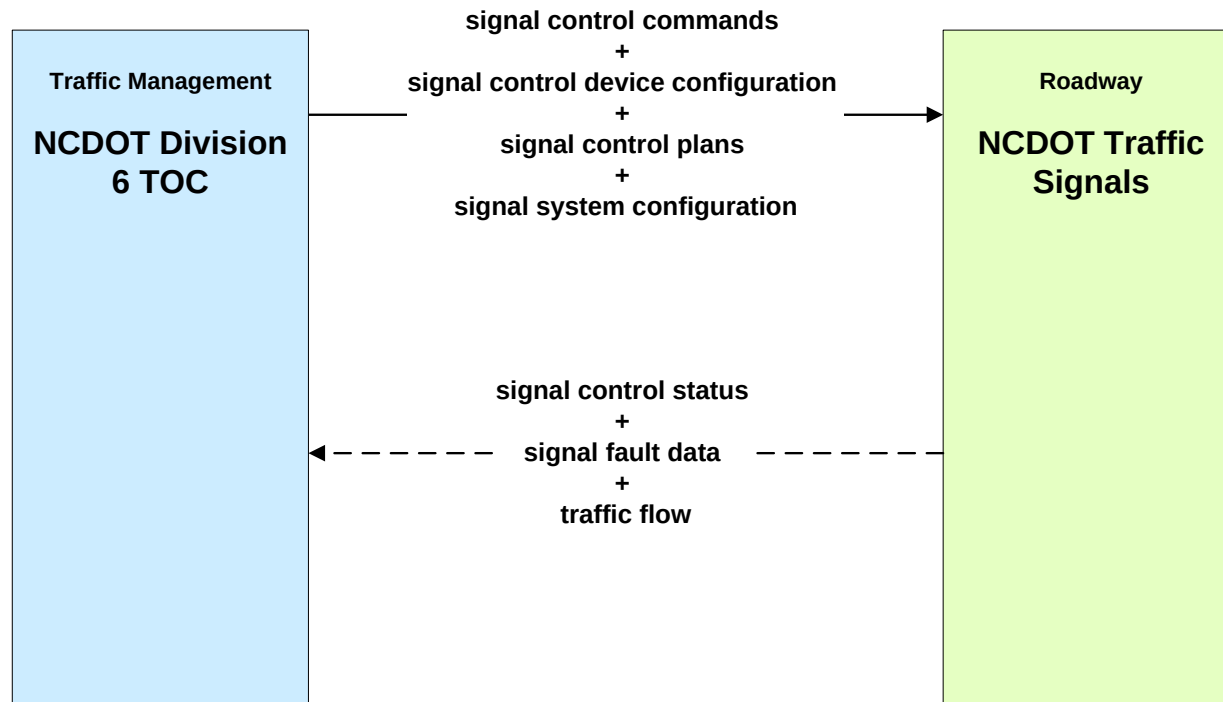
ATMS01 - Network Surveillance Fort Bragg



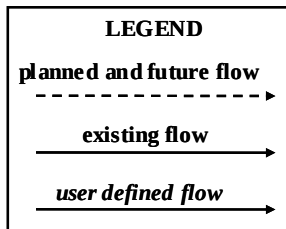
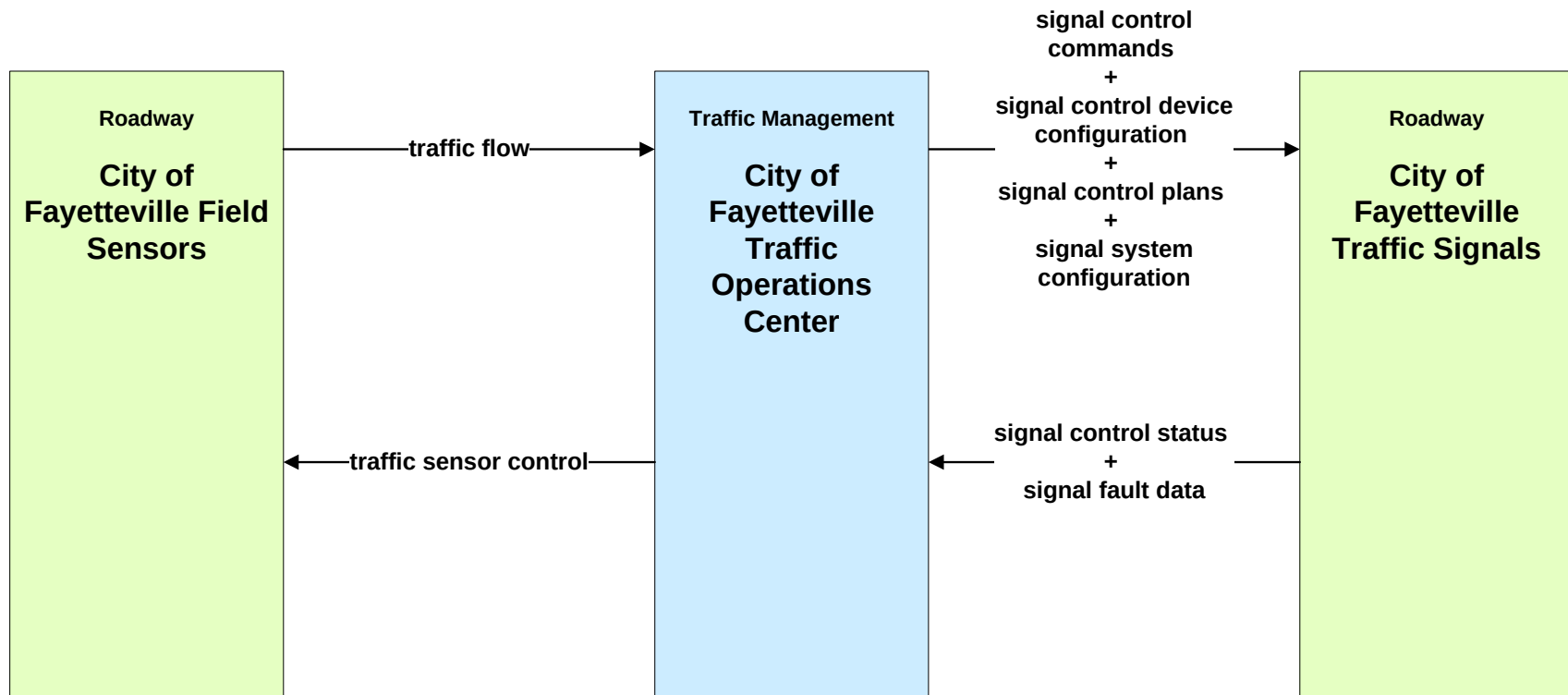
**ATMS01 - Network Surveillance
Local Municipalities**



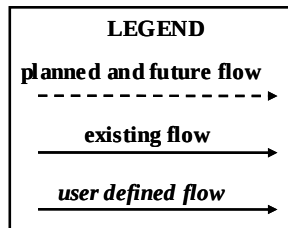
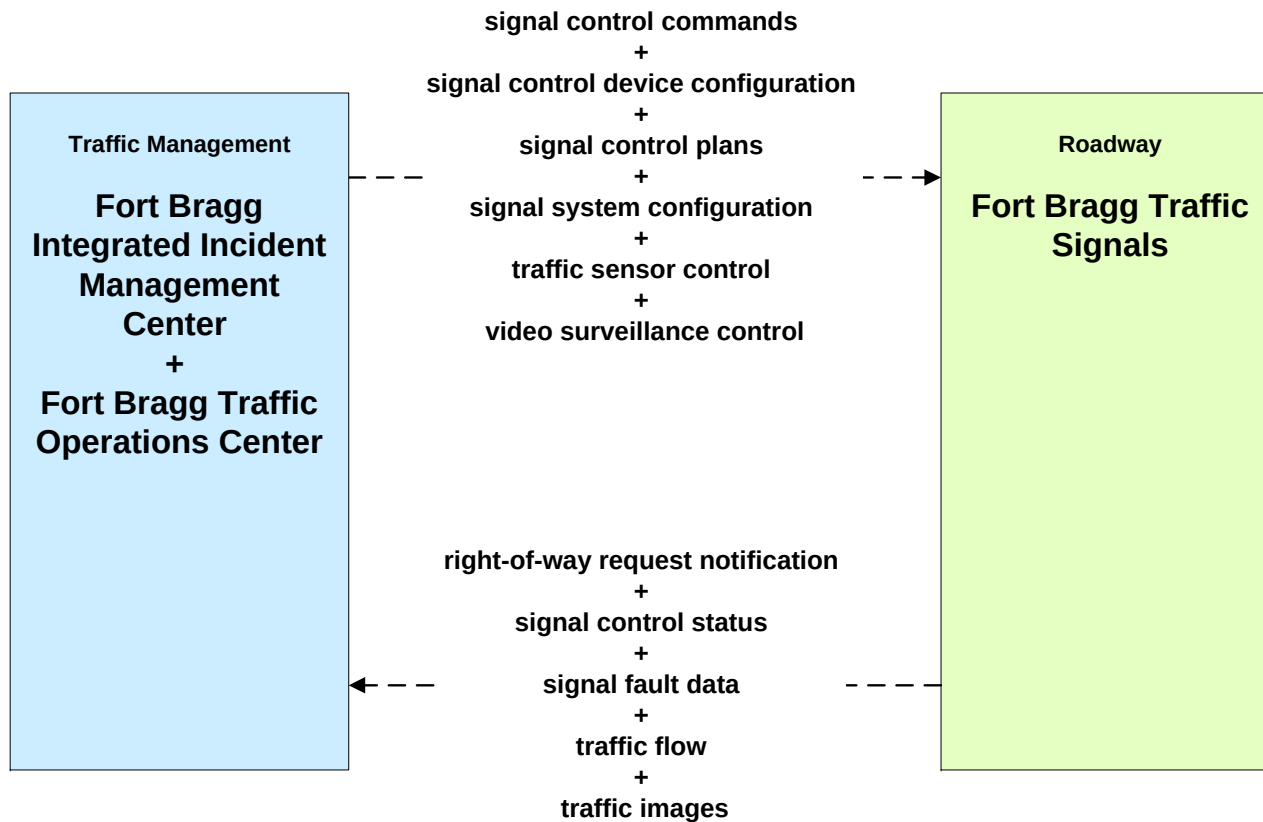
ATMS03 - Surface Street Control NCDOT



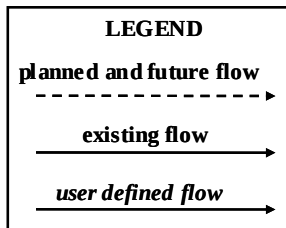
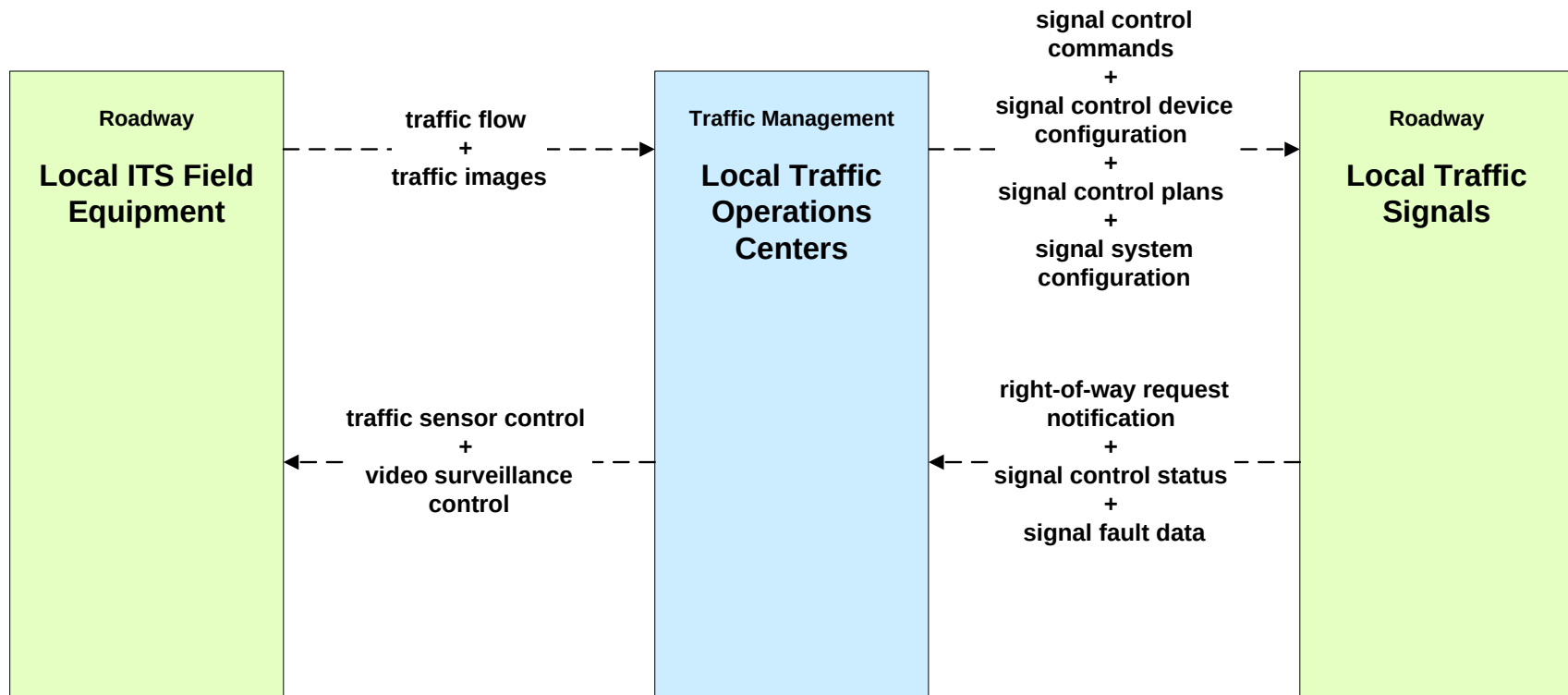
ATMS03 - Traffic Signal Control Fayetteville

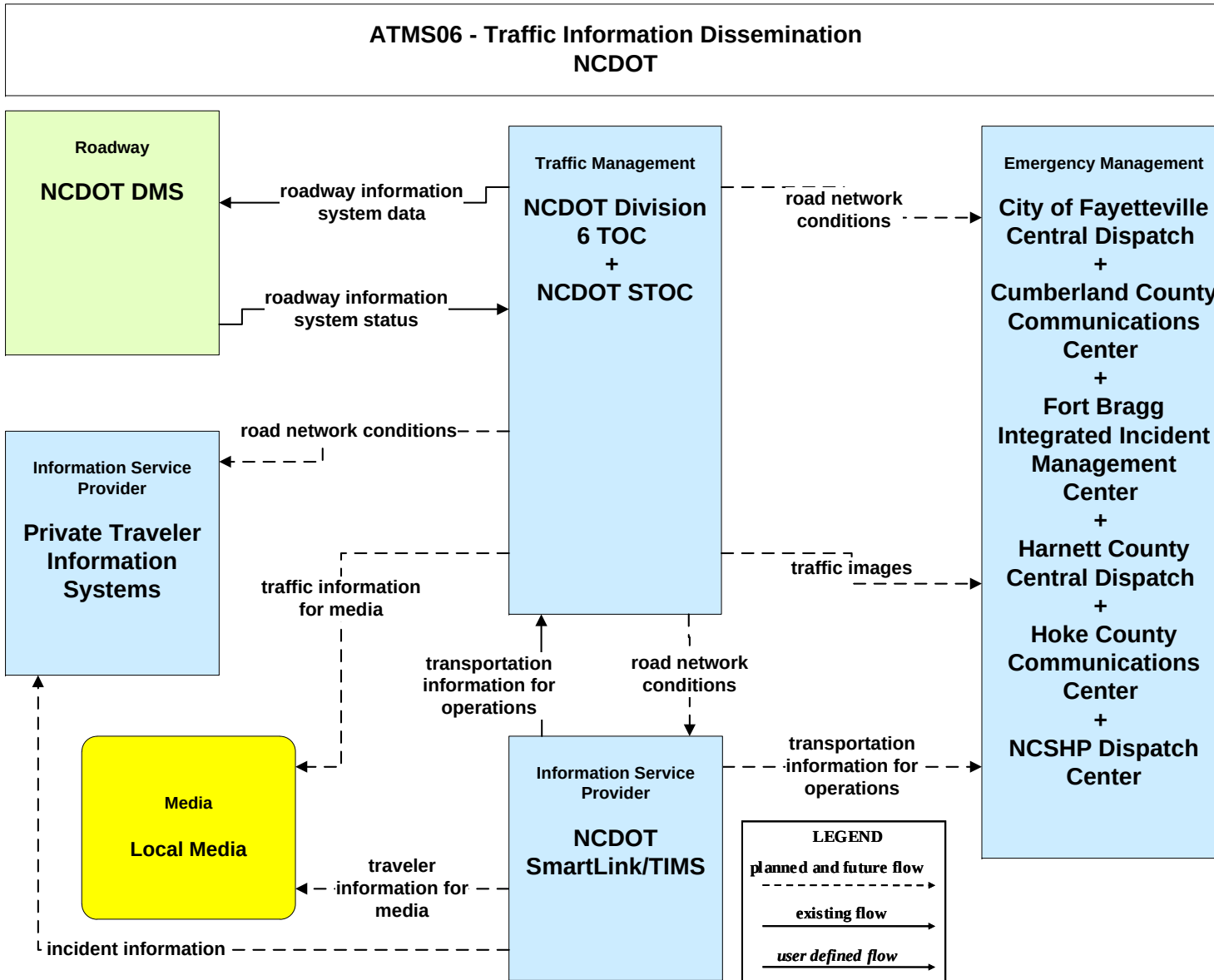


ATMS03 - Surface Street Control Fort Bragg

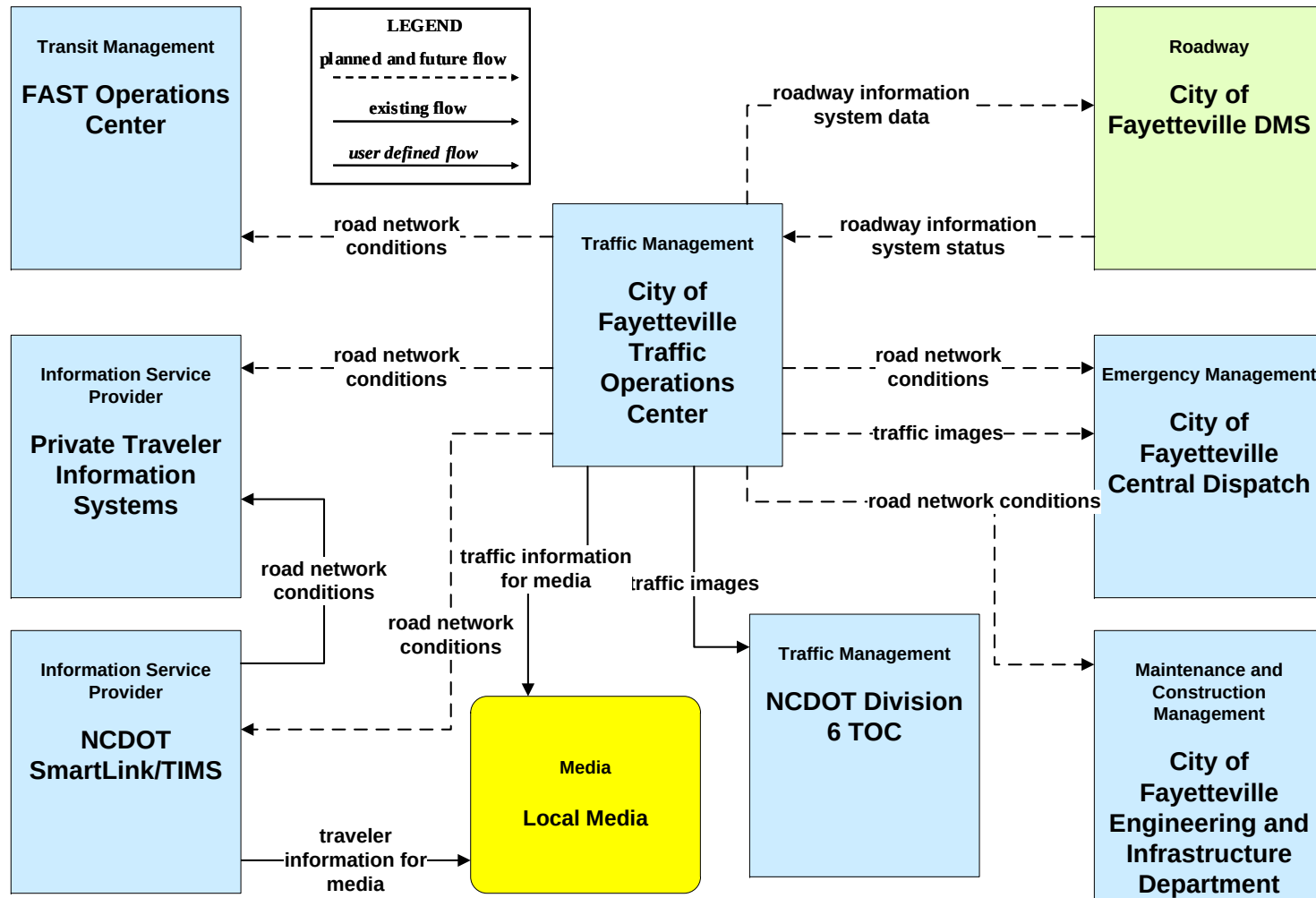


ATMS03 - Surface Street Control Local Municipalities

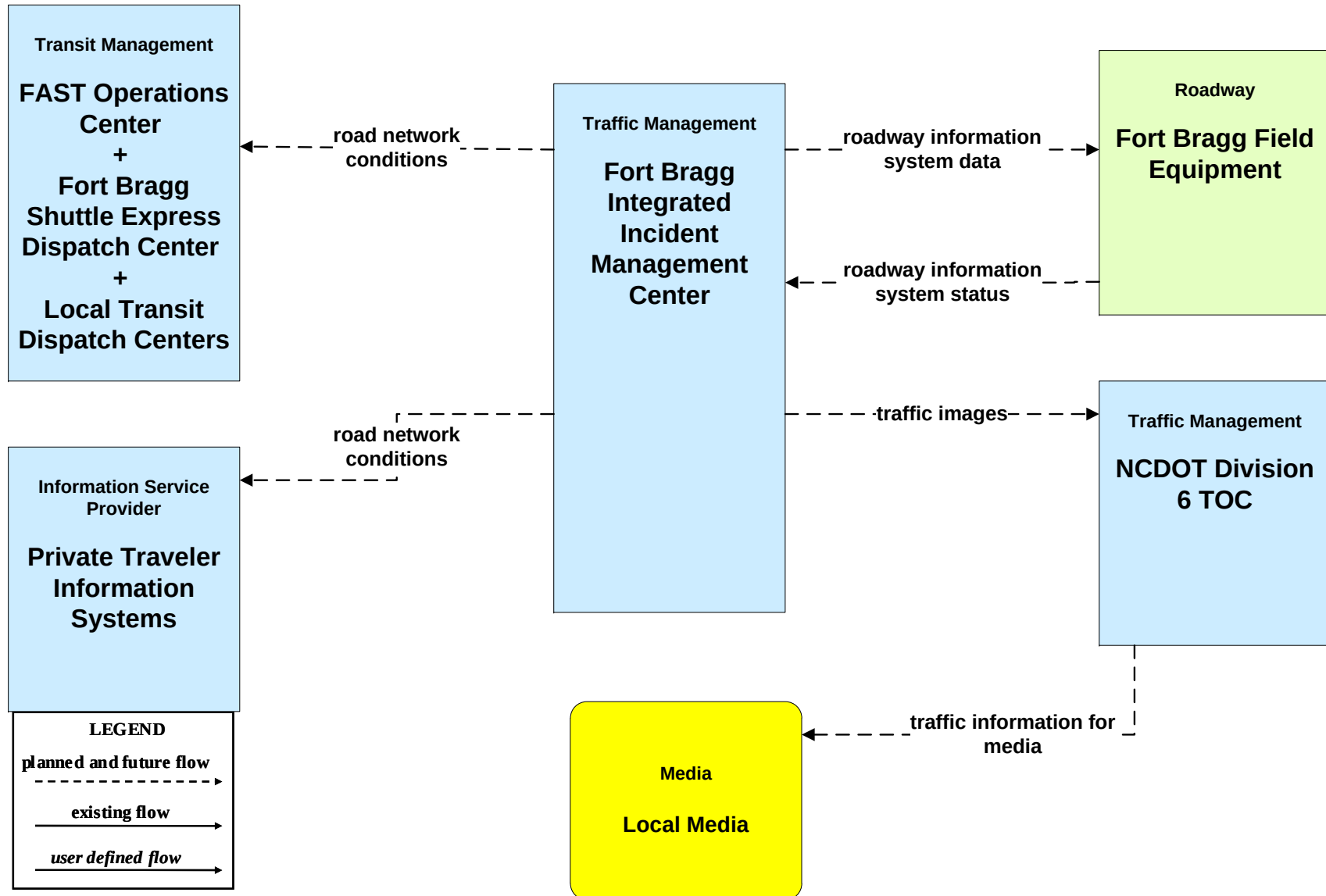




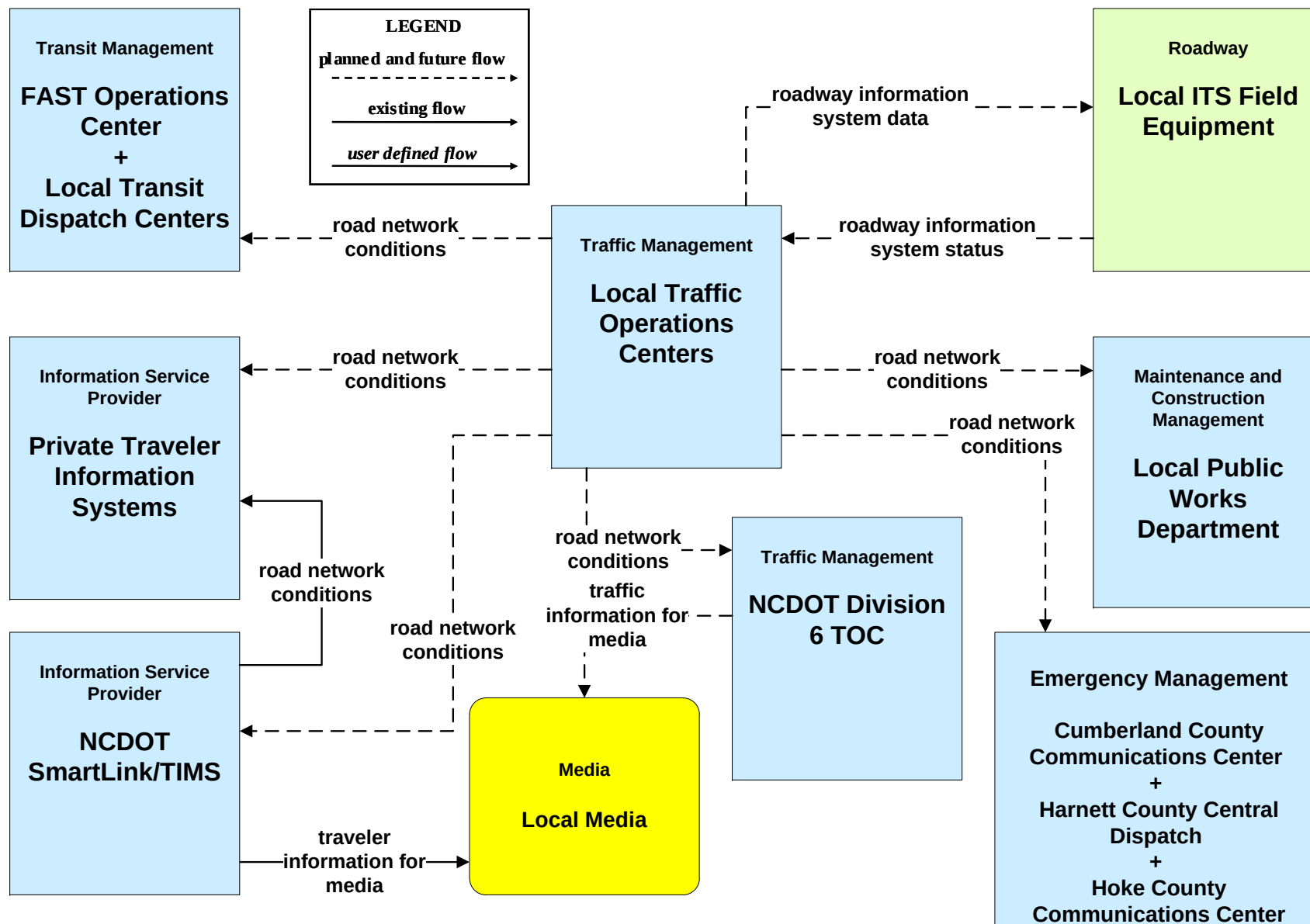
ATMS06 - Traffic Information Dissemination Fayetteville



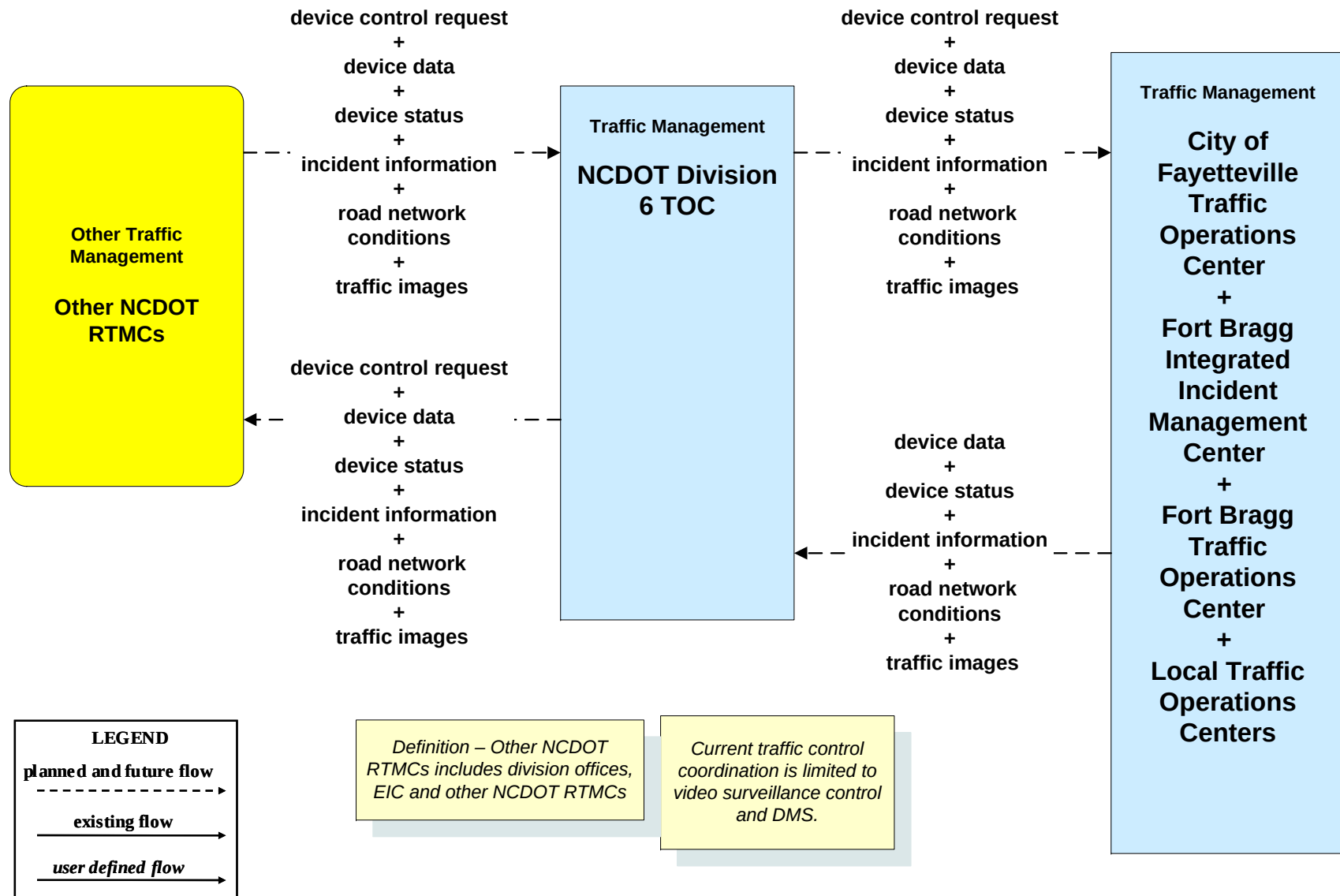
ATMS06 - Traffic Information Dissemination Fort Bragg



ATMS06 - Traffic Information Dissemination Local Traffic Operations Center

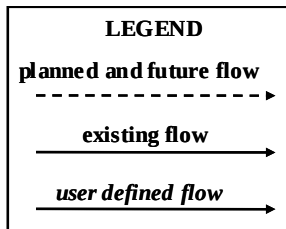
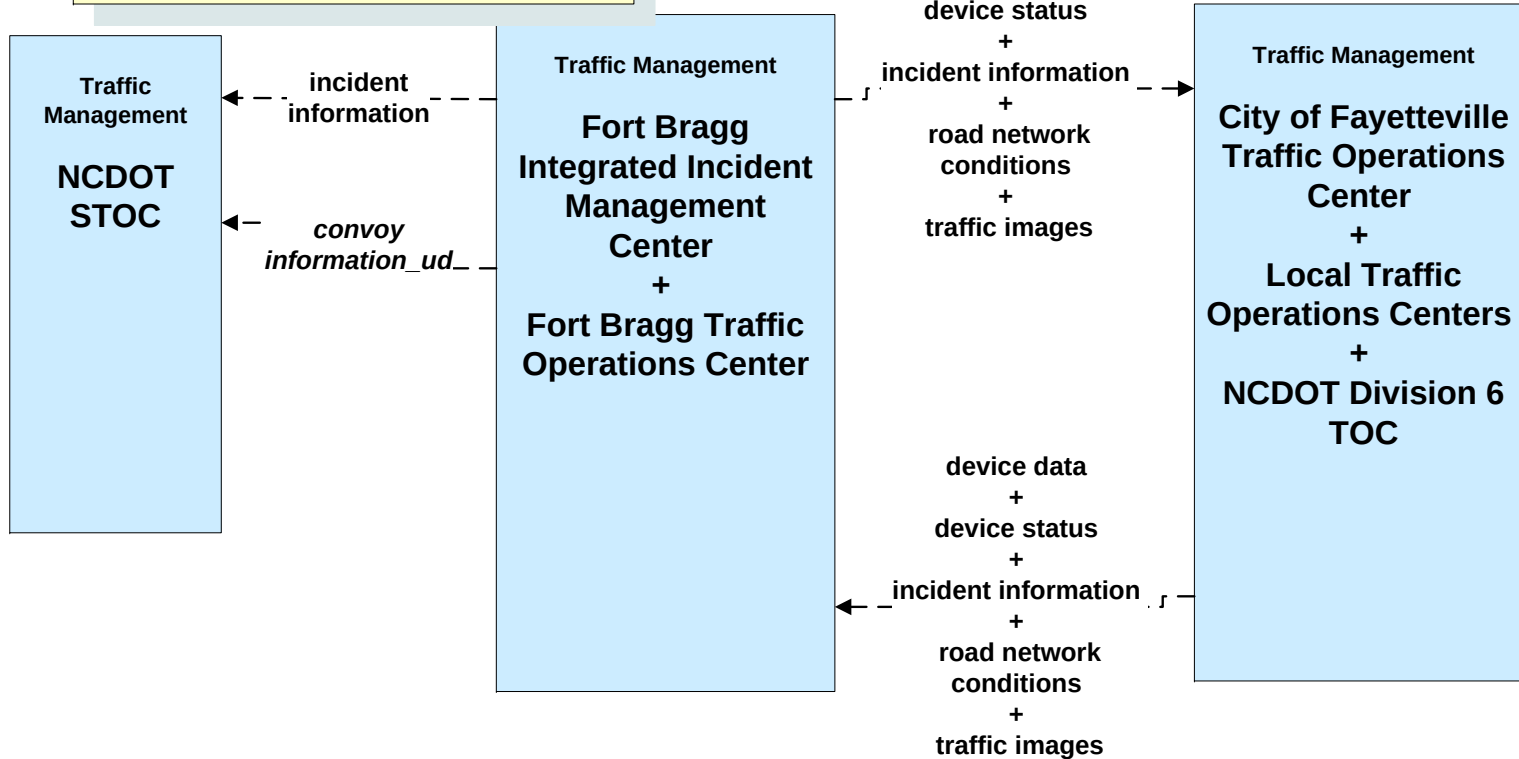


ATMS07 - Regional Traffic Management NCDOT



ATMS07 - Regional Traffic Management Fort Bragg

Incident information could include road closure info (access point status)- sharing info with STOC might be more important than to Div 6.



Incident Management Overview

ATMS08 Covered

Emergency Management <-- --> Traffic Management

Emergency Management <-- --> Maintenance and Construction

Traffic Management <-- --> Maintenance and Construction

Maintenance and Construction <-- --> Maintenance and Construction

*Event Plans and Weather <-- --> Traffic Management & Emergency
Management (see MCs for M&C)*

ATMS06, 03, 04, etc. Covered

Traffic Management <-- --> Roadway

ATMS07 Covered

Traffic Management <-- --> Traffic Management

EM01 Covered

Emergency Management <-- --> Emergency Management

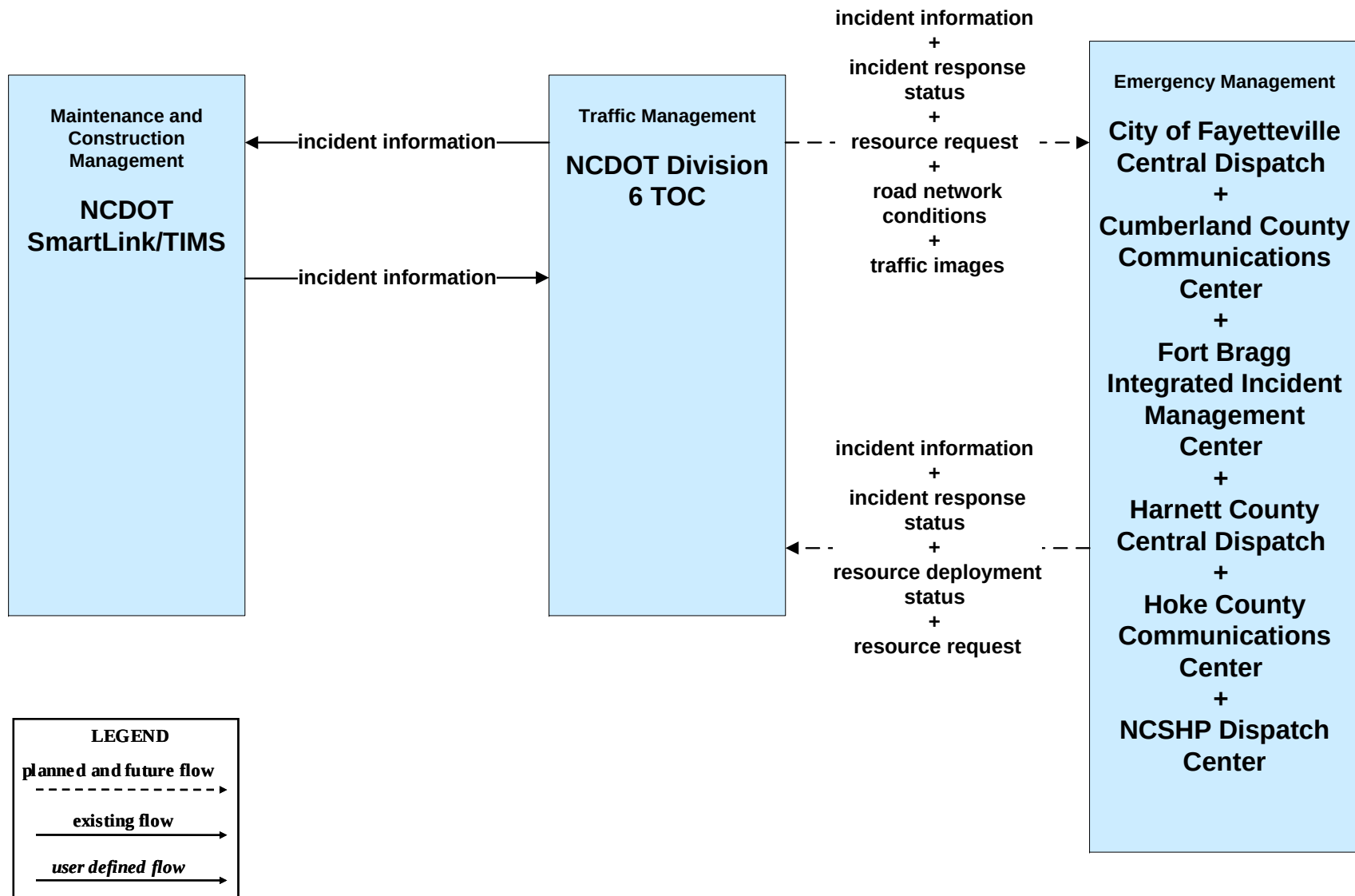
EM02 Covered

Emergency Vehicle Preemption

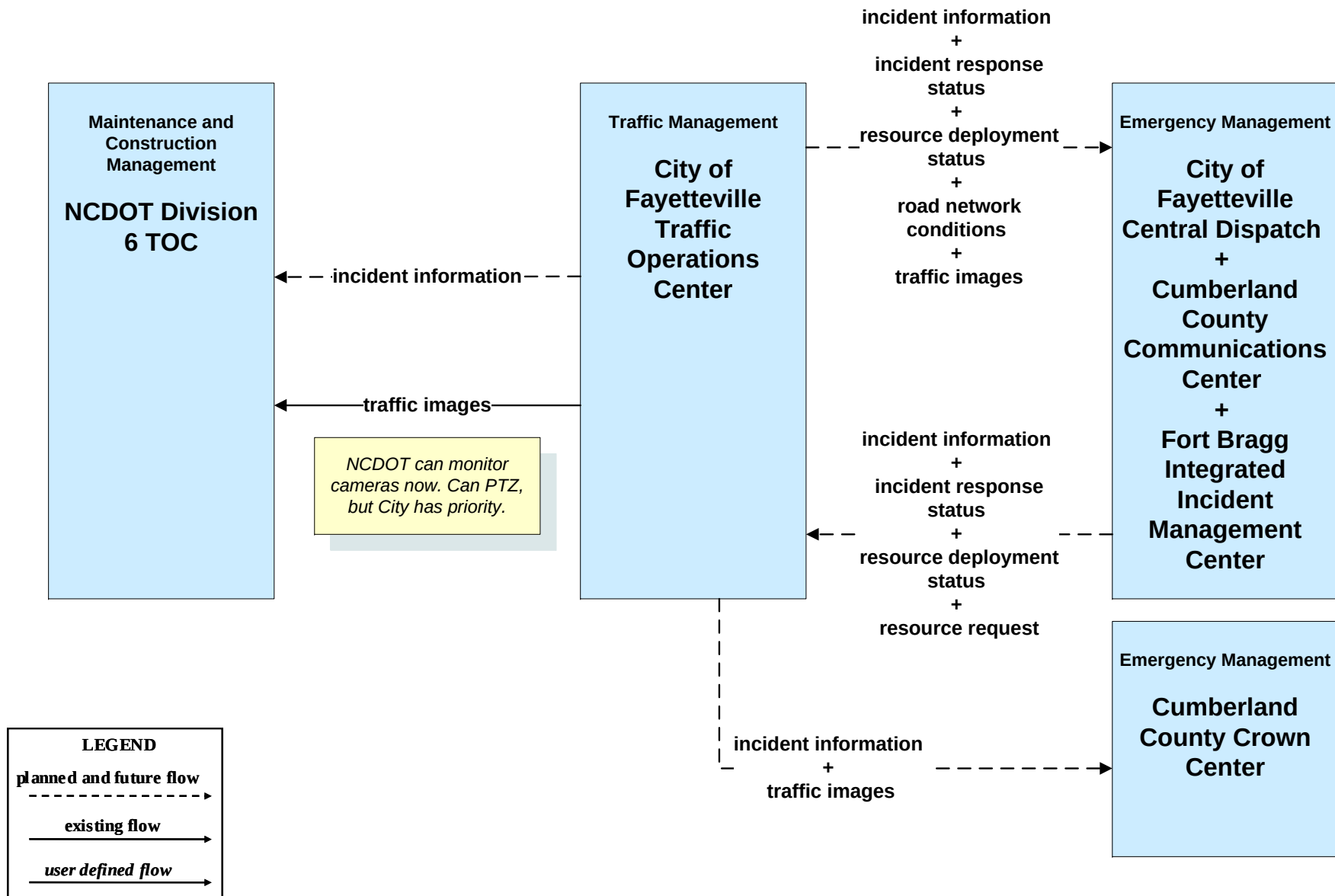
ATMS08 - Incident Management

Traffic Management <-- --> Emergency Management

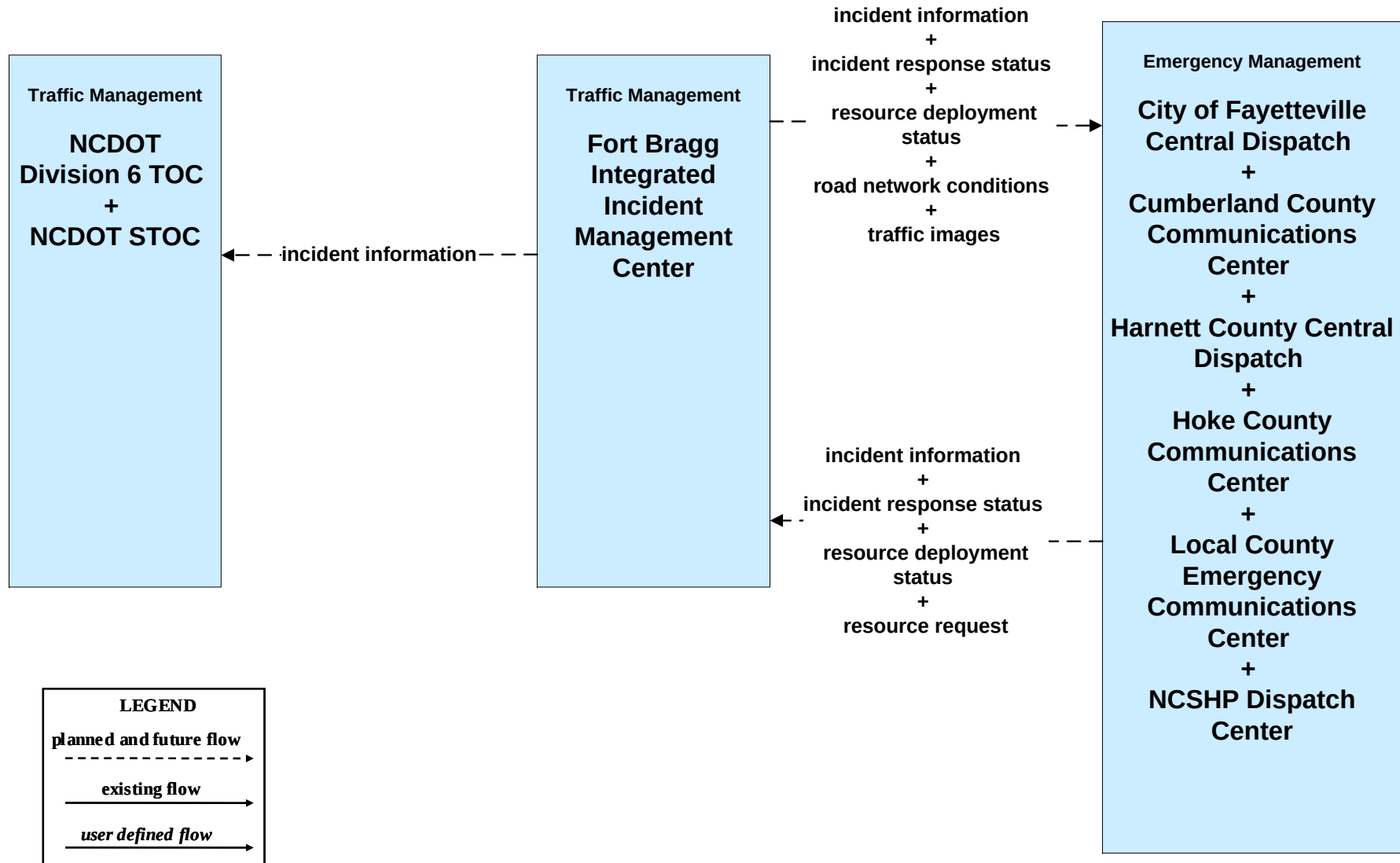
ATMS08 - Incident Management NCDOT (TM to EM)



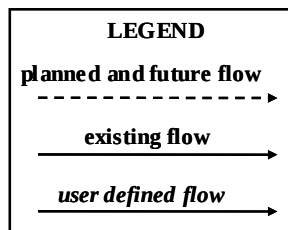
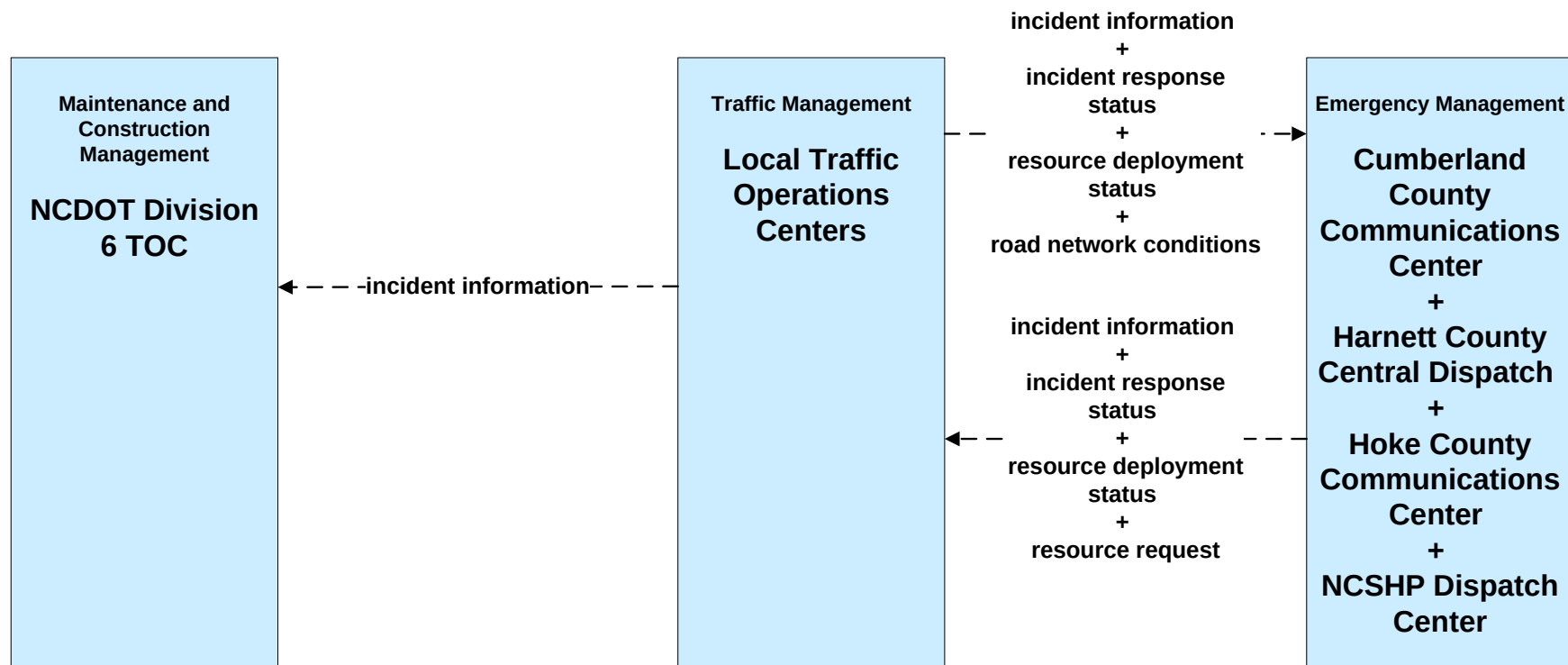
ATMS08 - Incident Management Fayetteville (TM to EM)



ATMS08 - Incident Management Fort Bragg (TM to EM)



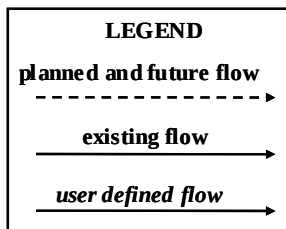
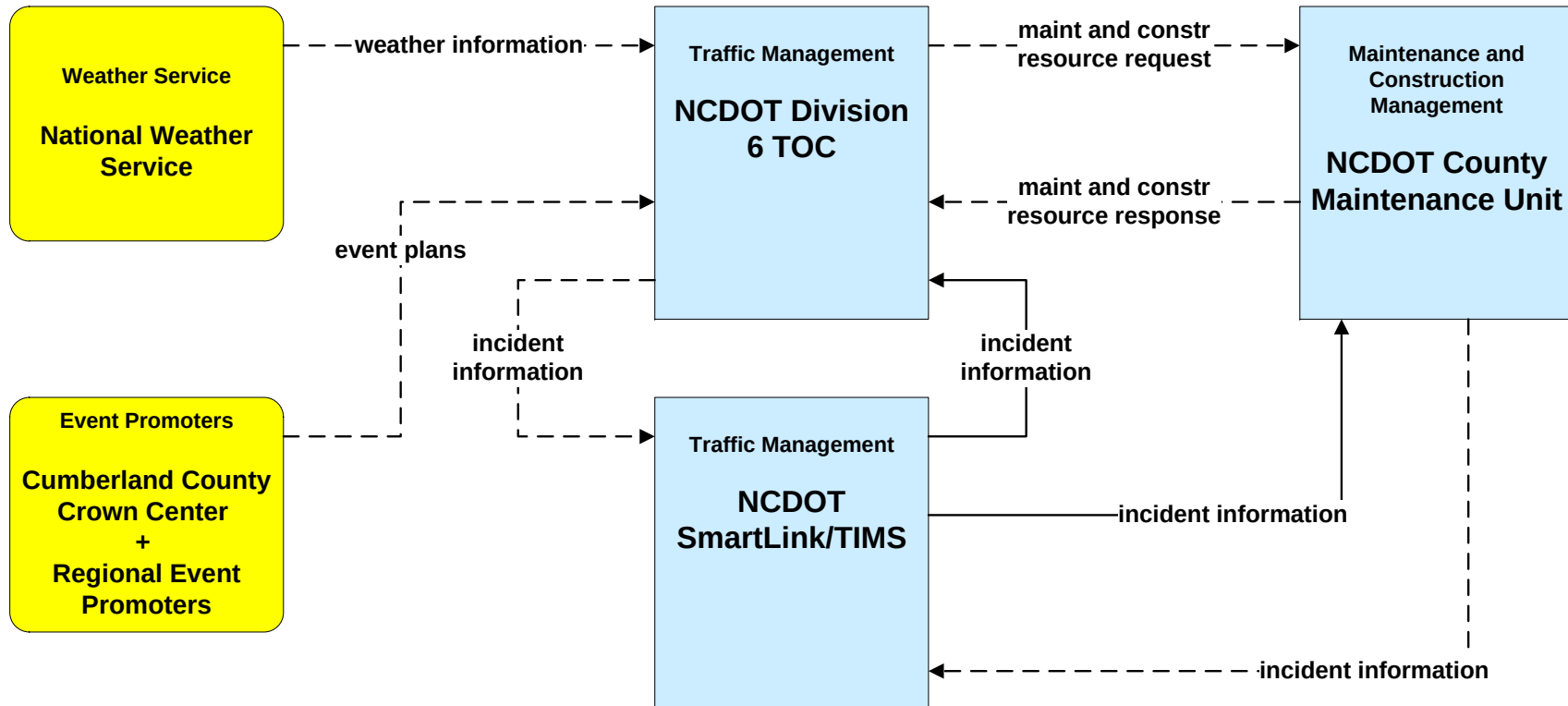
ATMS08 - Incident Management Local Municipalities (TM to EM)



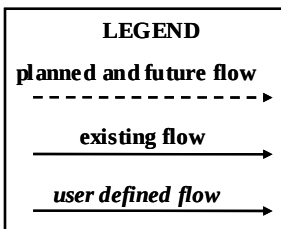
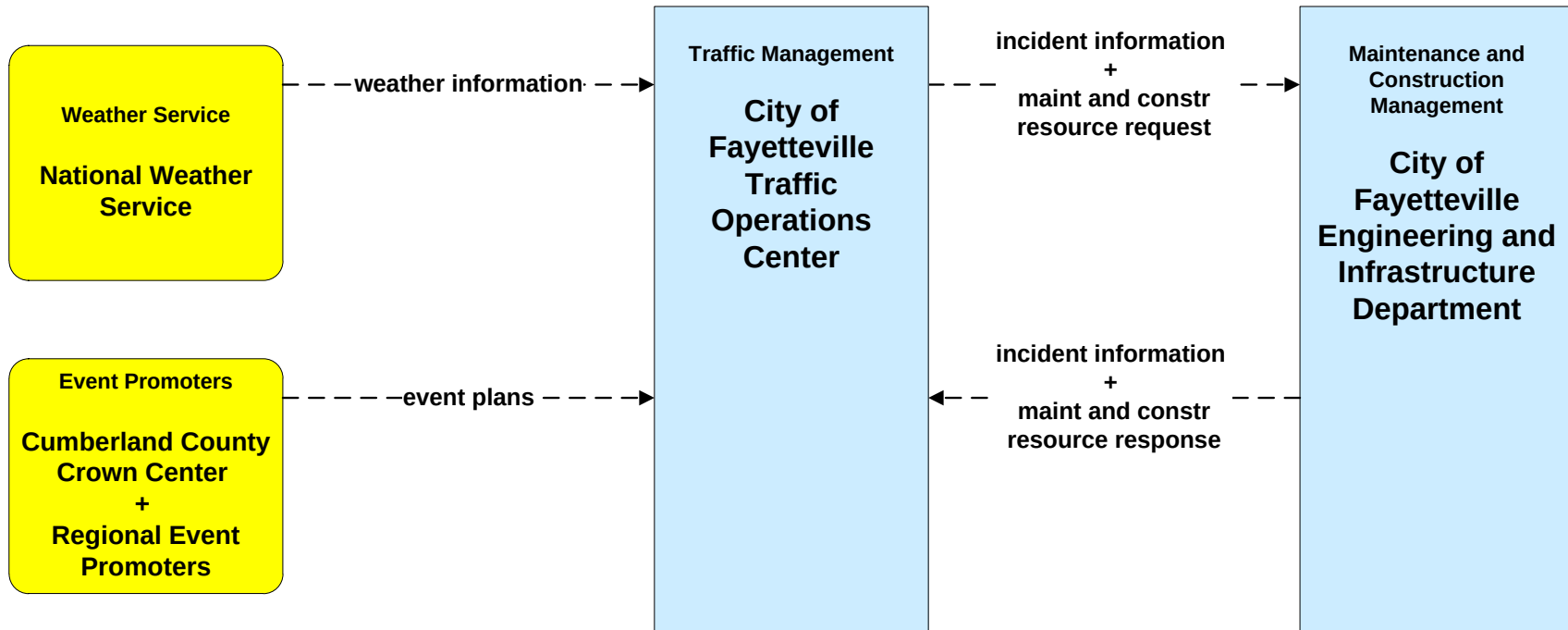
ATMS08 - Incident Management

Traffic Management <-- --> Maintenance and Construction Management

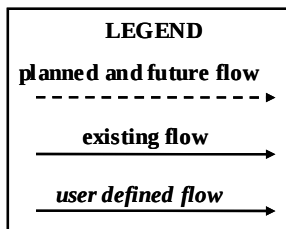
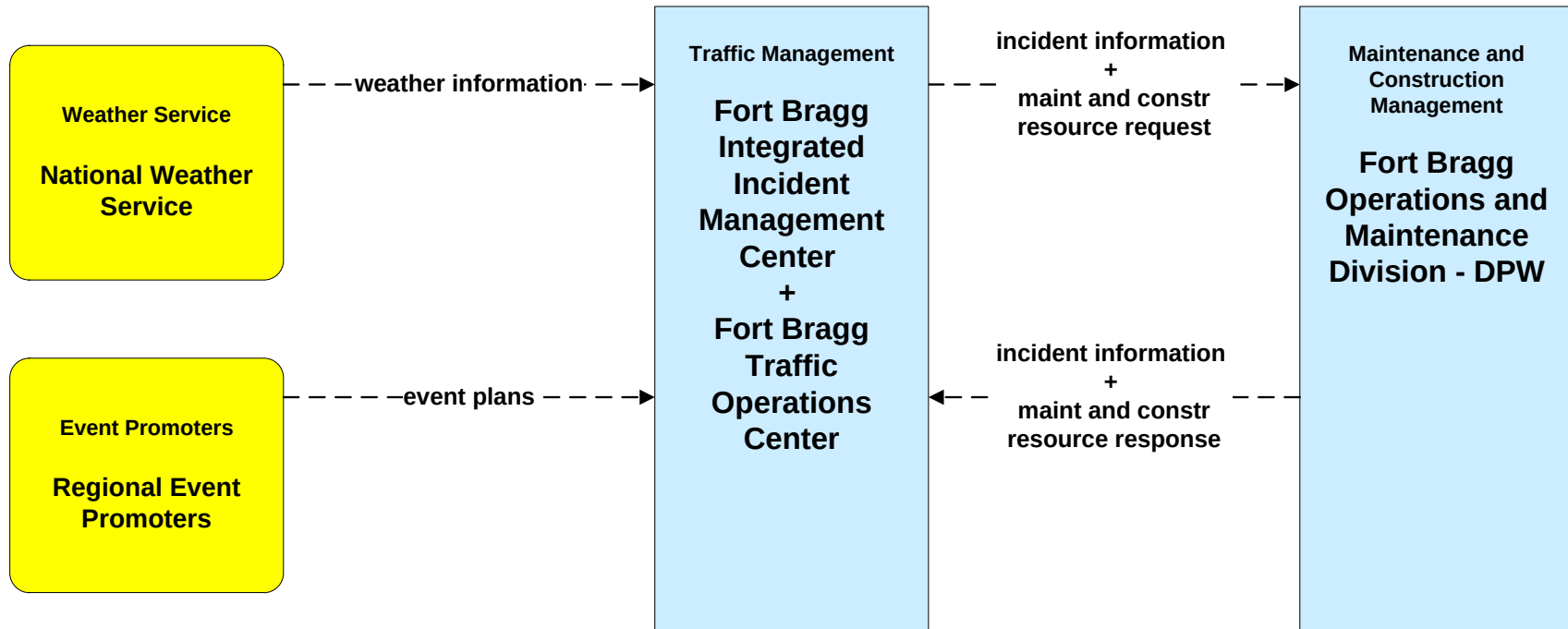
ATMS08 - Incident Management NCDOT (TM to MCM)



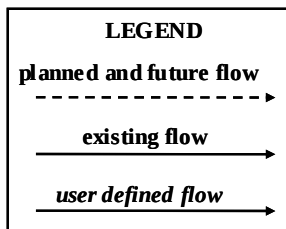
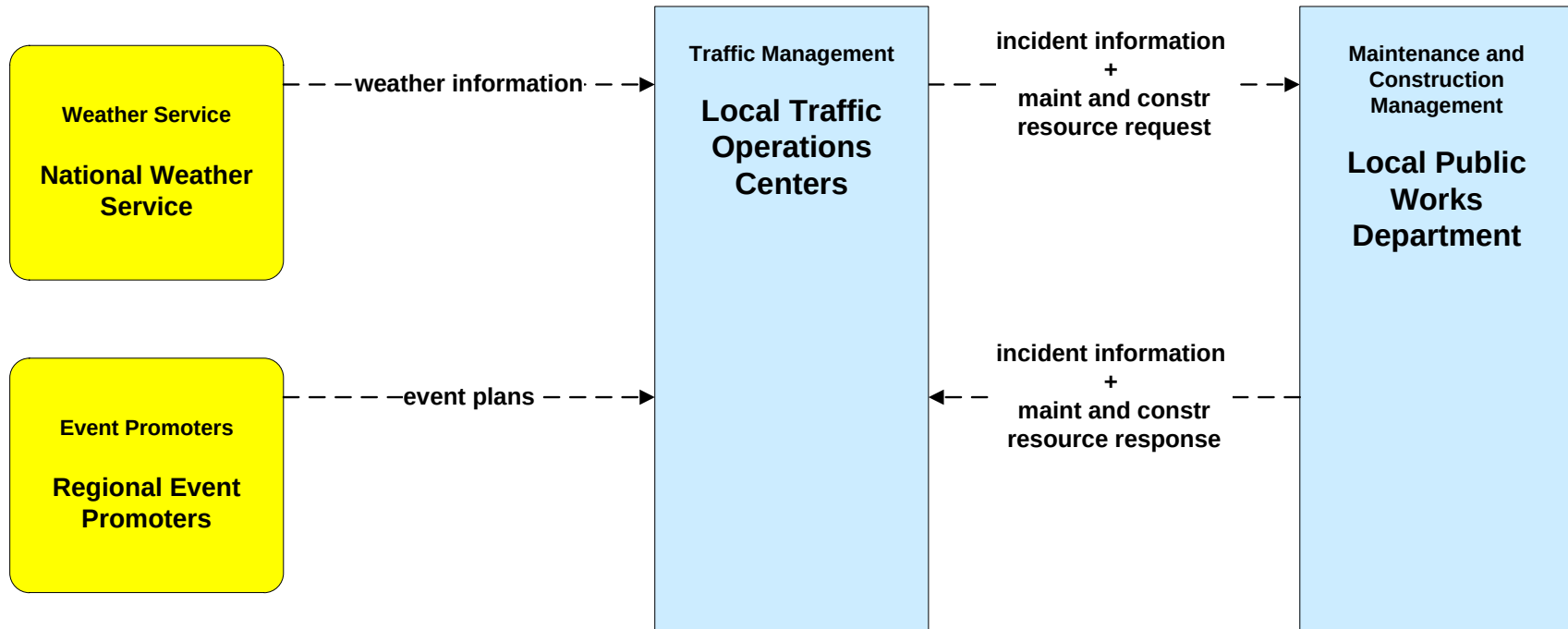
ATMS08 - Incident Management Fayetteville (TM to MCM)



ATMS08 - Incident Management Fort Bragg (TM to MCM)



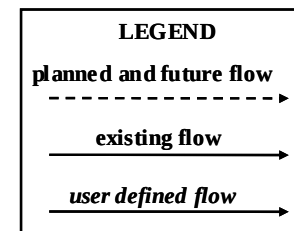
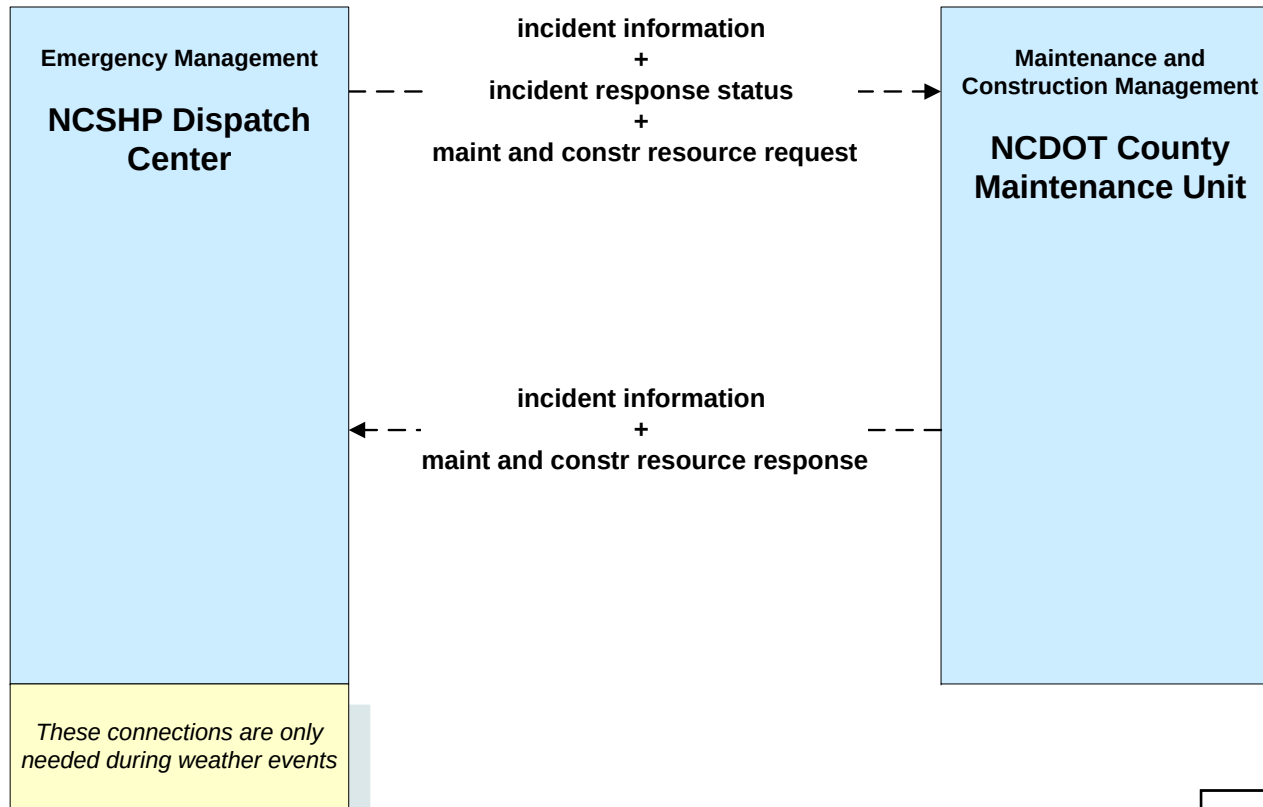
ATMS08 - Incident Management Local Municipalities (TM to MCM)



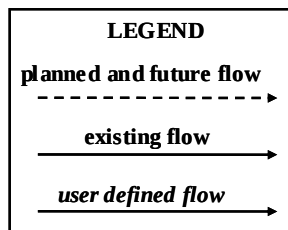
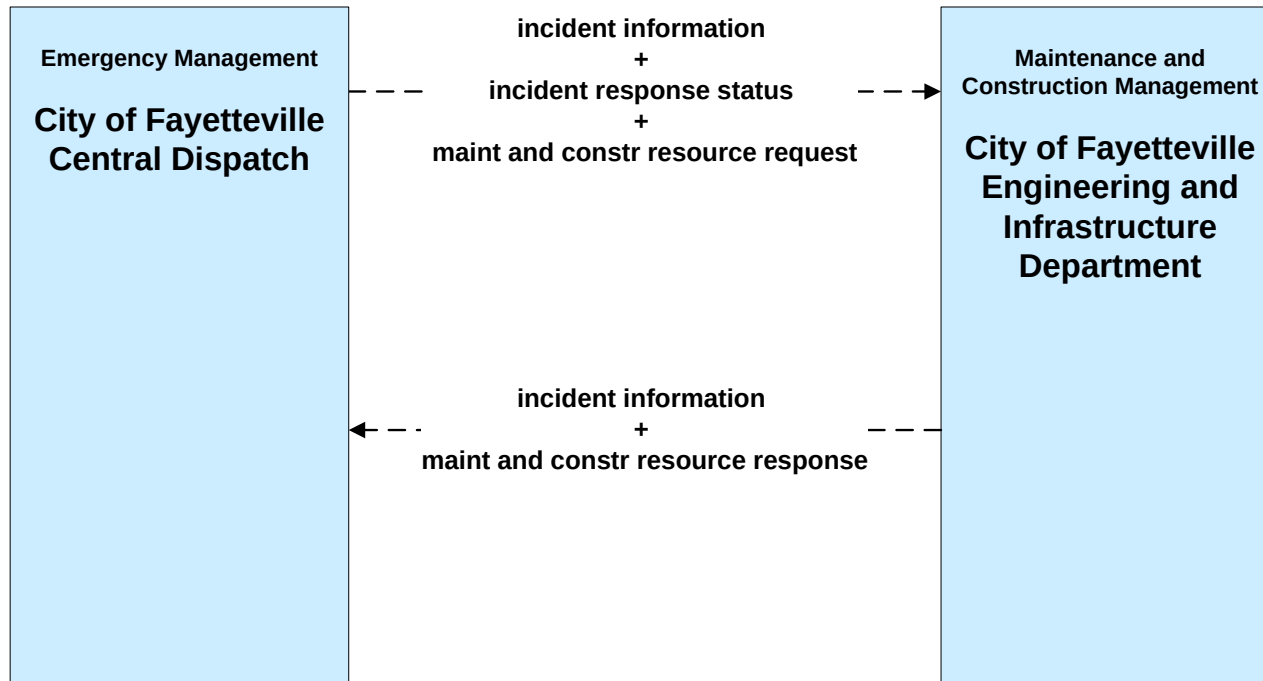
ATMS08 - Incident Management

Emergency Management <-- --> Maintenance and Construction Management

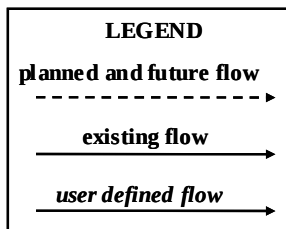
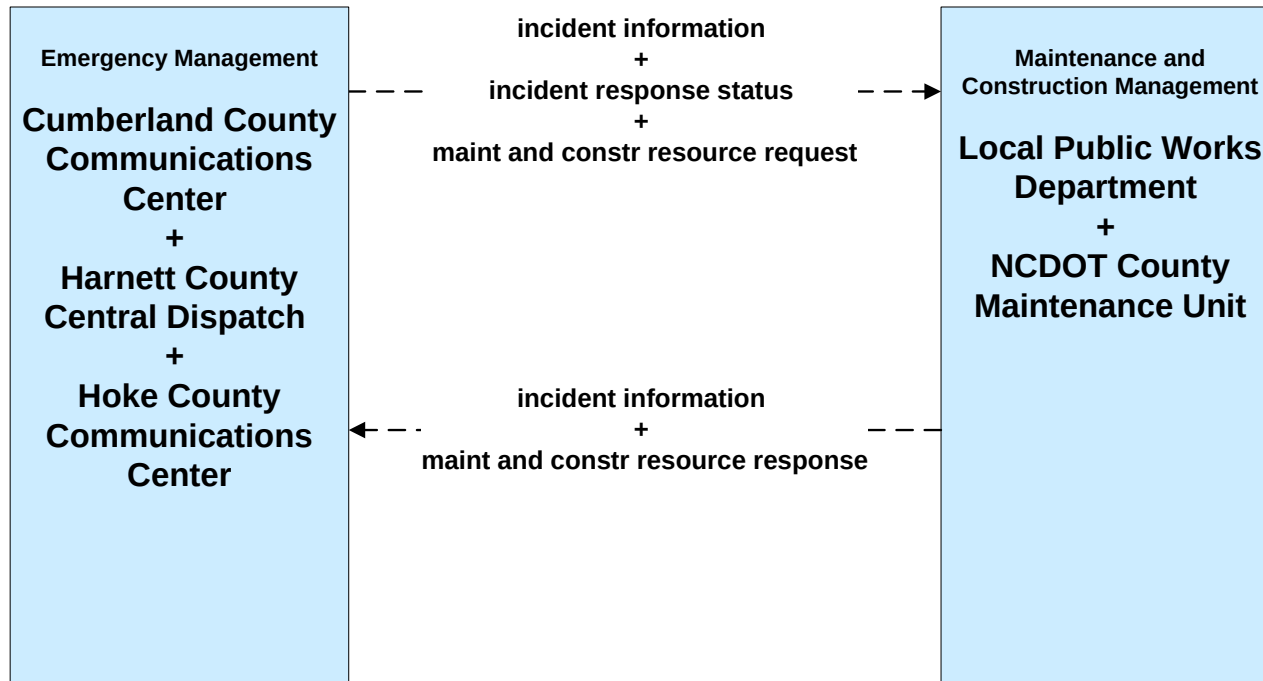
ATMS08 - Incident Management
North Carolina State Highway Patrol (EM to MCM)



**ATMS08 - Incident Management
Fayetteville (EM to MCM)**



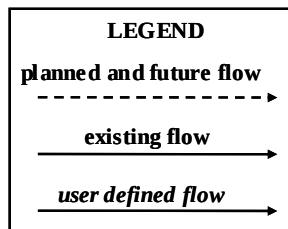
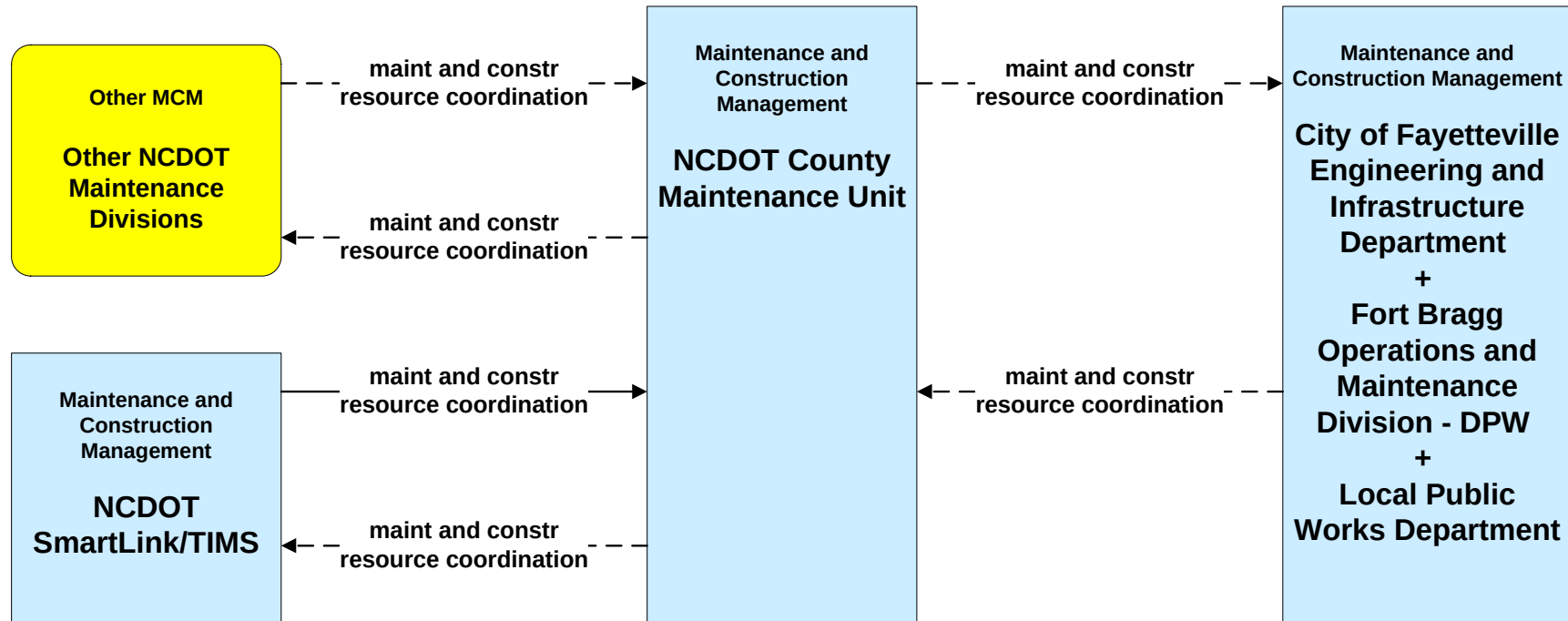
**ATMS08 - Incident Management
County Communications Center (EM to MCM)**



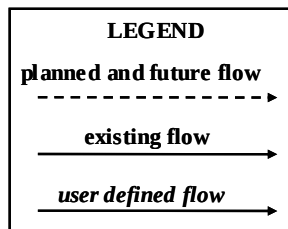
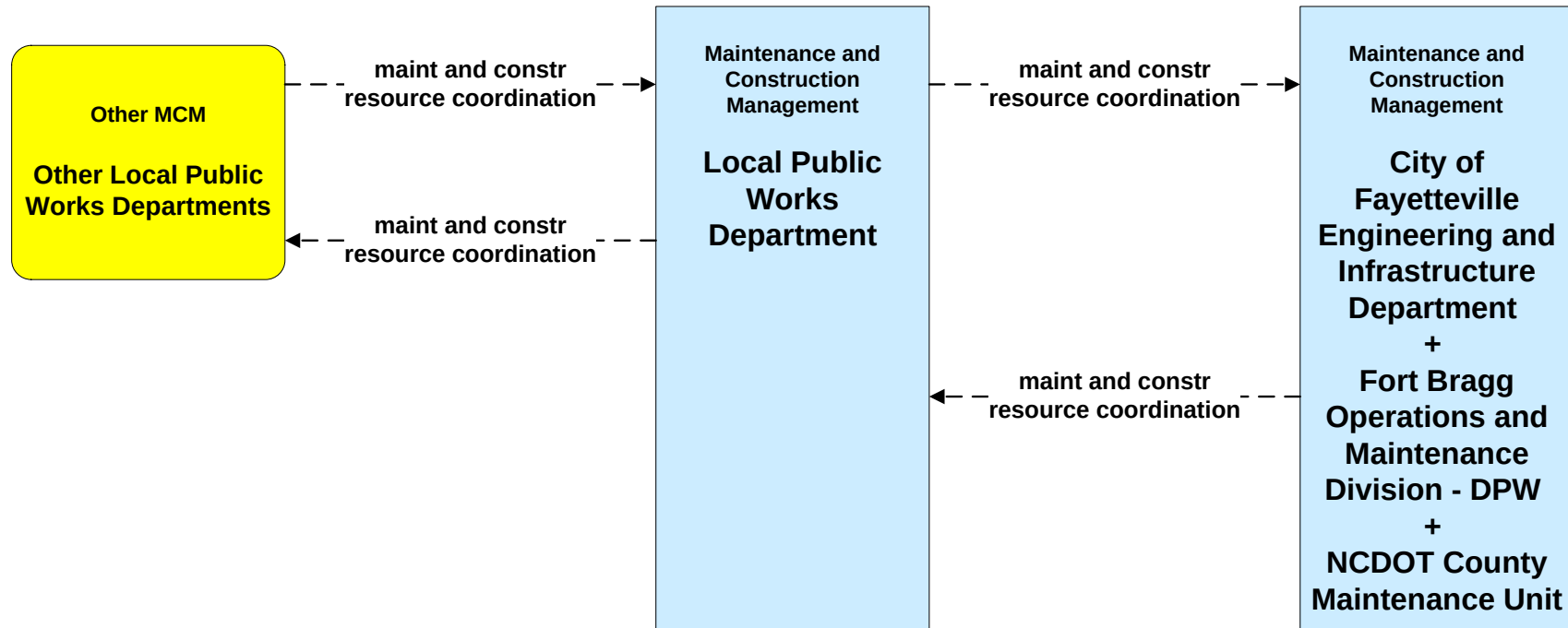
ATMS08 - Incident Management

*Maintenance and Construction Management <-- --> Maintenance and
Construction Management*

ATMS08 - Incident Management NCDOT (MCM to MCM)



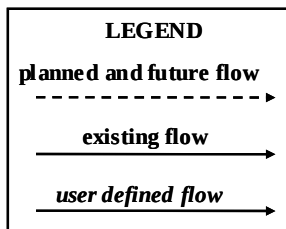
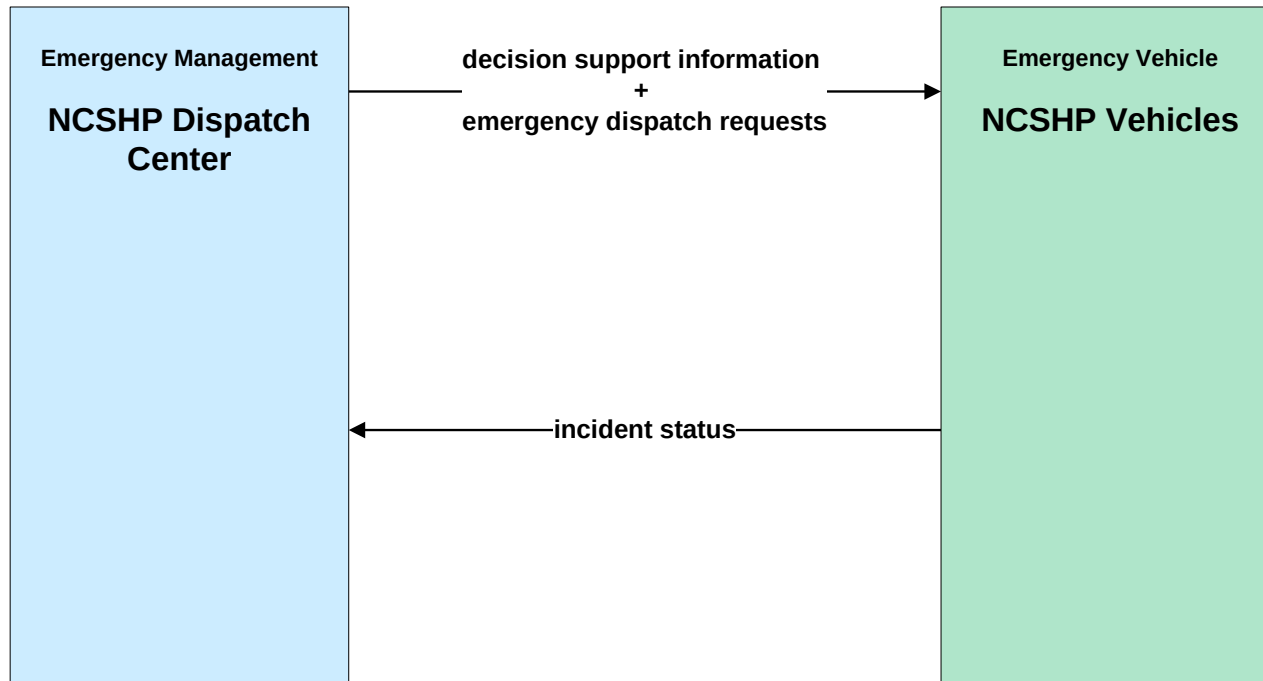
**ATMS08 - Incident Management
Local Municipalities (MCM to MCM)**



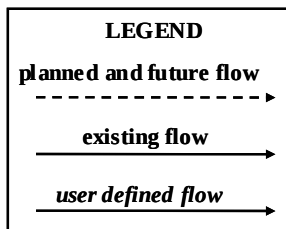
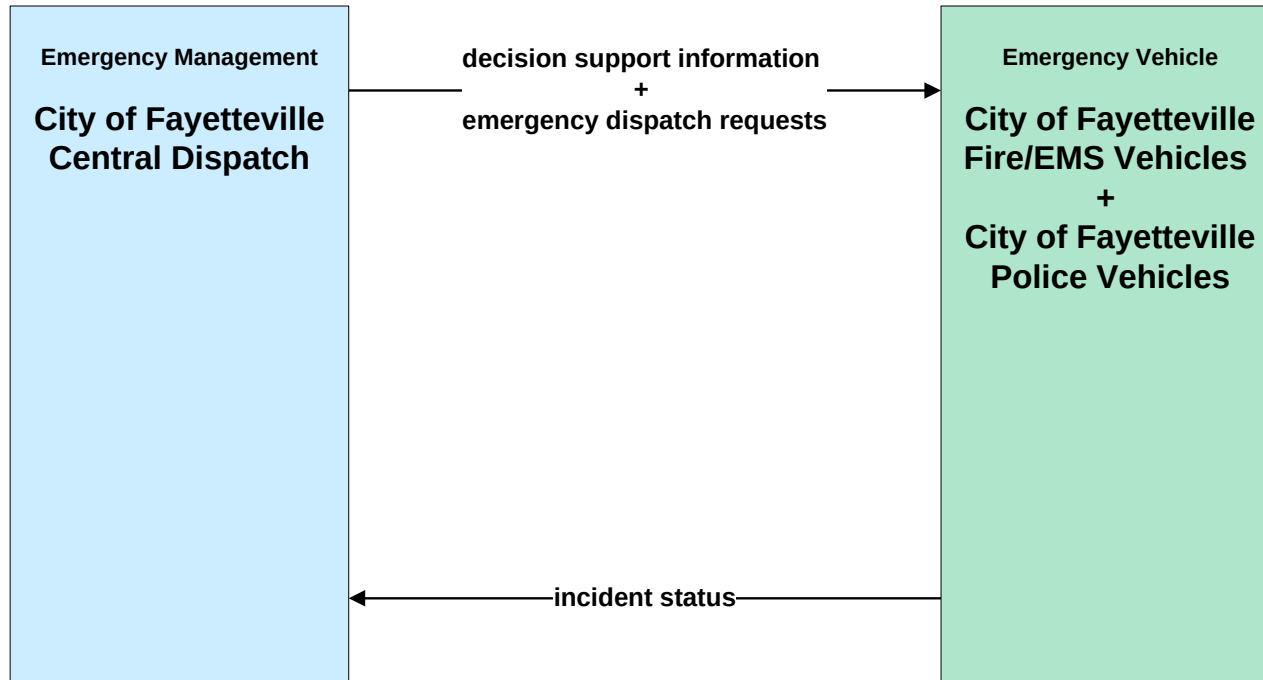
ATMS08 - Incident Management

Emergency Management <-- --> Emergency Vehicles

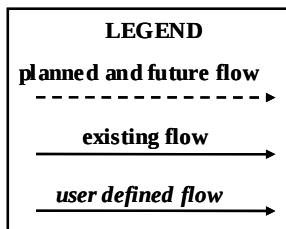
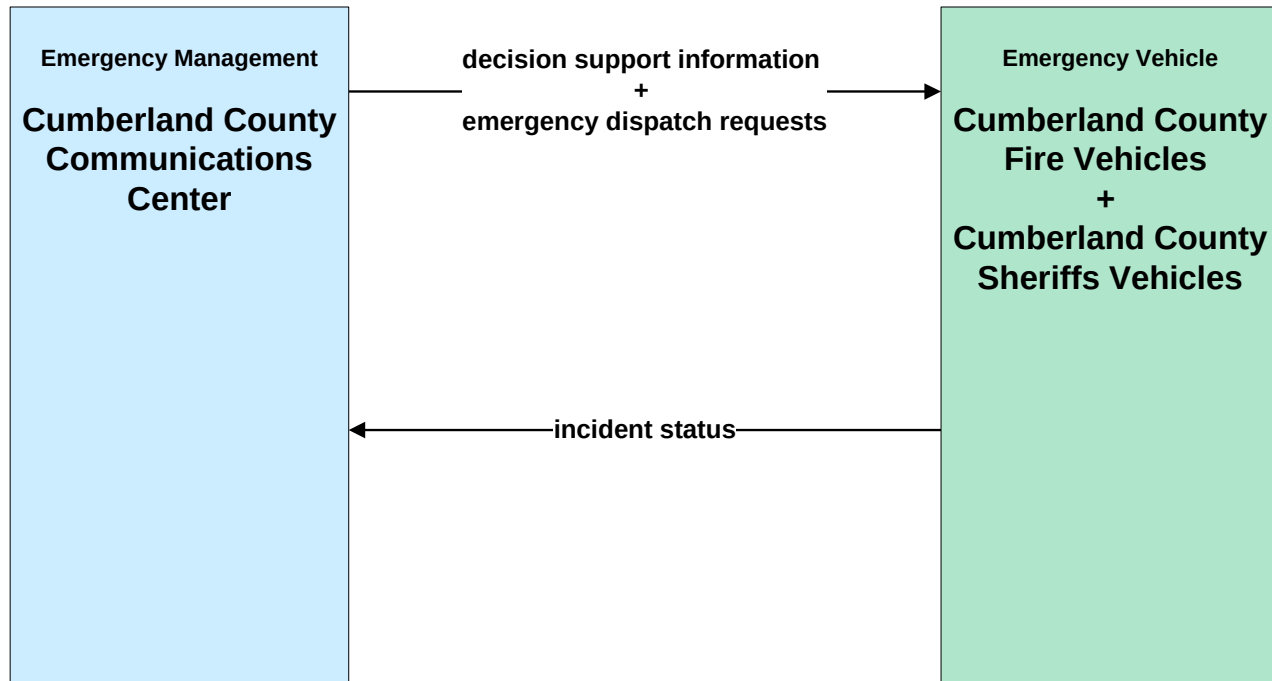
ATMS08 - Incident Management
North Carolina State Highway Patrol (EM to EVS)



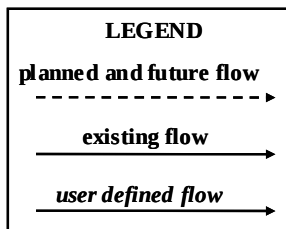
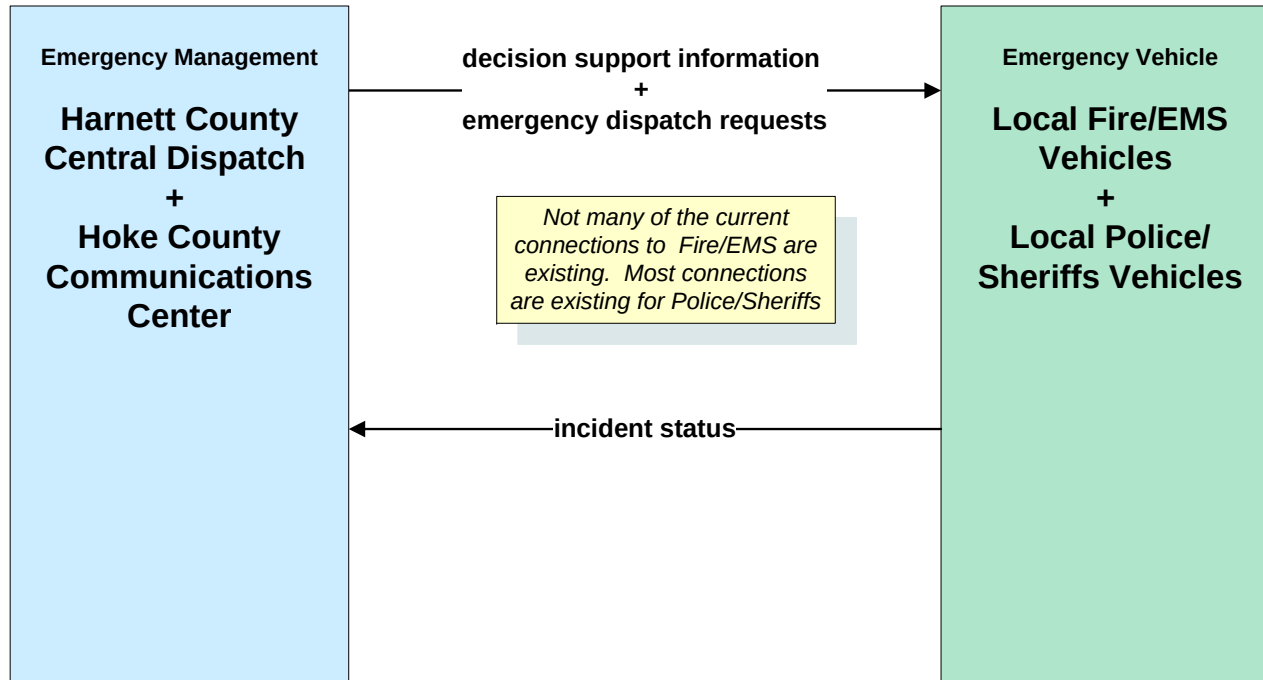
**ATMS08 - Incident Management
Fayetteville (EM to EVS)**



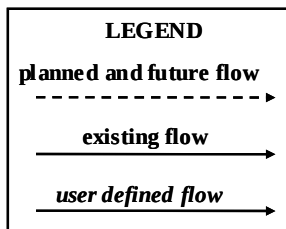
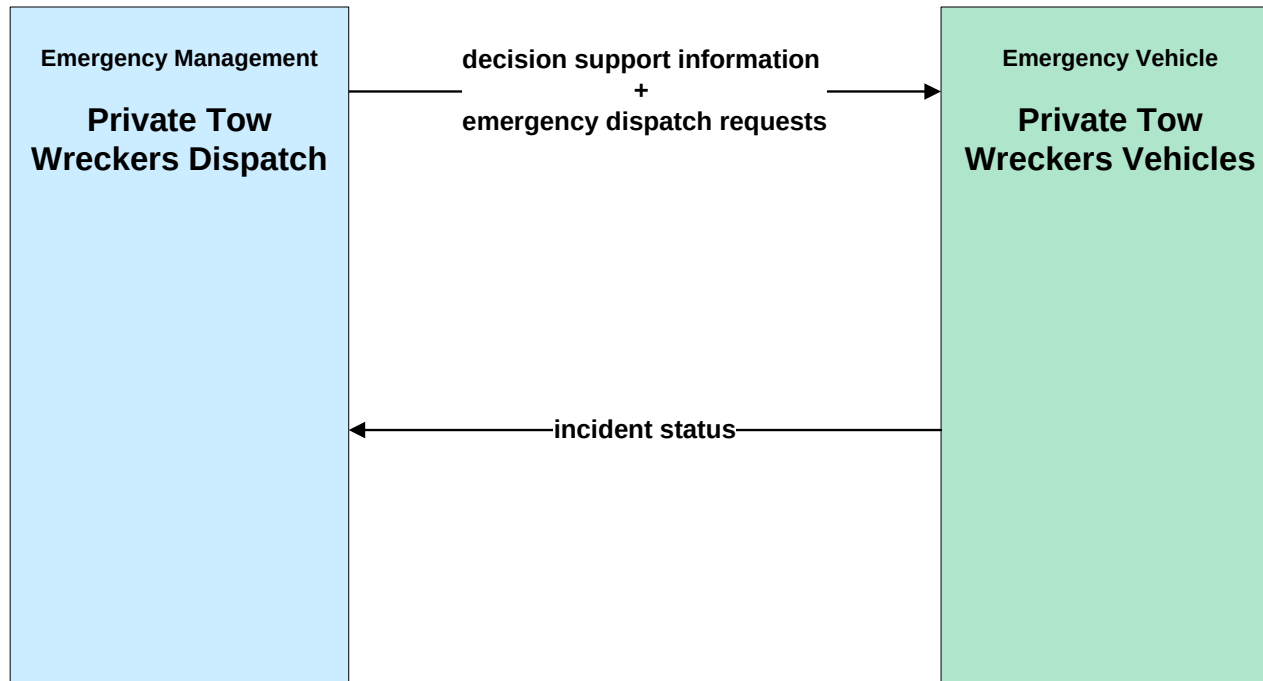
ATMS08 - Incident Management
Cumberland County Communications Center (EM to EVS)



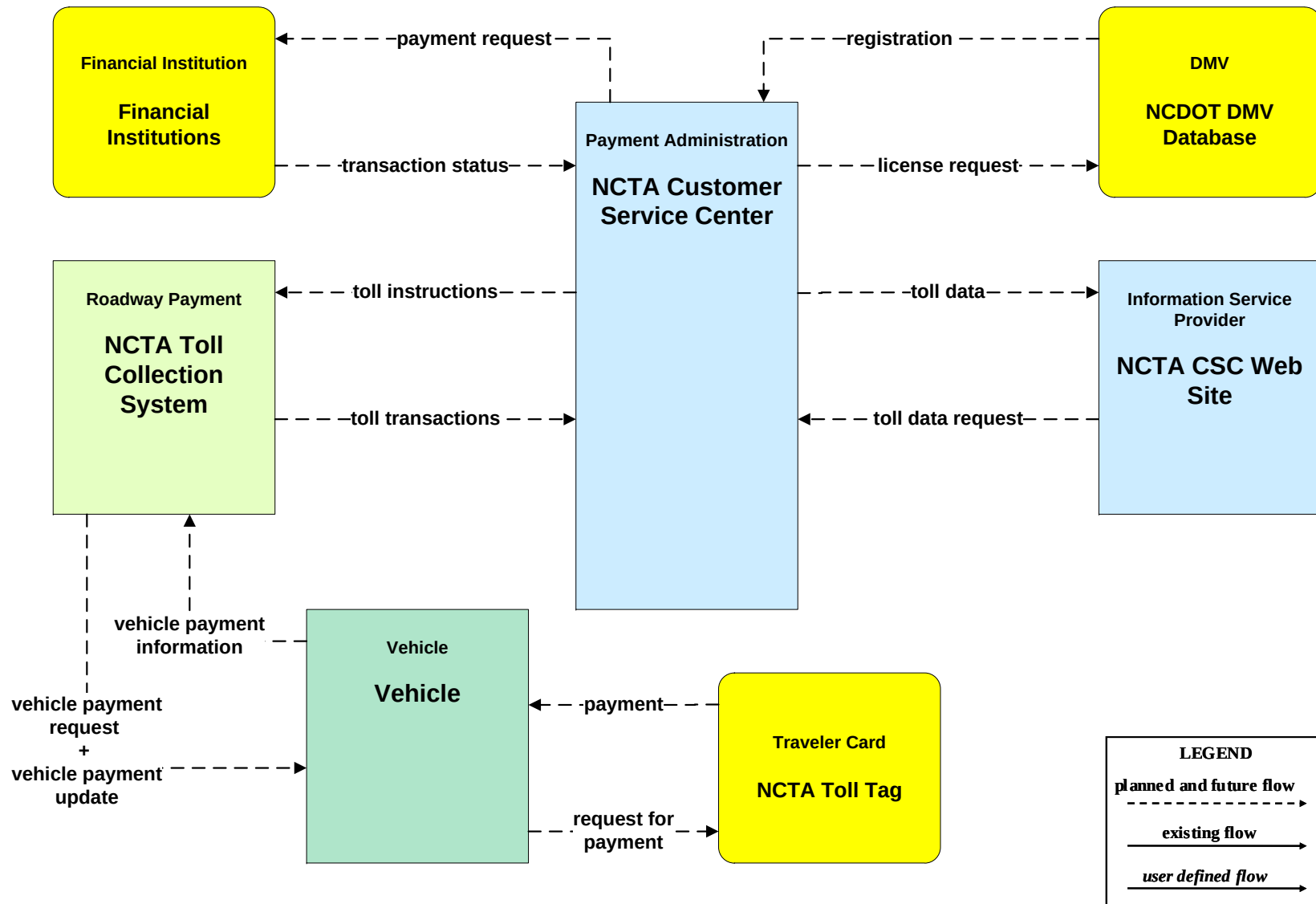
**ATMS08 - Incident Management
County Communications Center (EM to EVS)**



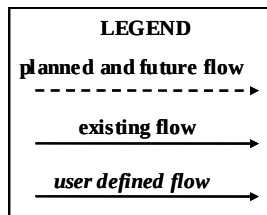
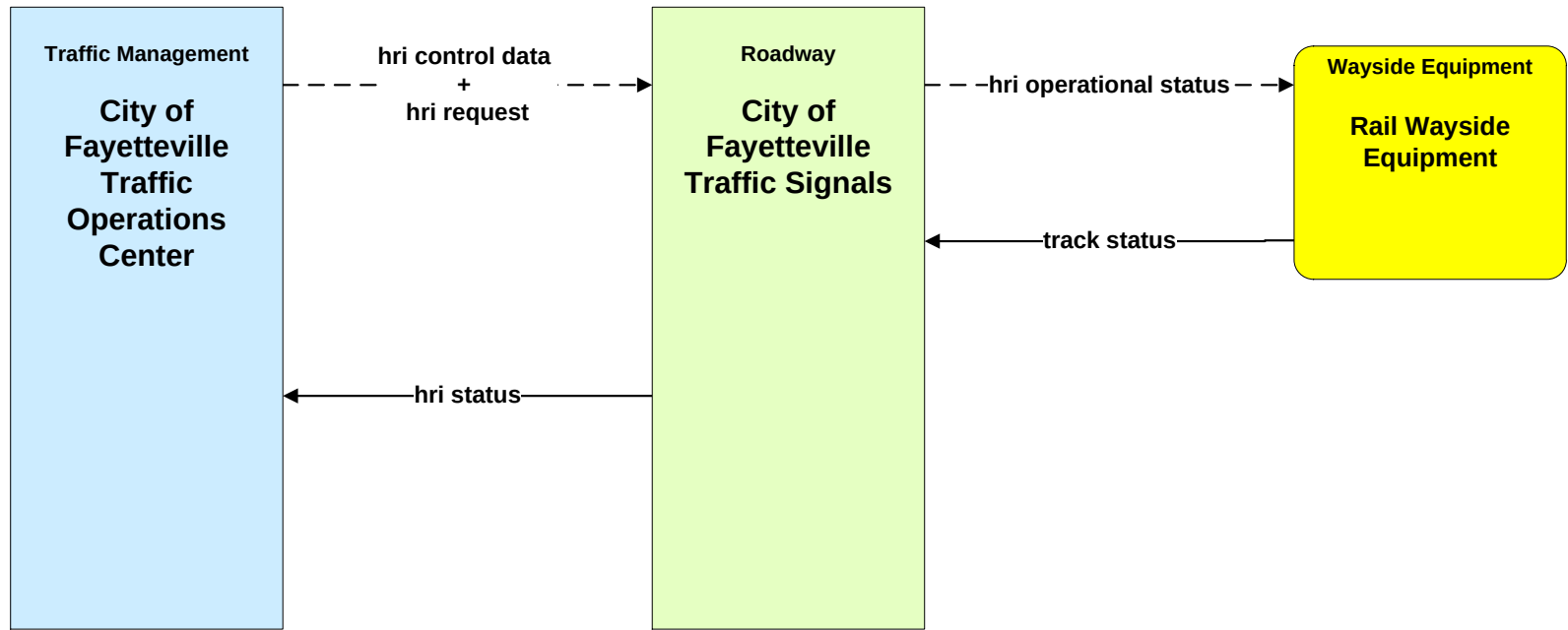
**ATMS08 - Incident Management
Private Tow Wreckers (EM to EVS)**



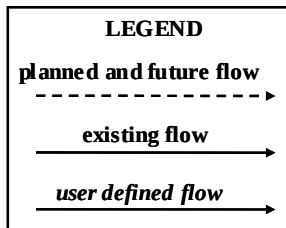
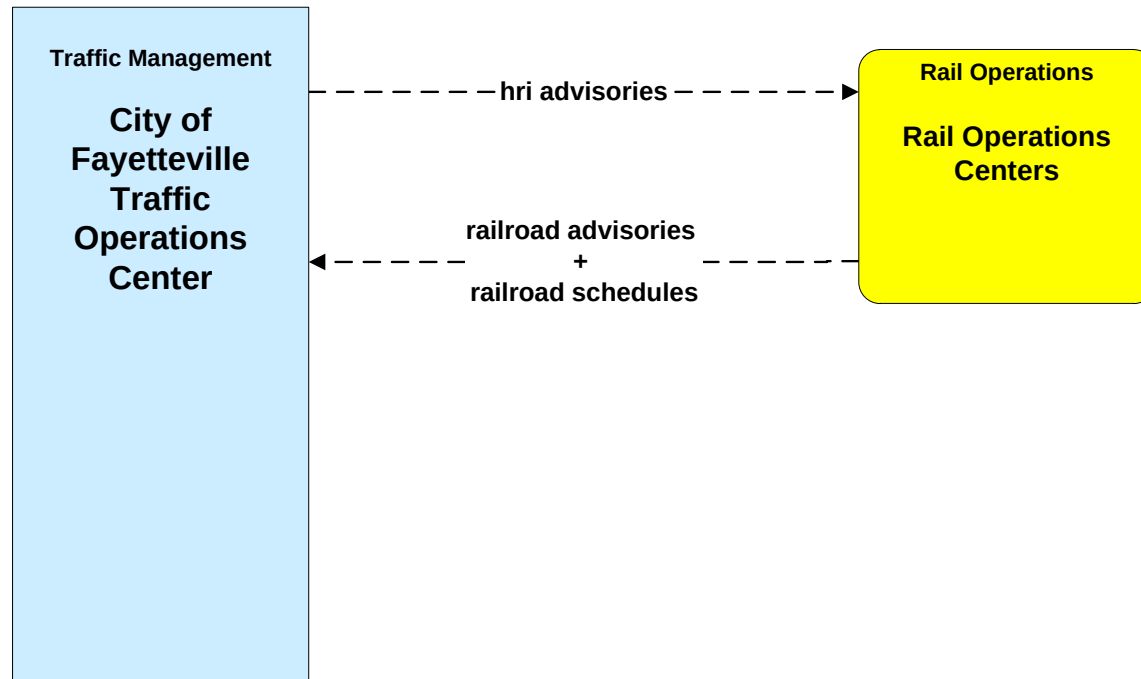
ATMS10 – Electronic Toll Collection North Carolina Turnpike Authority



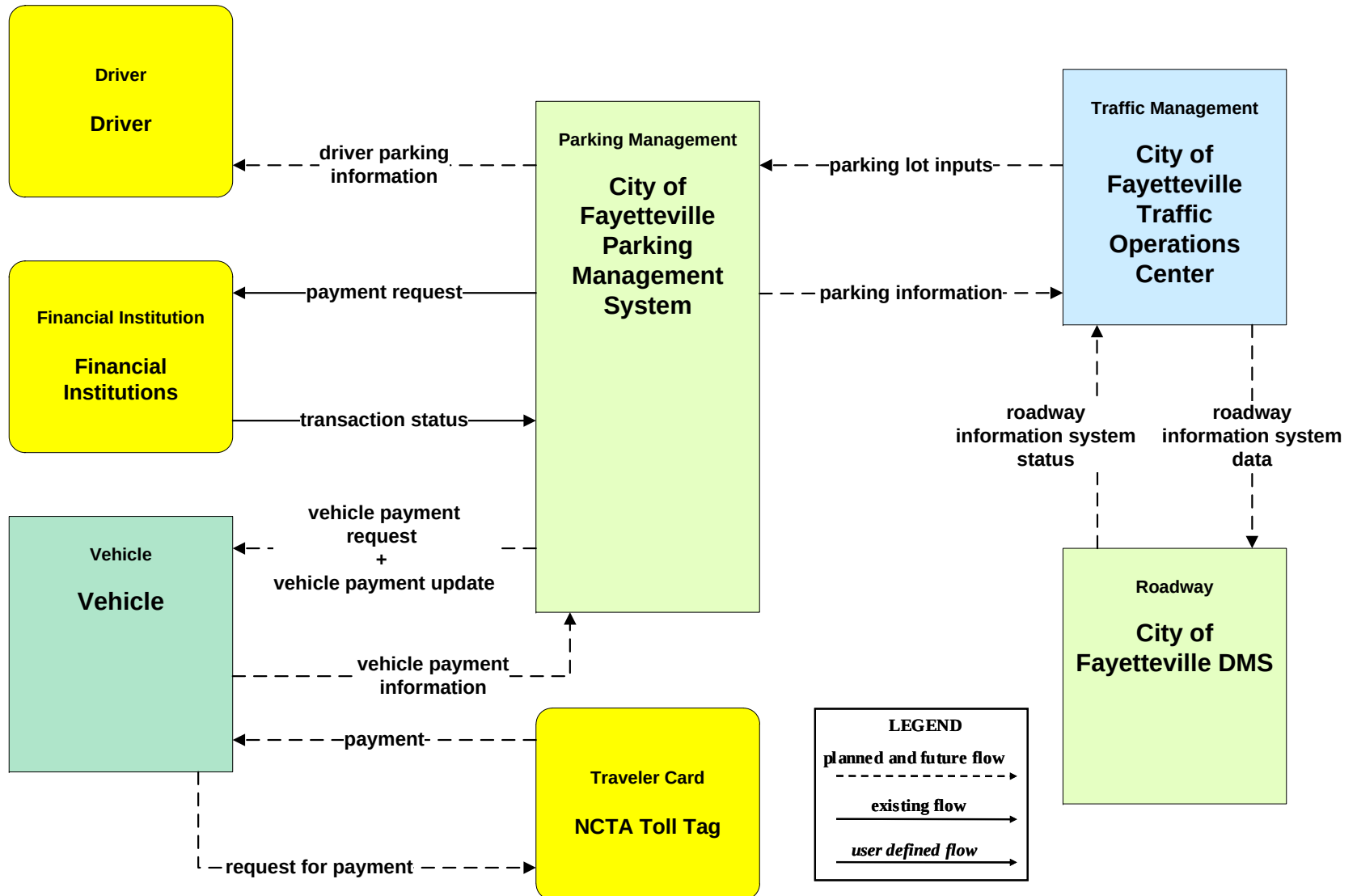
**ATMS13 - Standard Railroad Crossing
Fayetteville**



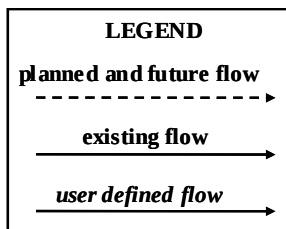
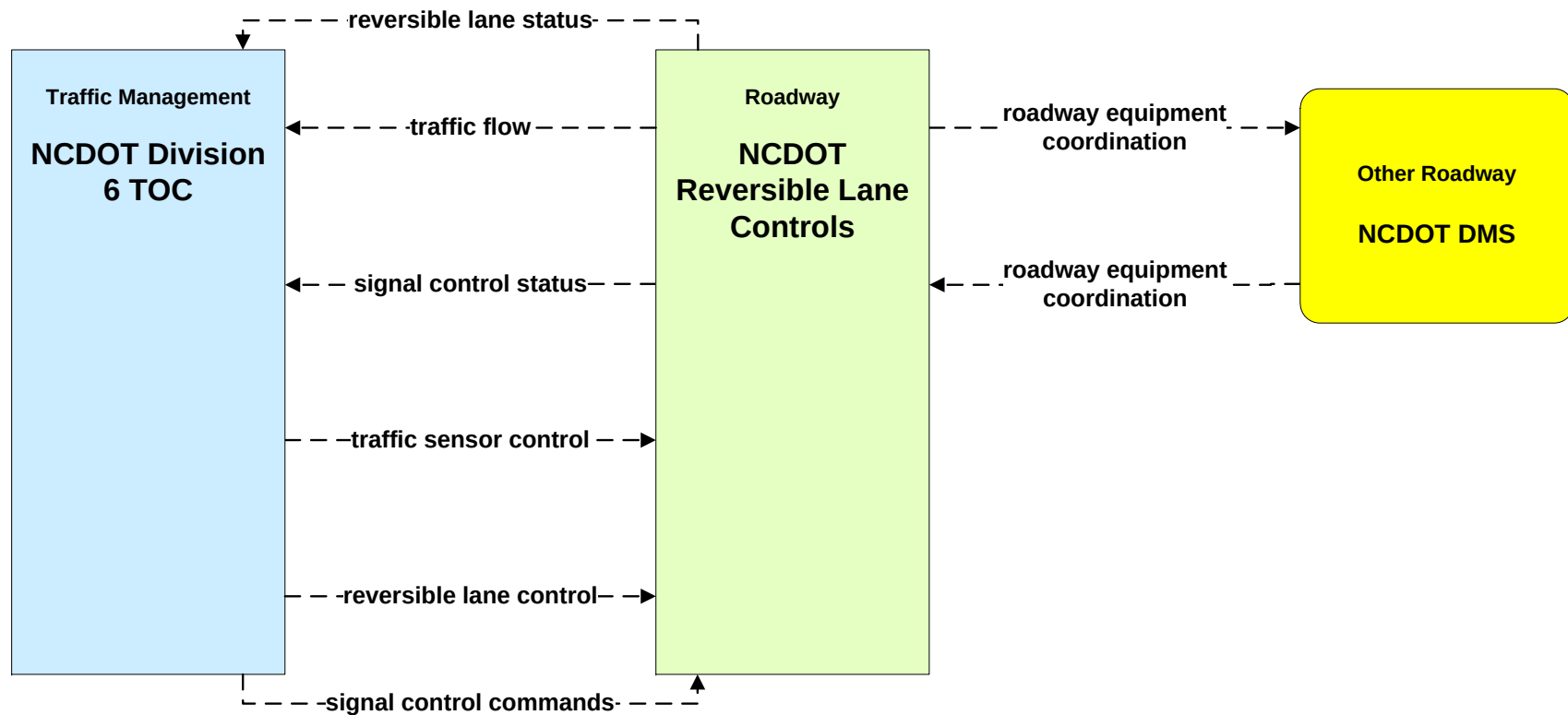
**ATMS15 – Railroad Operations Coordination
City of Fayetteville**



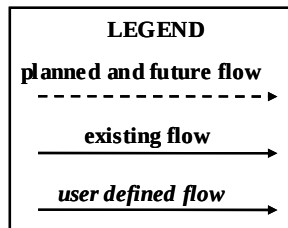
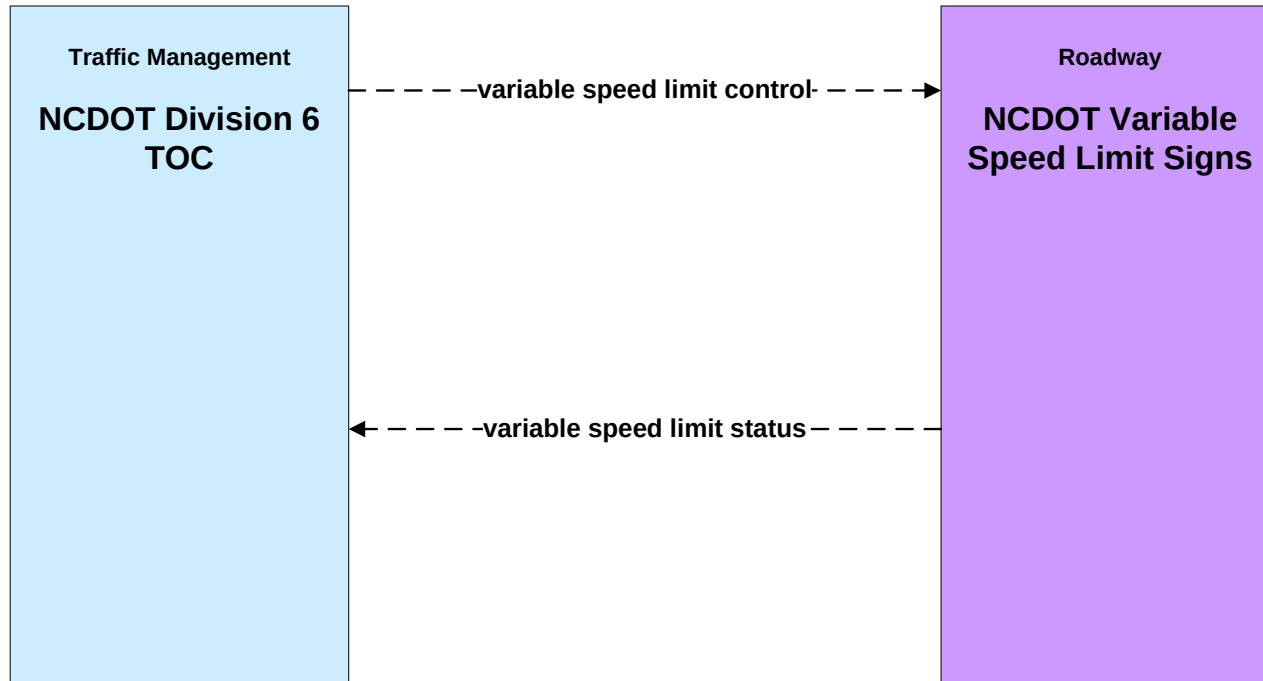
ATMS16 - Parking Facility Management Fayetteville



ATMS18 - Reversible Lane Management NCDOT



**ATMS22 – Variable Speed Limits
NCDOT**

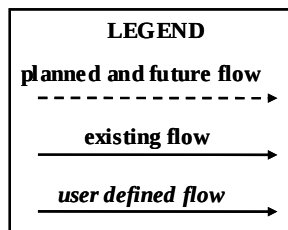
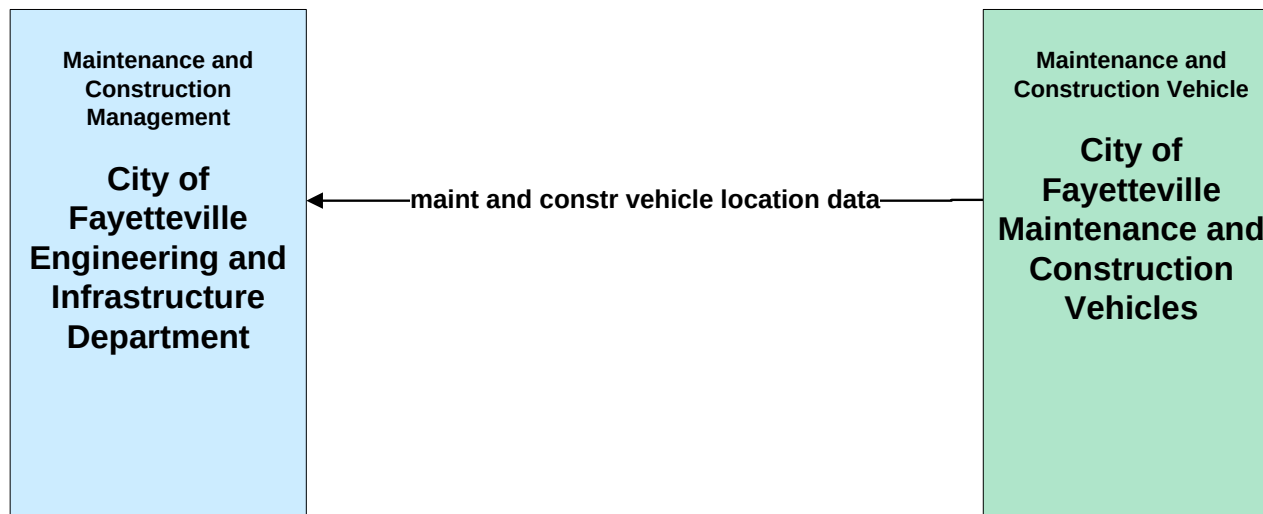


FAMPO Regional ITS Architecture

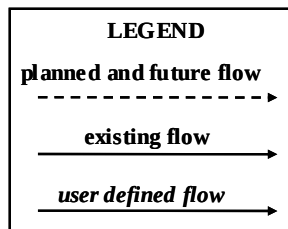
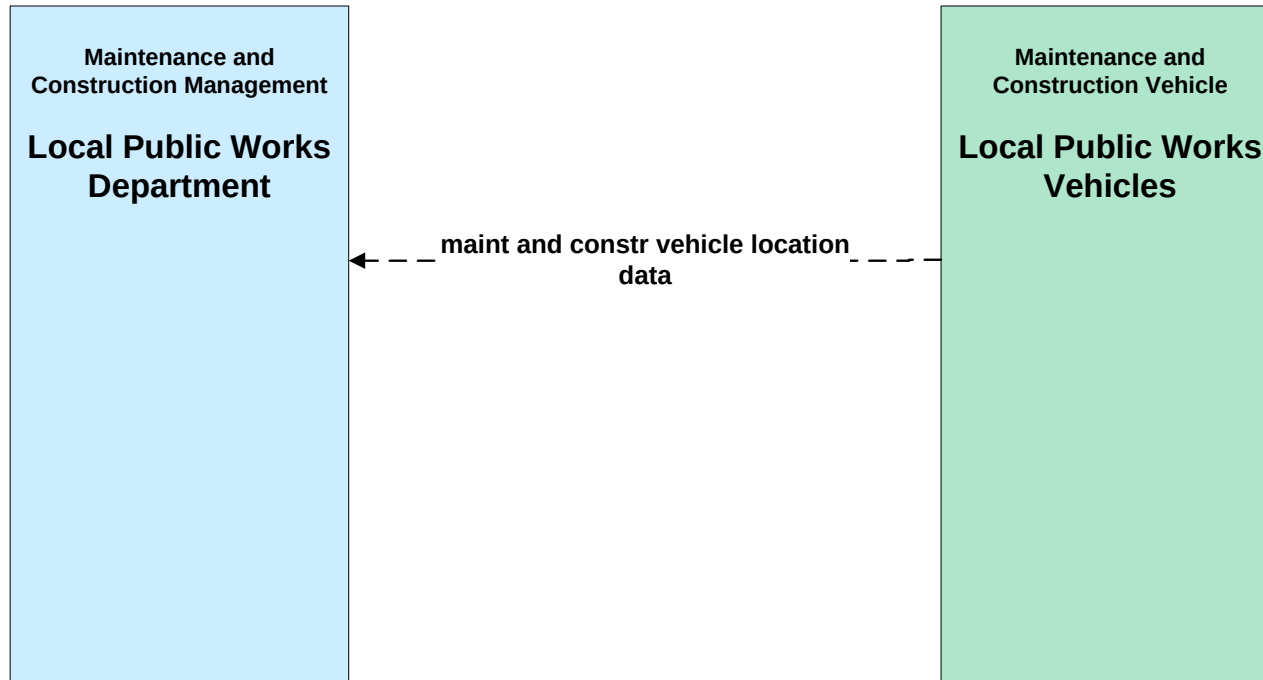
Customized Service Package Diagrams

Maintenance and Construction (MC)

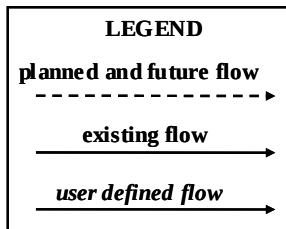
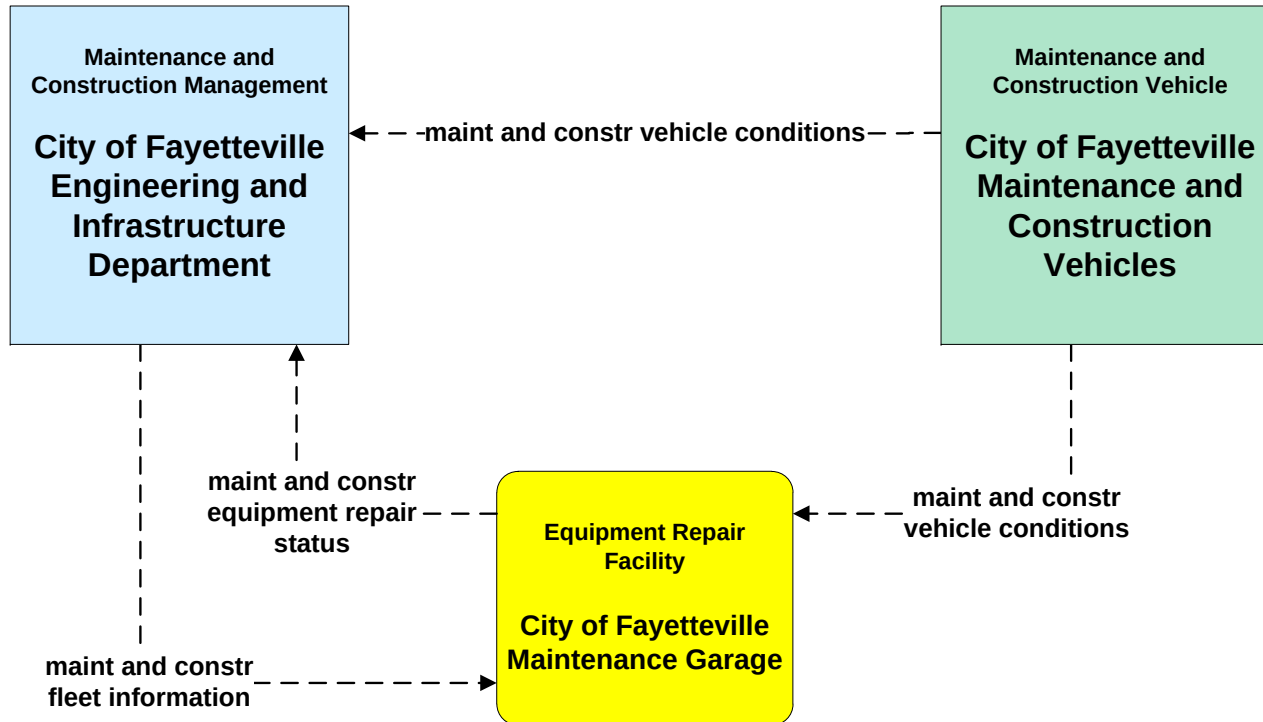
MC01 - Maintenance and Construction Vehicle Tracking



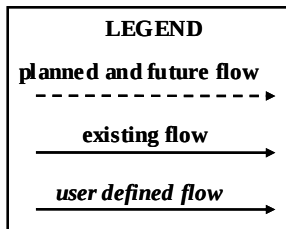
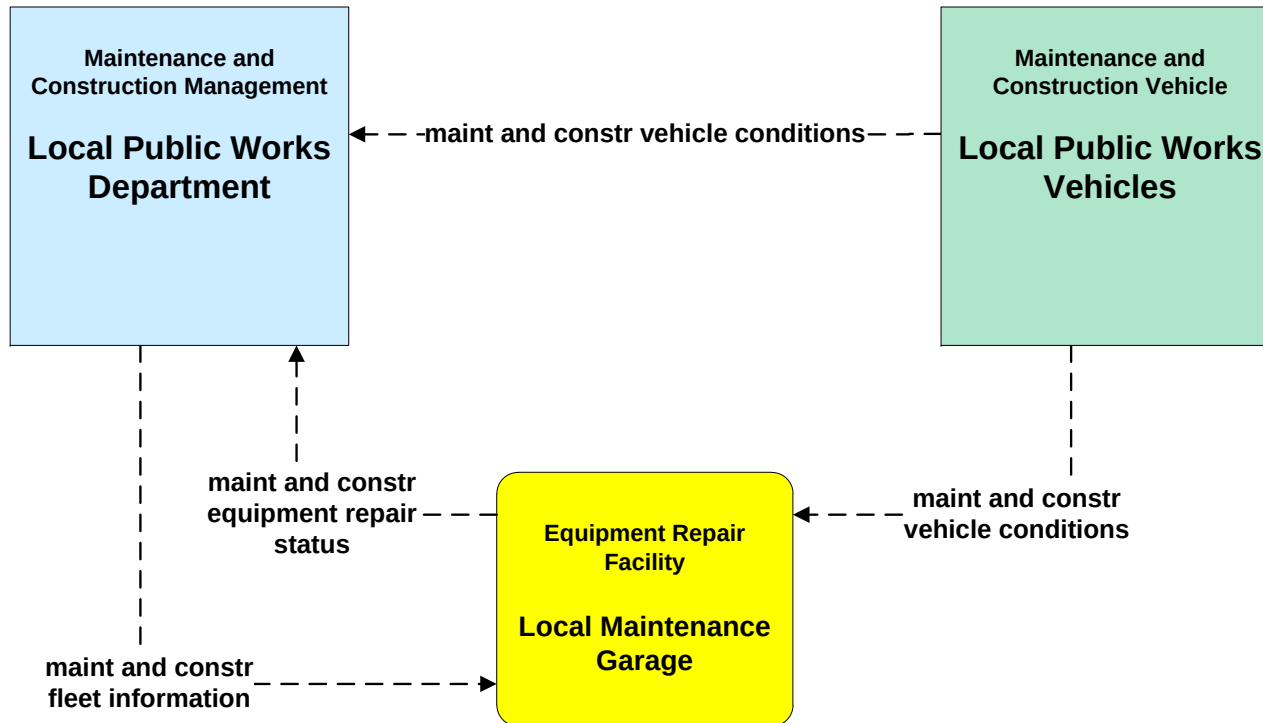
**MC01 - Maintenance and Construction Vehicle and Equipment Tracking
Local Counties and Municipalities**



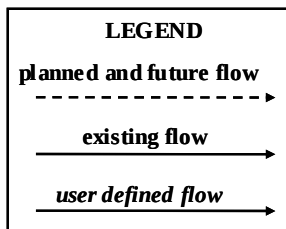
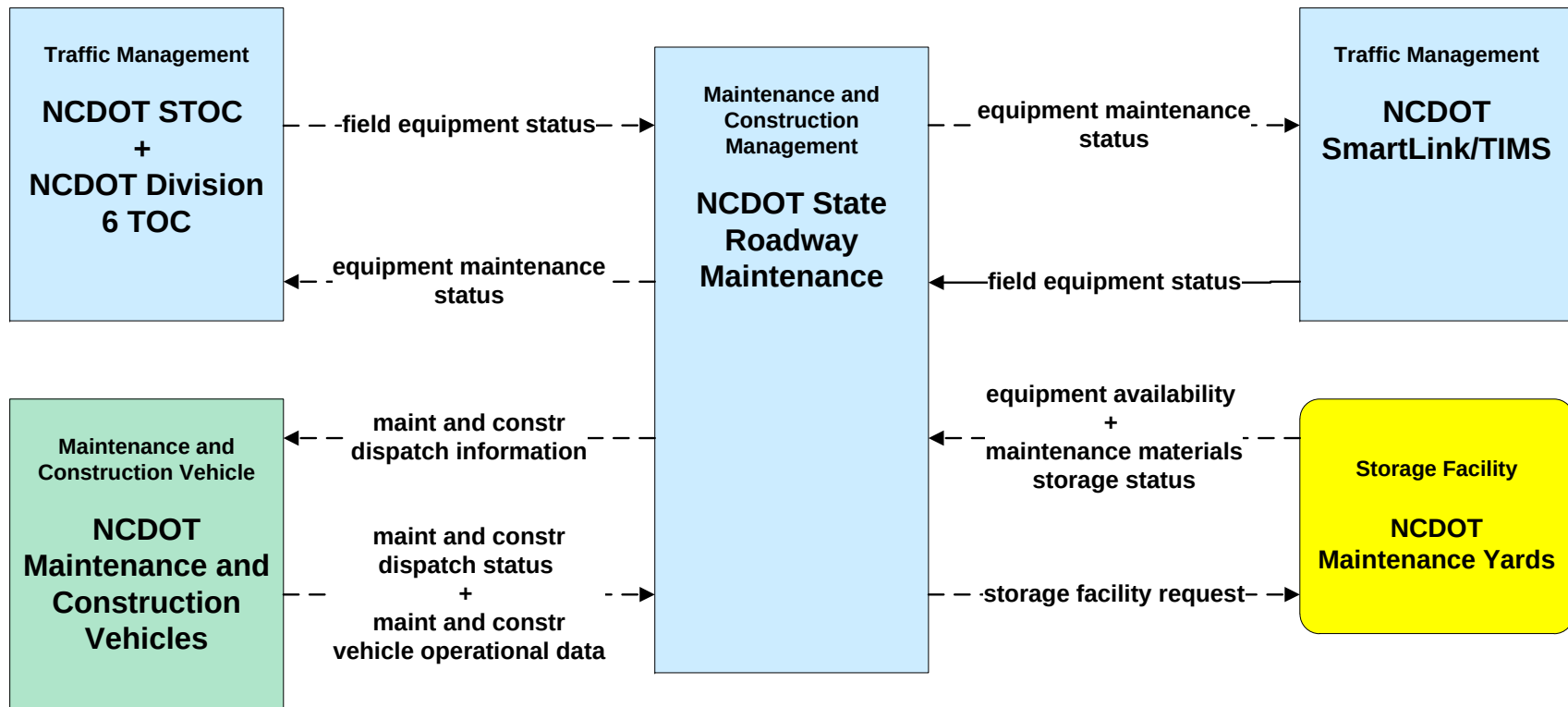
**MC02 - Maintenance and Construction Vehicle Maintenance
Fayetteville**



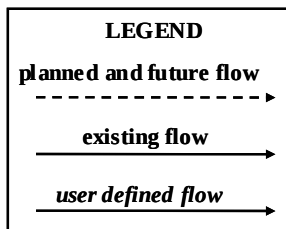
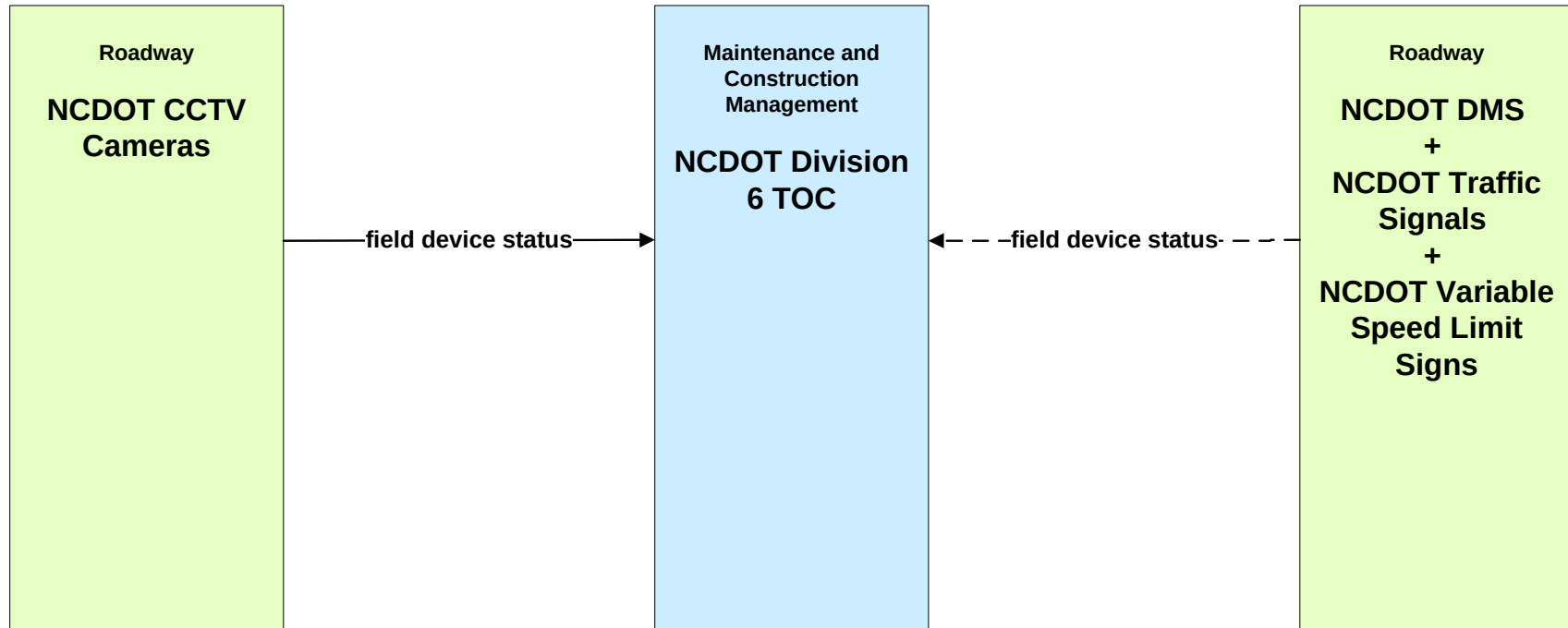
**MC02 - Maintenance and Construction Vehicle Maintenance
Local Counties and Municipalities**



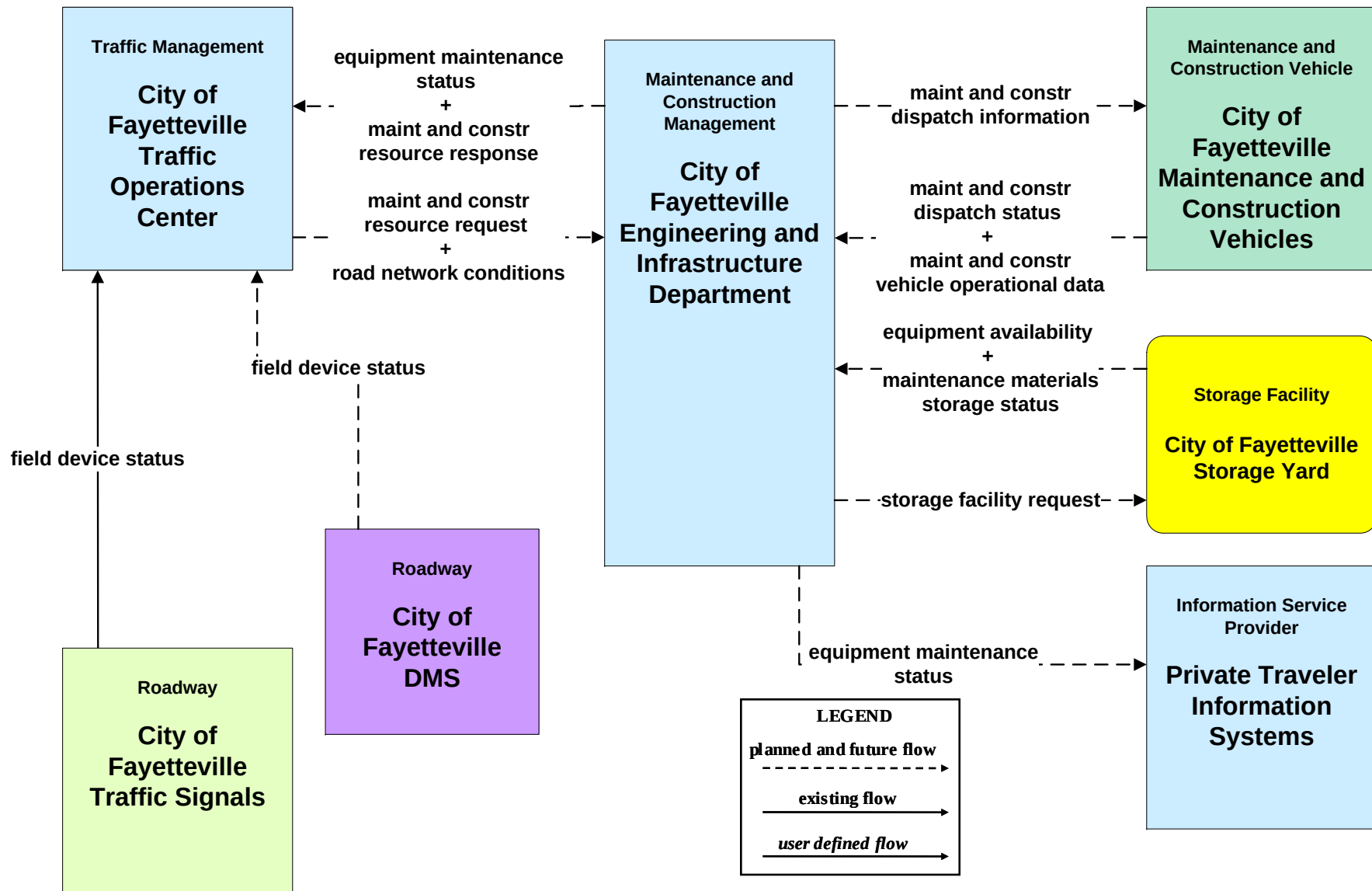
**MC07 - Roadway Maintenance and Construction
NCDOT (1 of 2)**



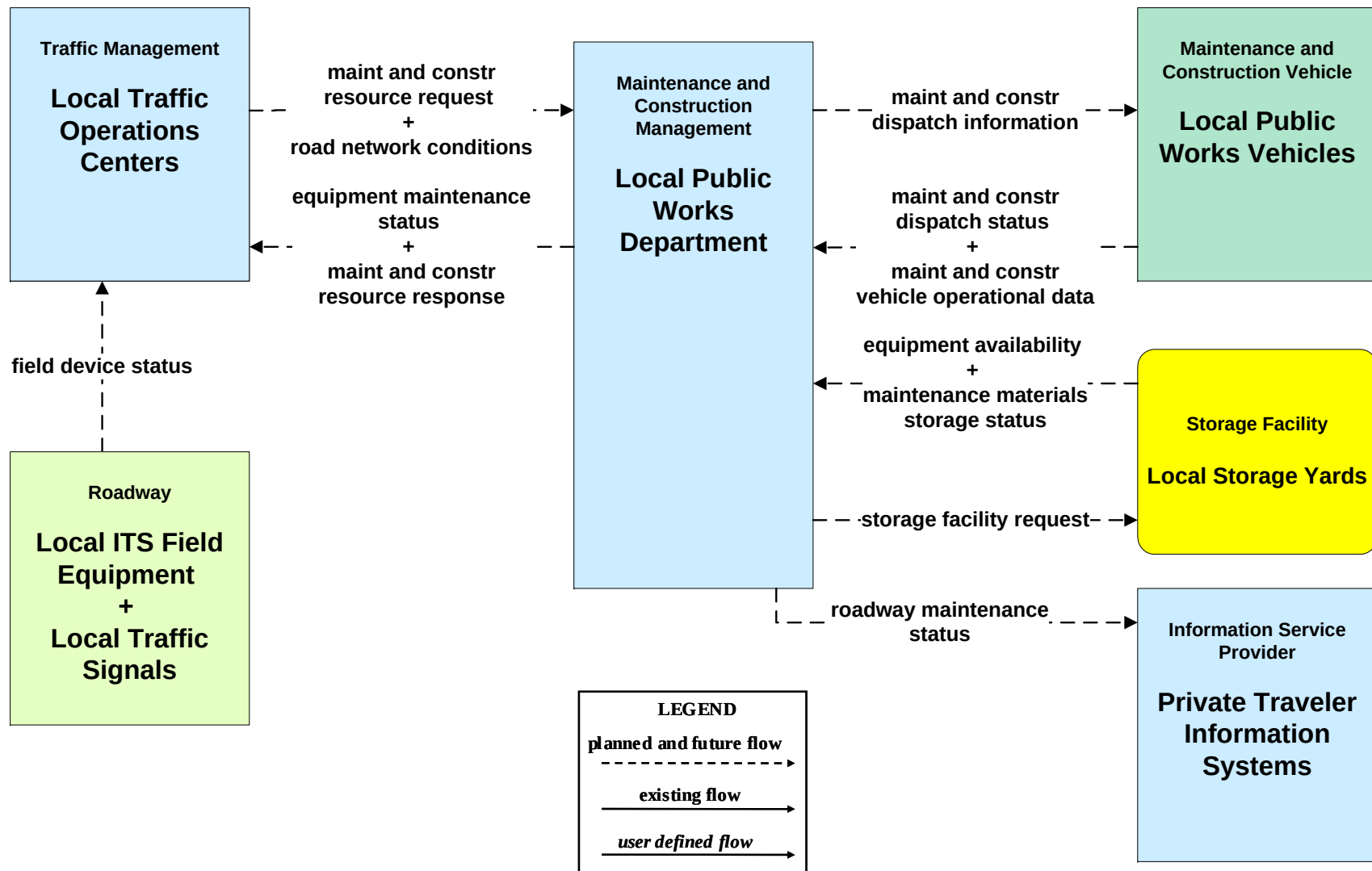
**MC07 - Roadway Maintenance and Construction
NCDOT (2 of 2)**



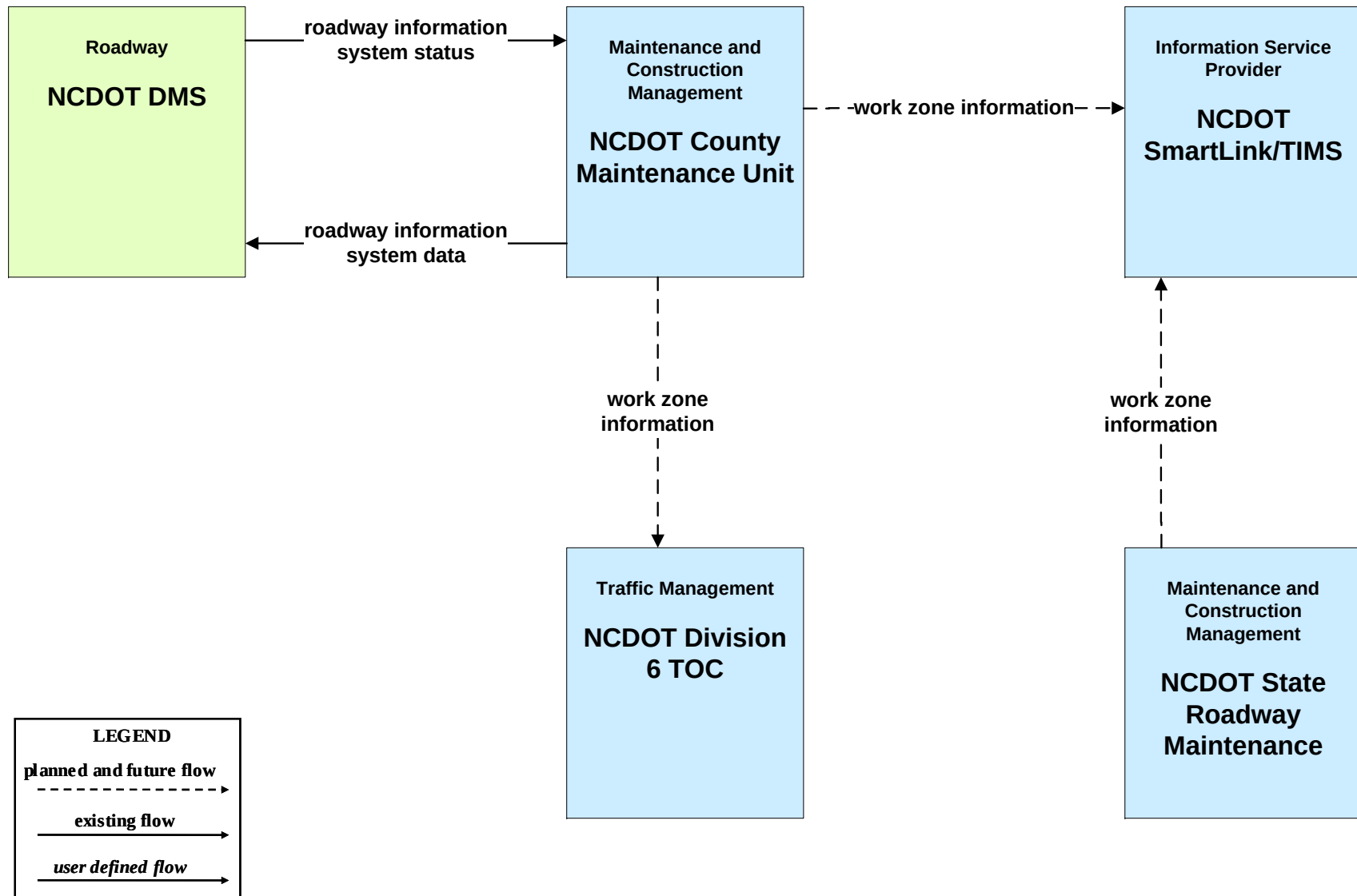
MC07 - Roadway Maintenance and Construction Fayetteville



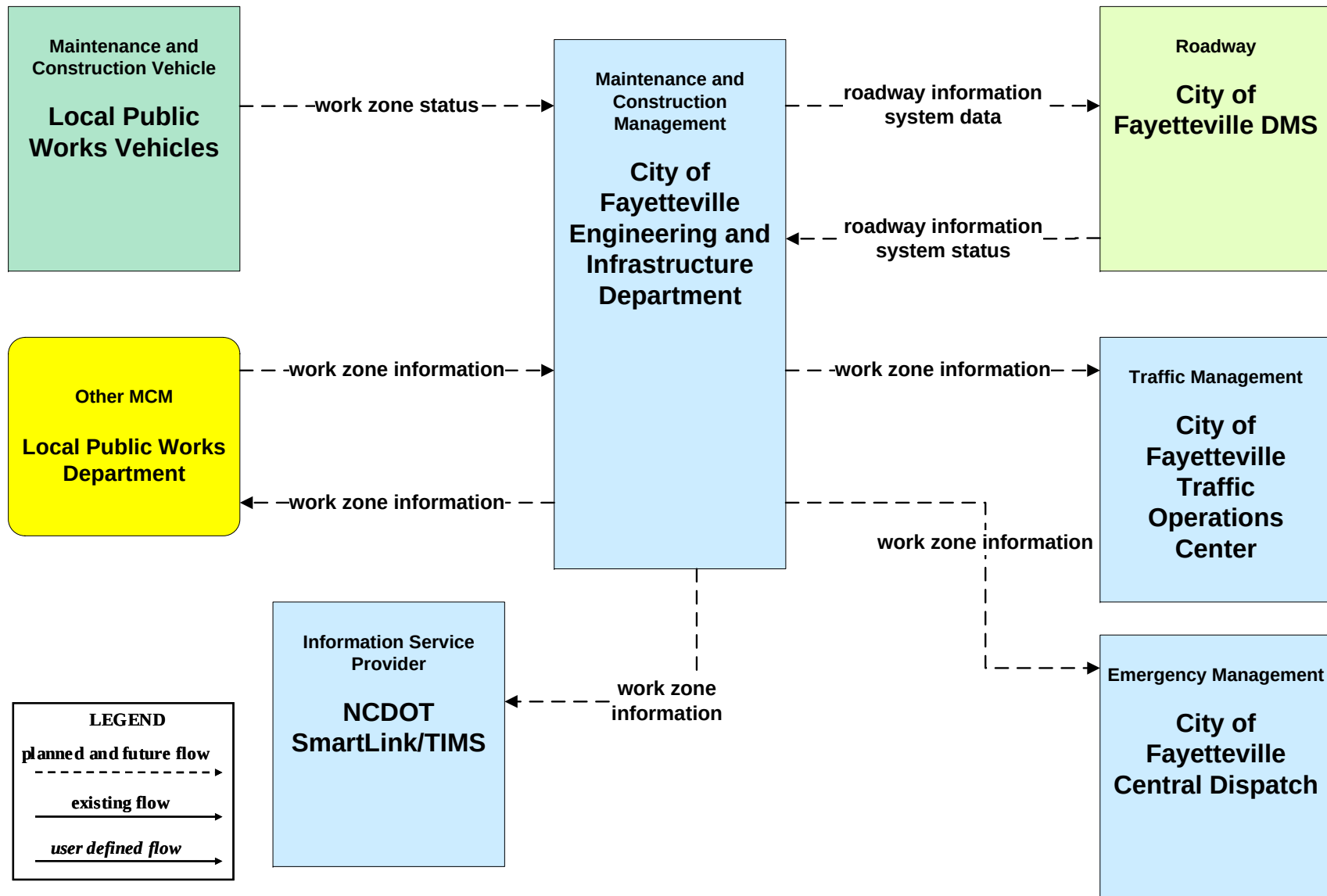
MC07 - Roadway Maintenance and Construction Local Municipalities



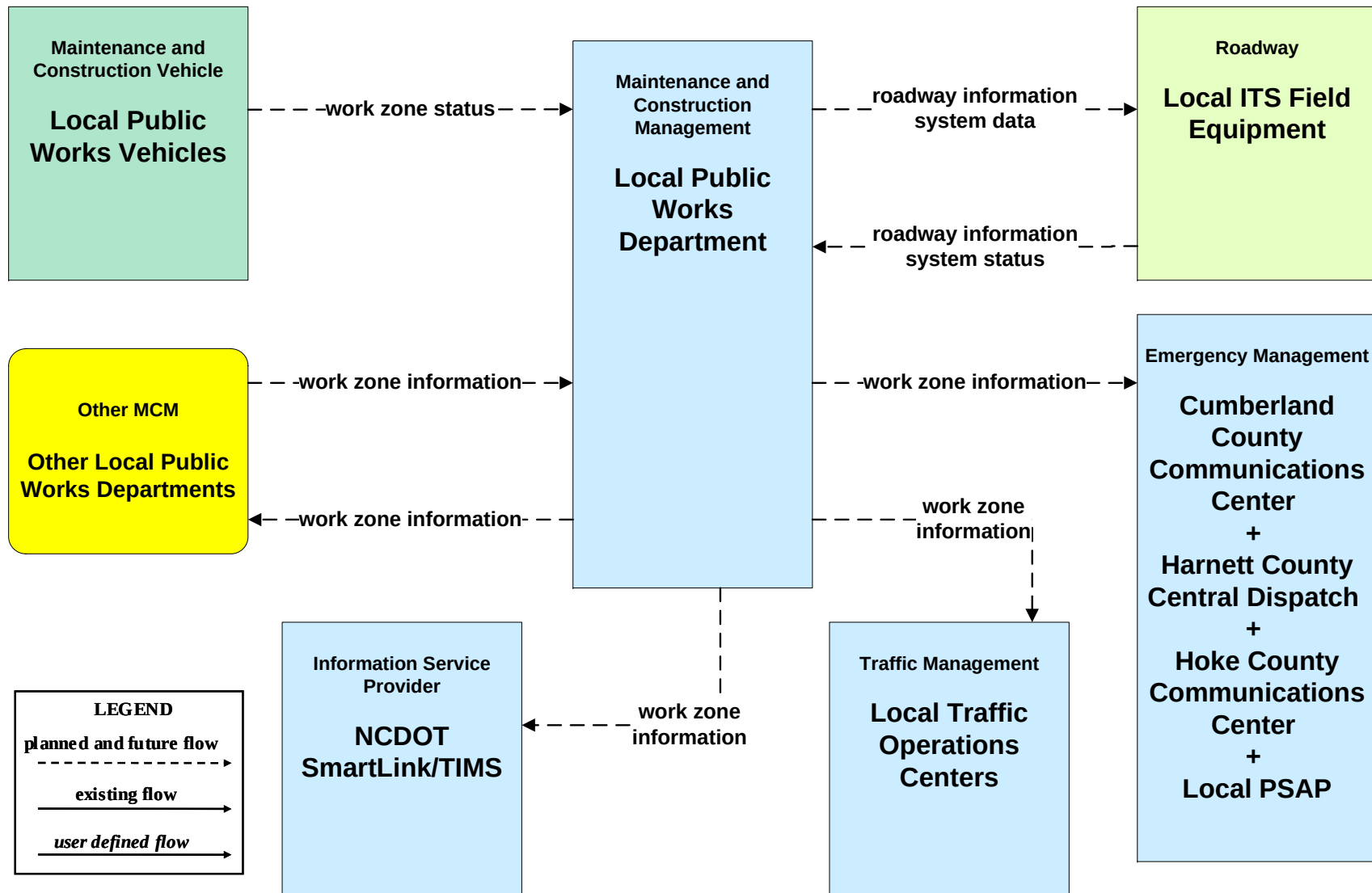
**MC08 - Work Zone Management
NCDOT**



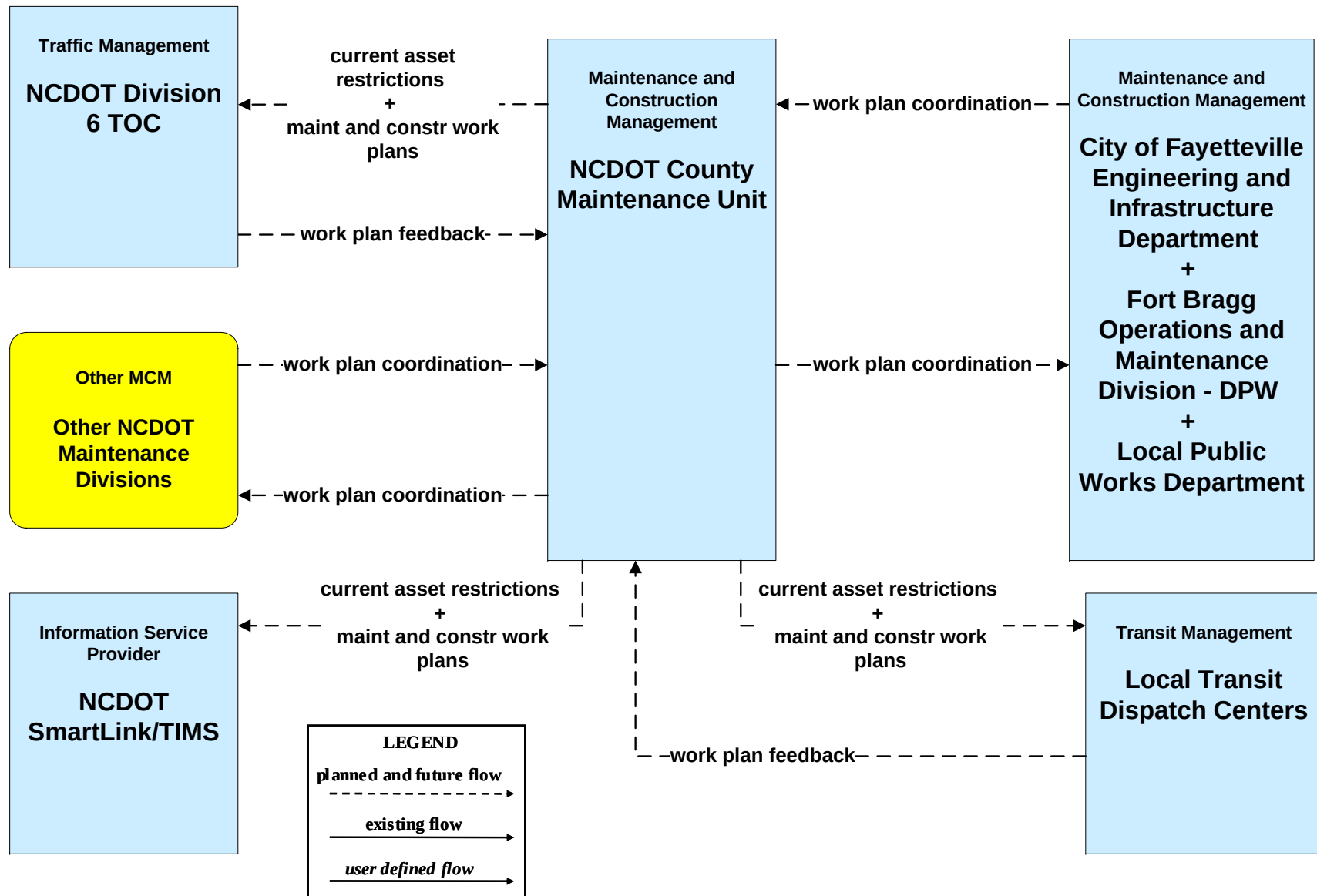
MC08 - Work Zone Management Fayetteville



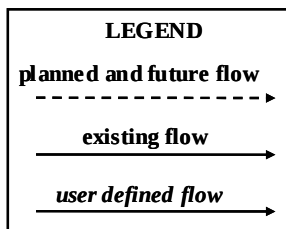
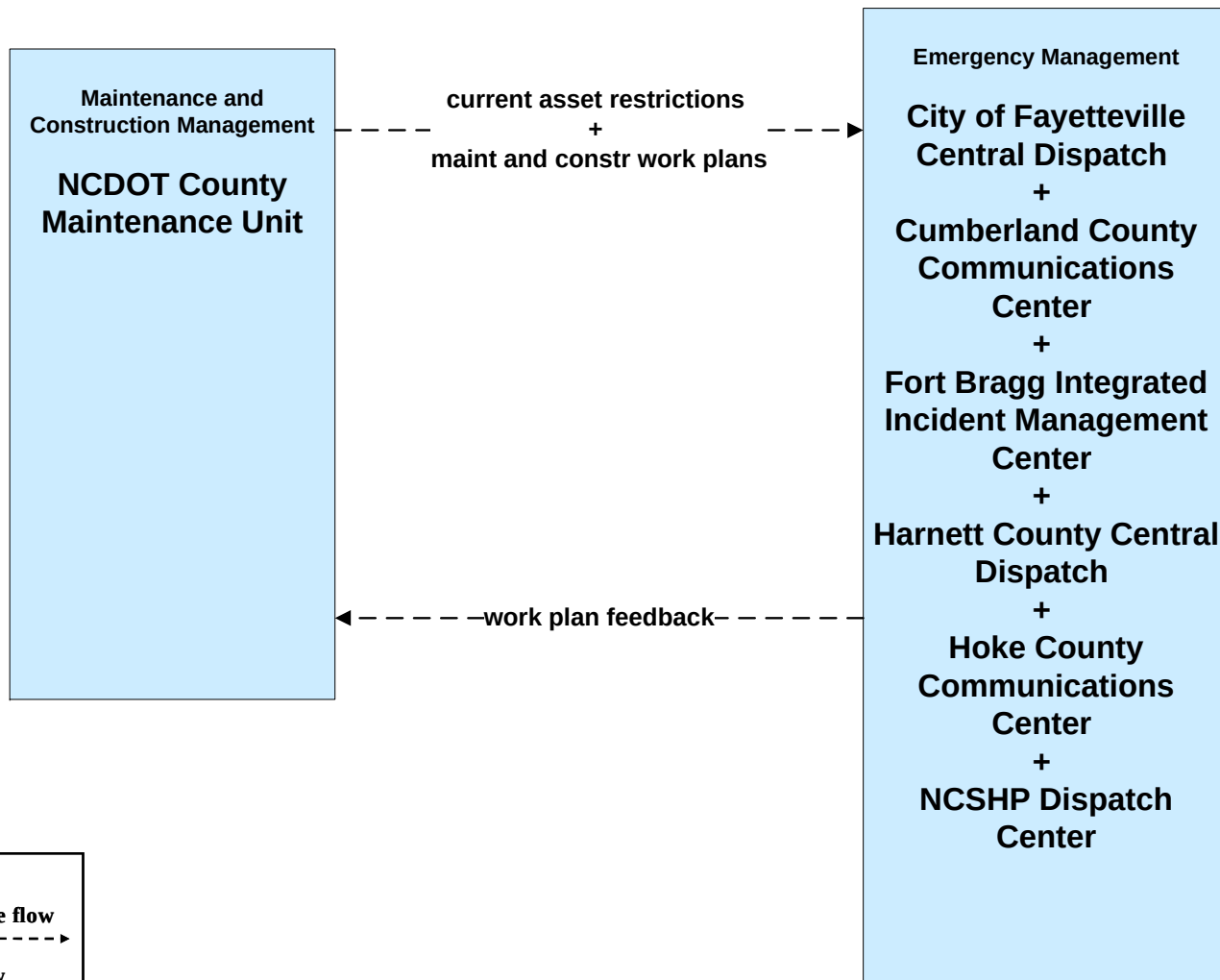
MC08 - Work Zone Management Local Municipalities



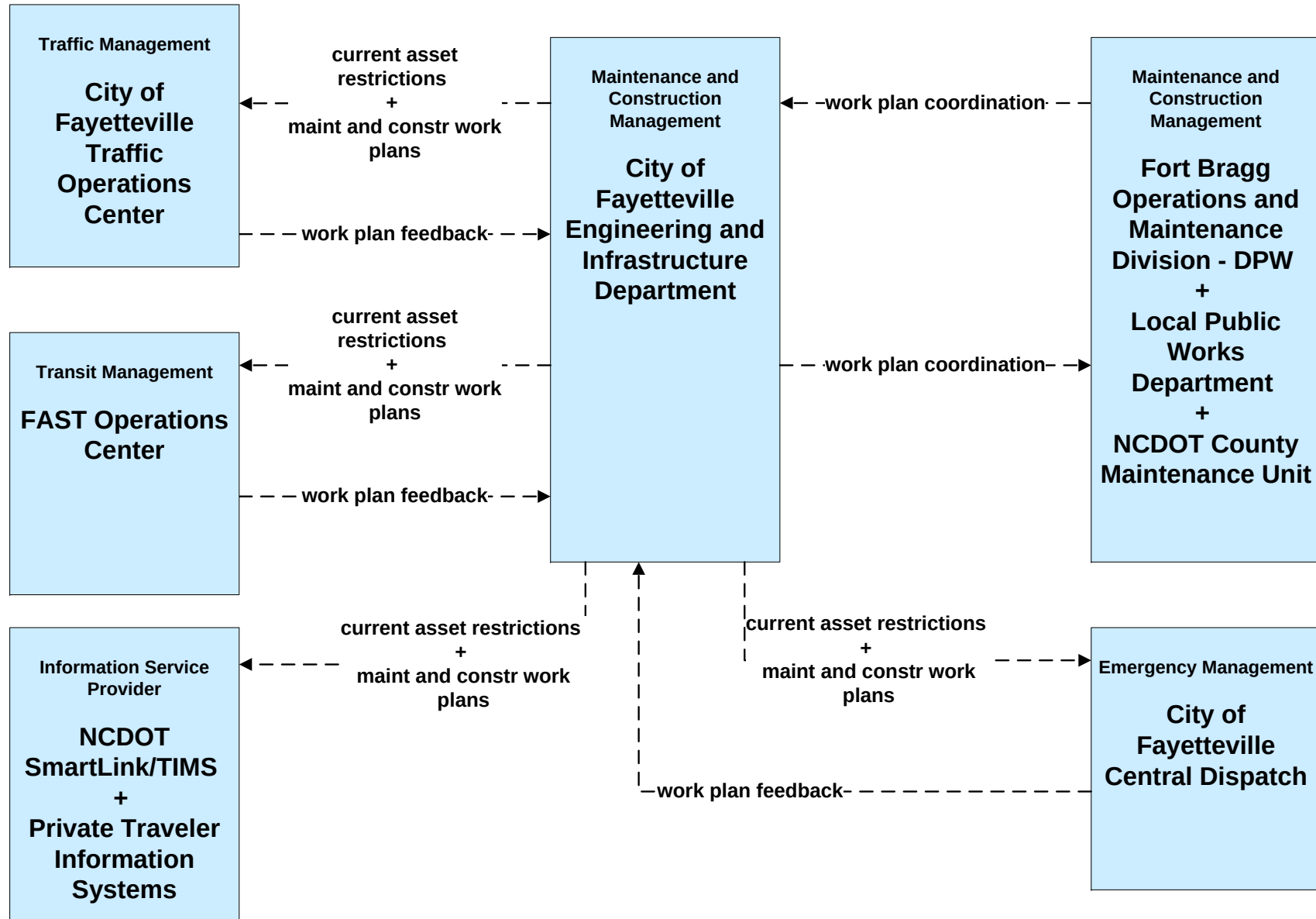
**MC10 - Maintenance and Construction Activity Coordination
NCDOT (1 of 2)**



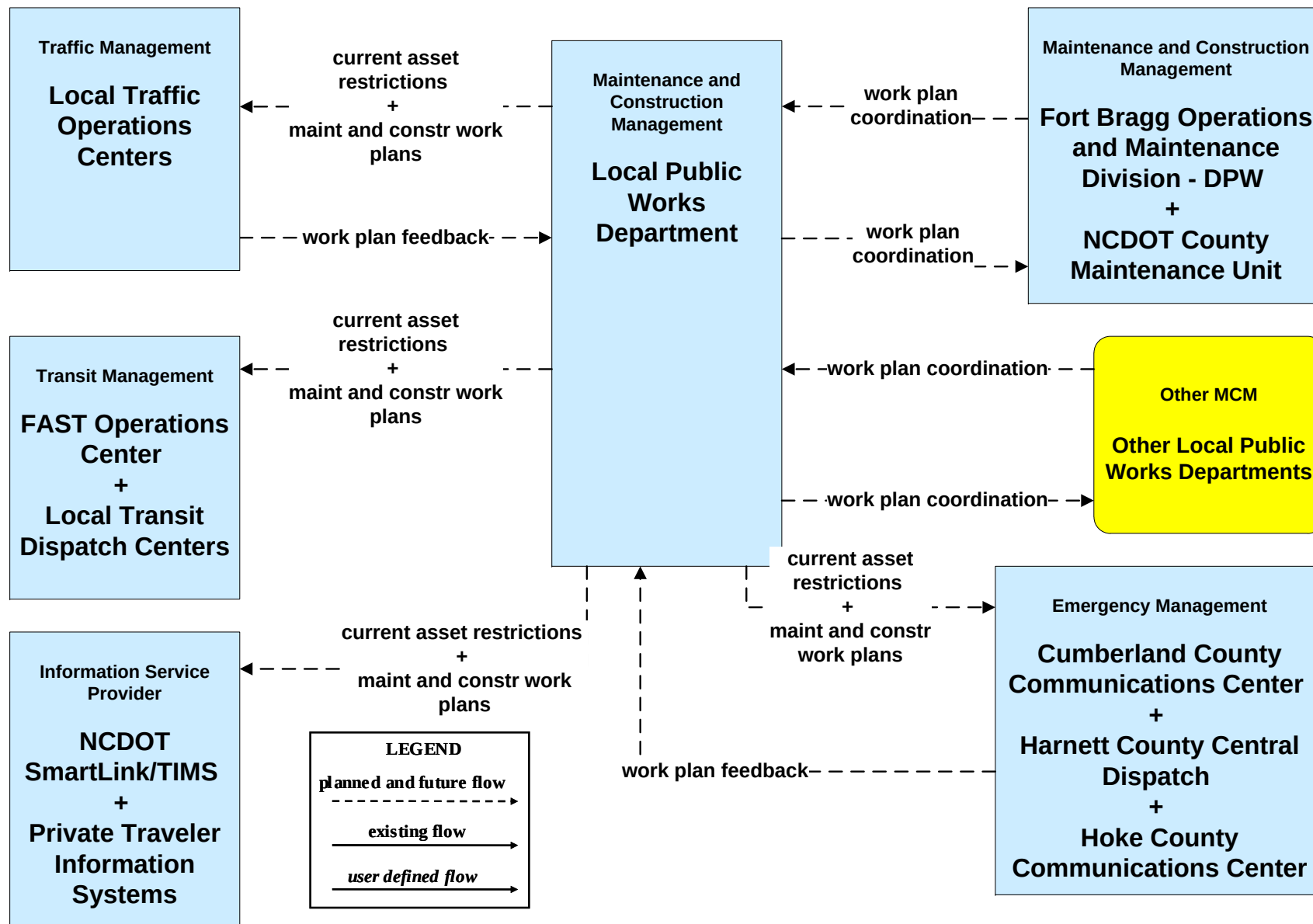
**MC10 - Maintenance and Construction Activity Coordination
NCDOT (2 of 2)**



MC10 - Maintenance and Construction Activity Coordination Fayetteville



MC10 - Maintenance and Construction Activity Coordination Local Counties and Municipalities

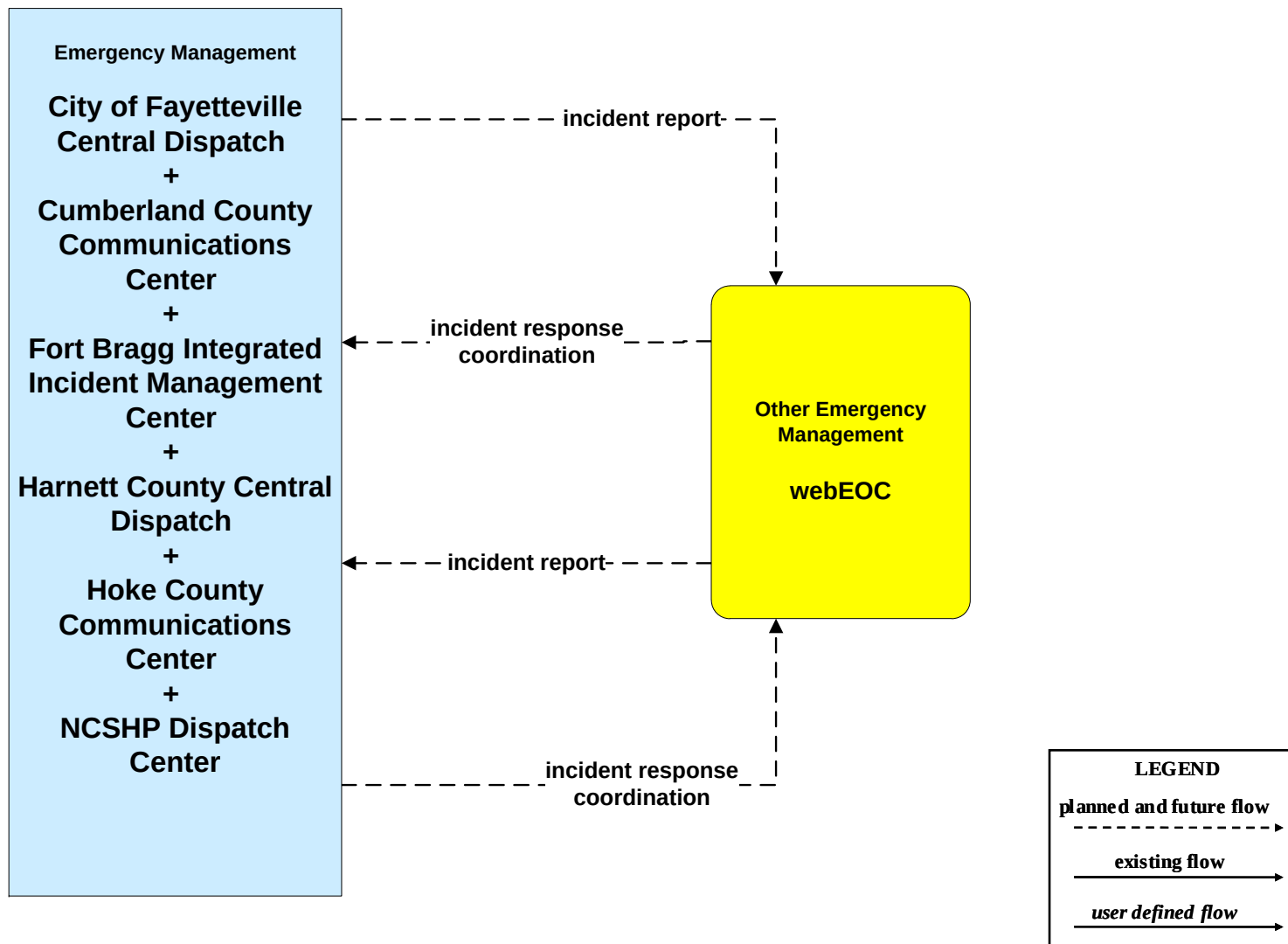


FAMPO Regional ITS Architecture

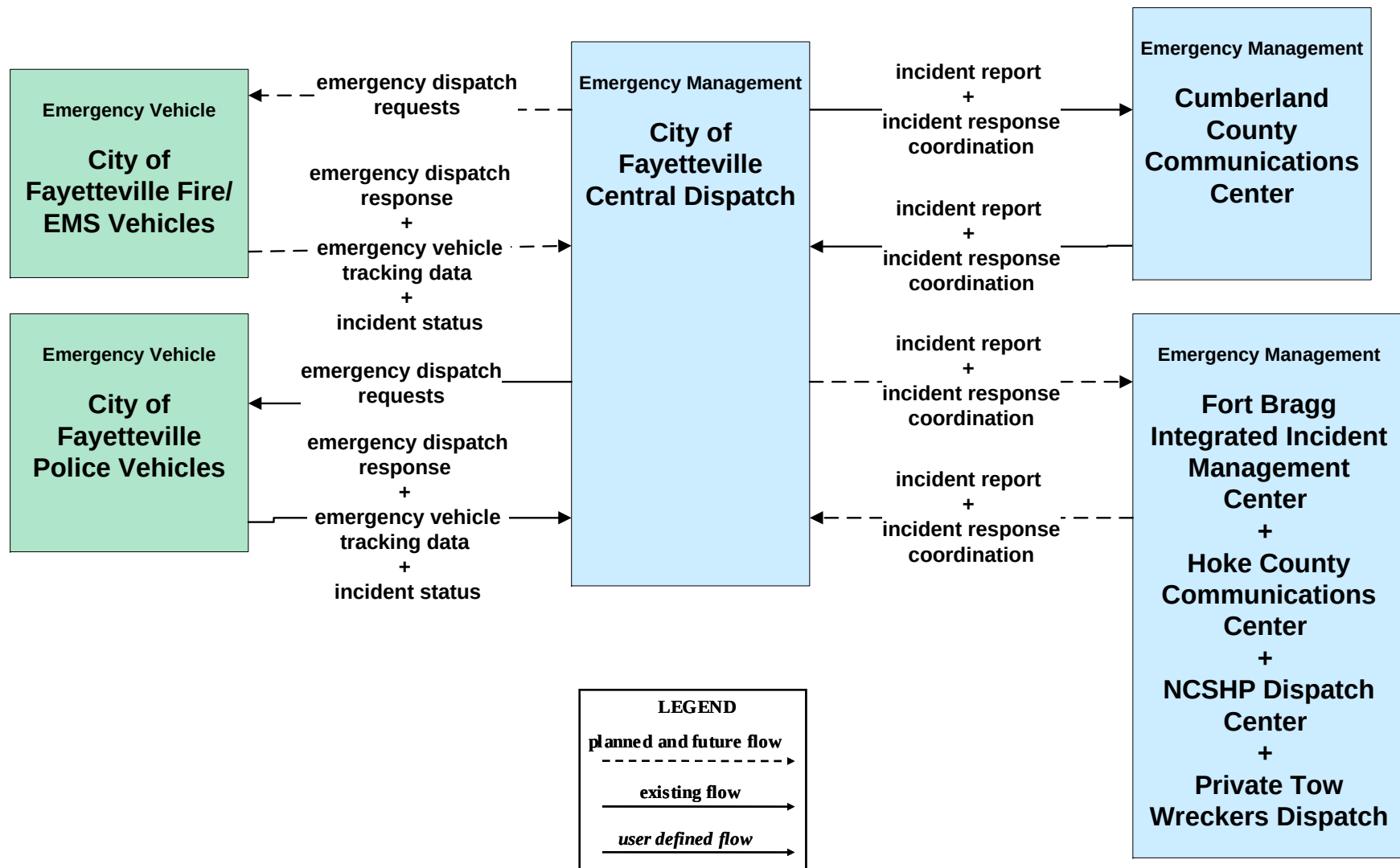
Customized Service Package Diagrams

Emergency Management (EM)

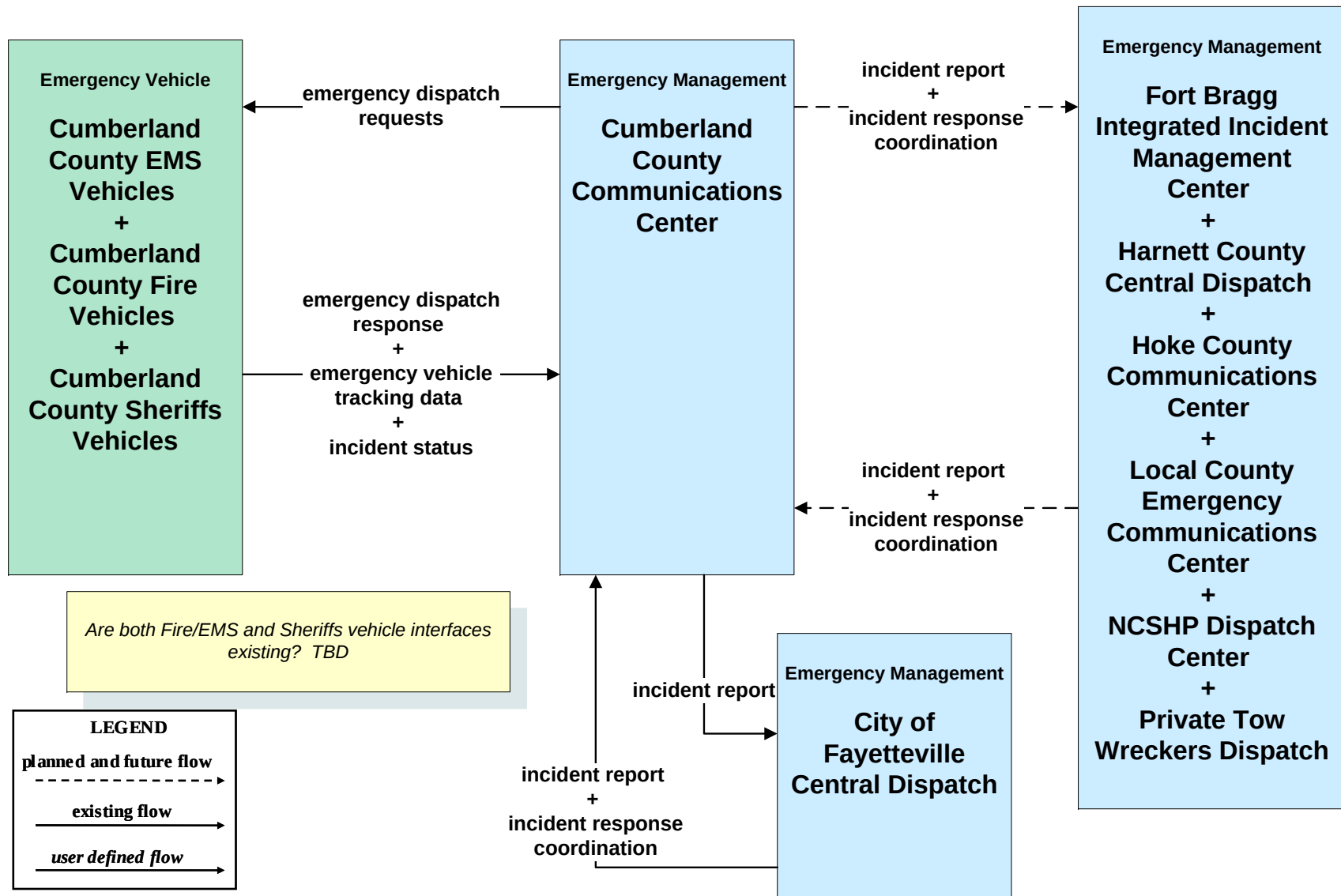
**EM01 - Emergency Call-Taking and Dispatch
Regional Emergency Communications Network (EM to Other EM)**



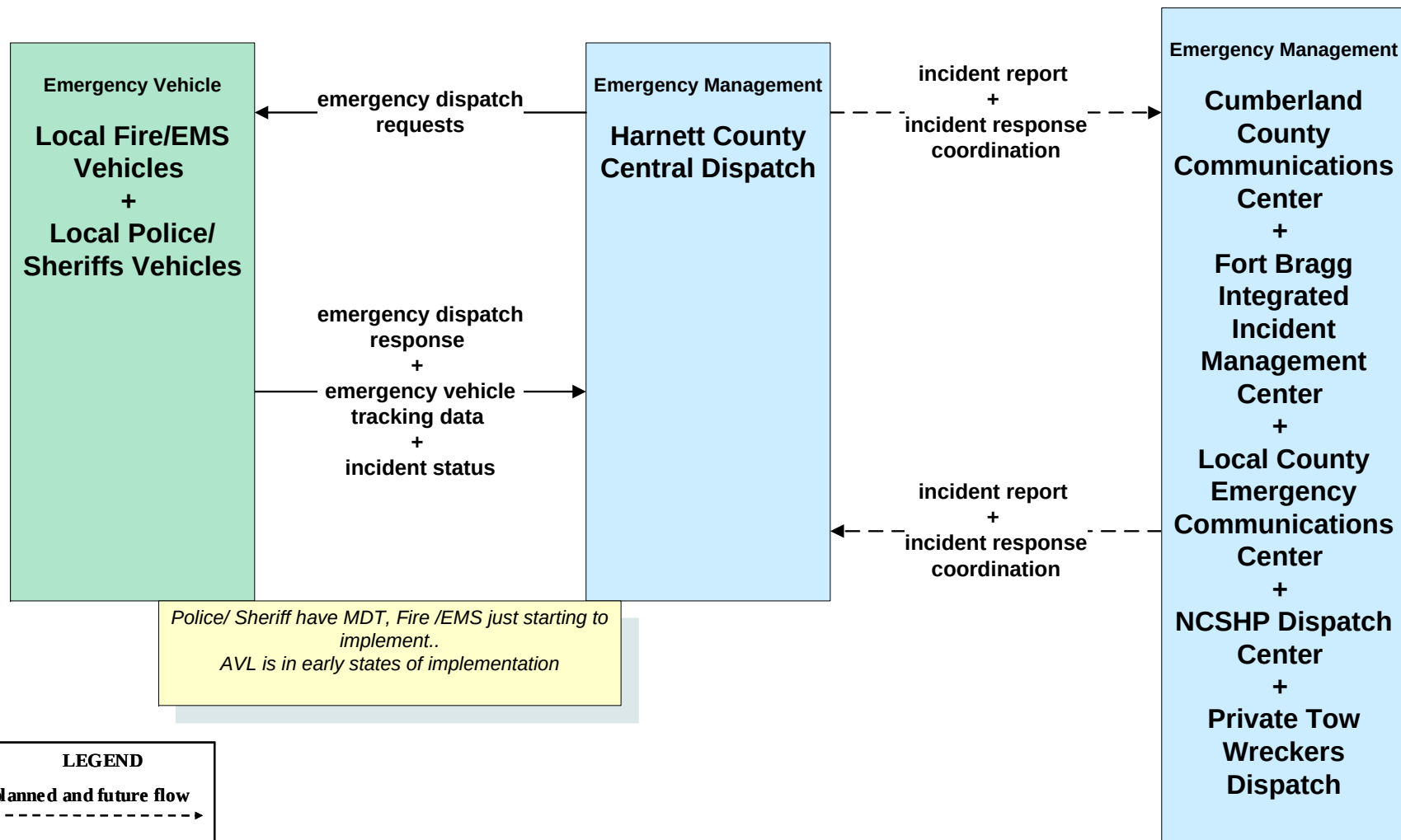
EM01 - Emergency Call Taking and Dispatch Fayetteville



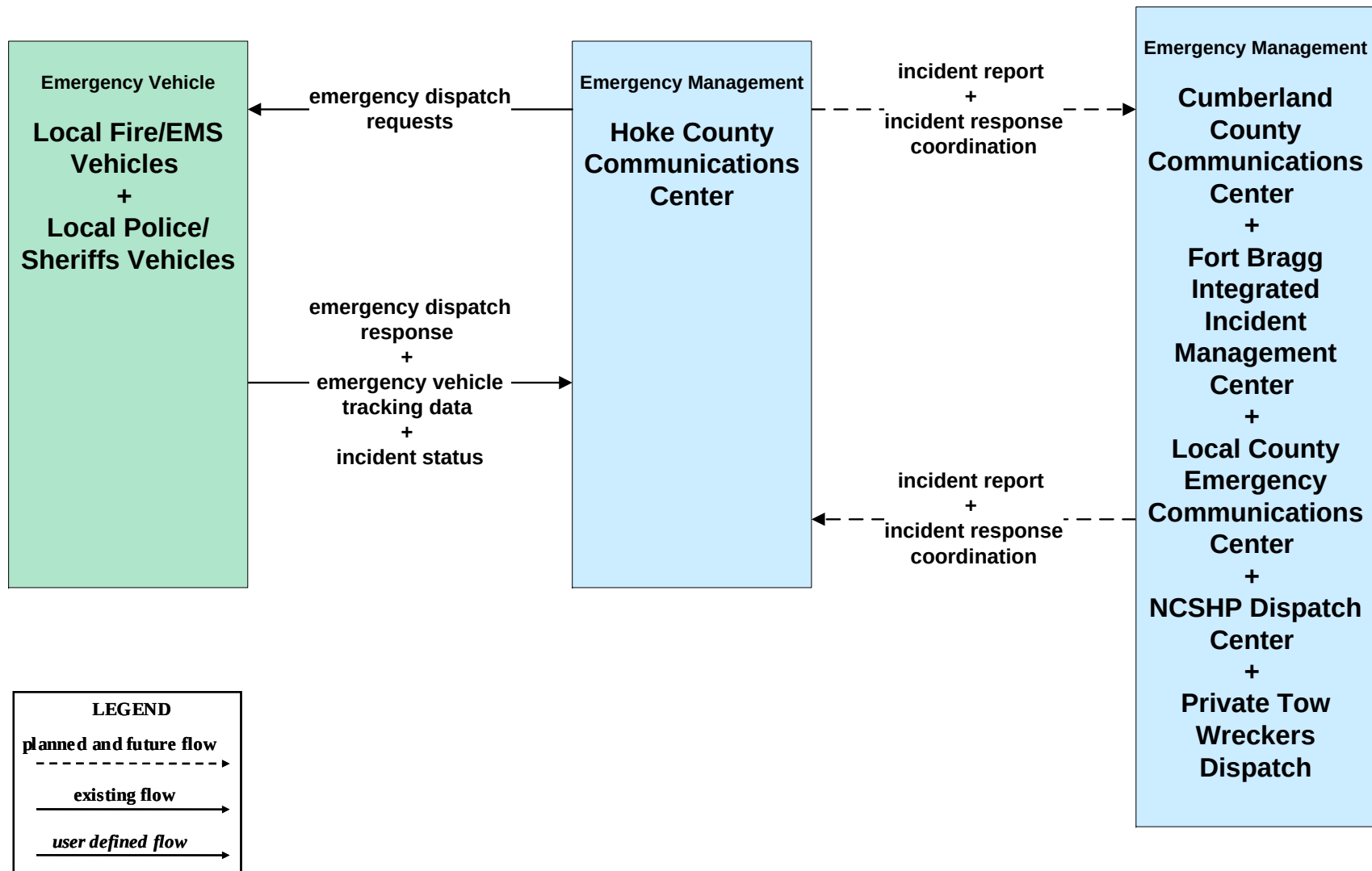
EM01 - Emergency Call Taking and Dispatch Cumberland County Communications Center



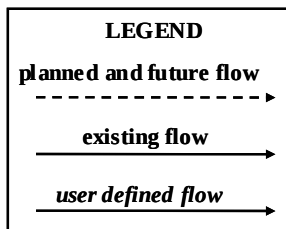
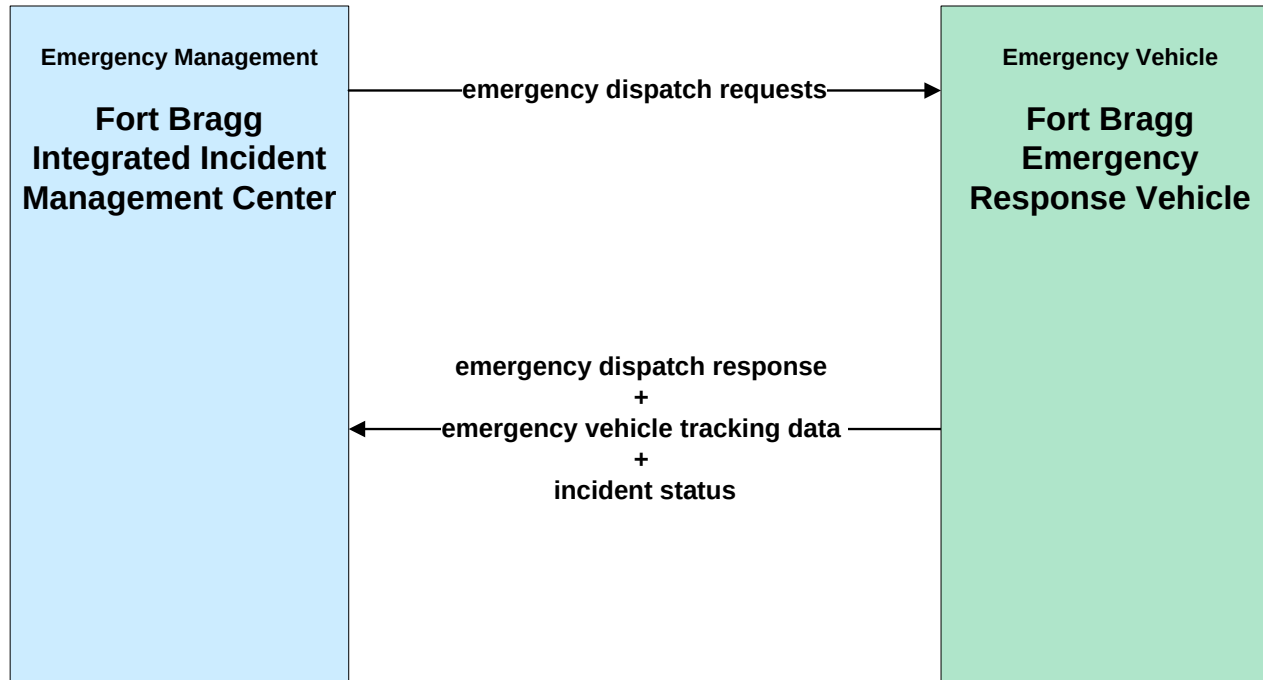
EM01 - Emergency Call Taking and Dispatch Harnett County Central Dispatch



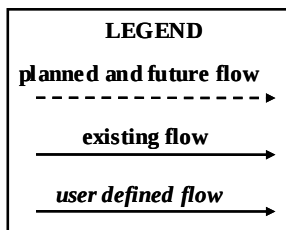
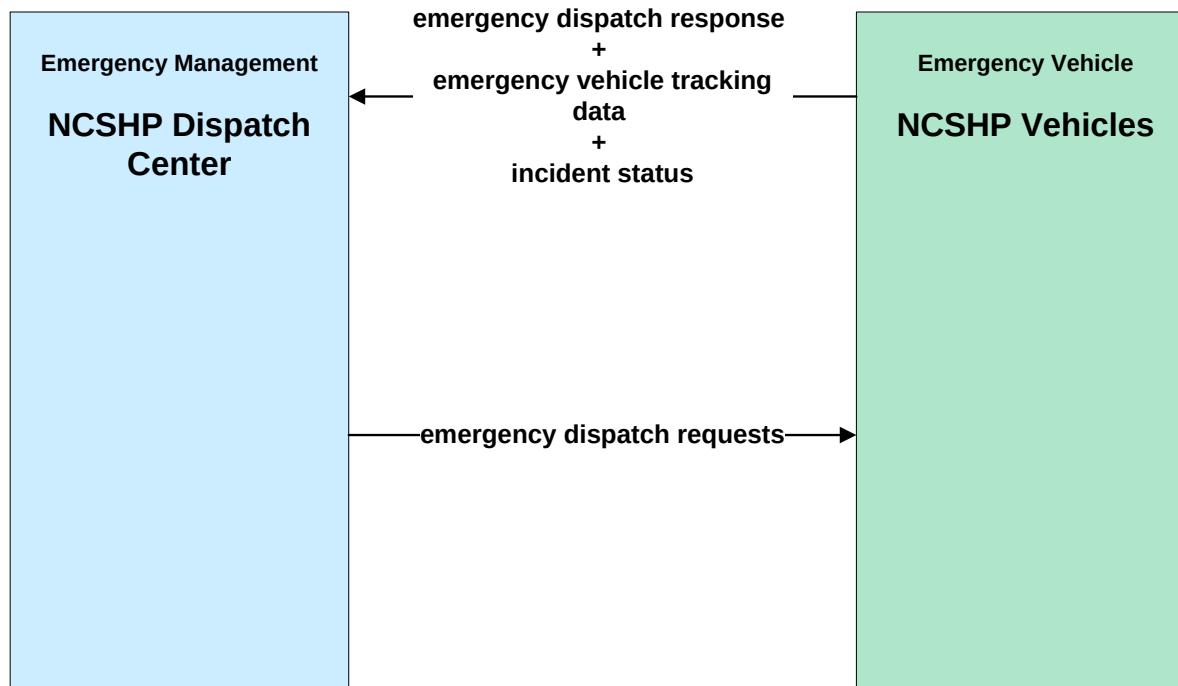
EM01 - Emergency Call Taking and Dispatch Hoke County Communications Center



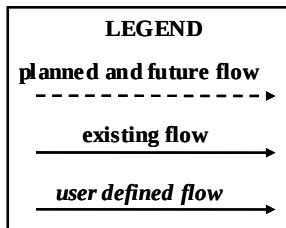
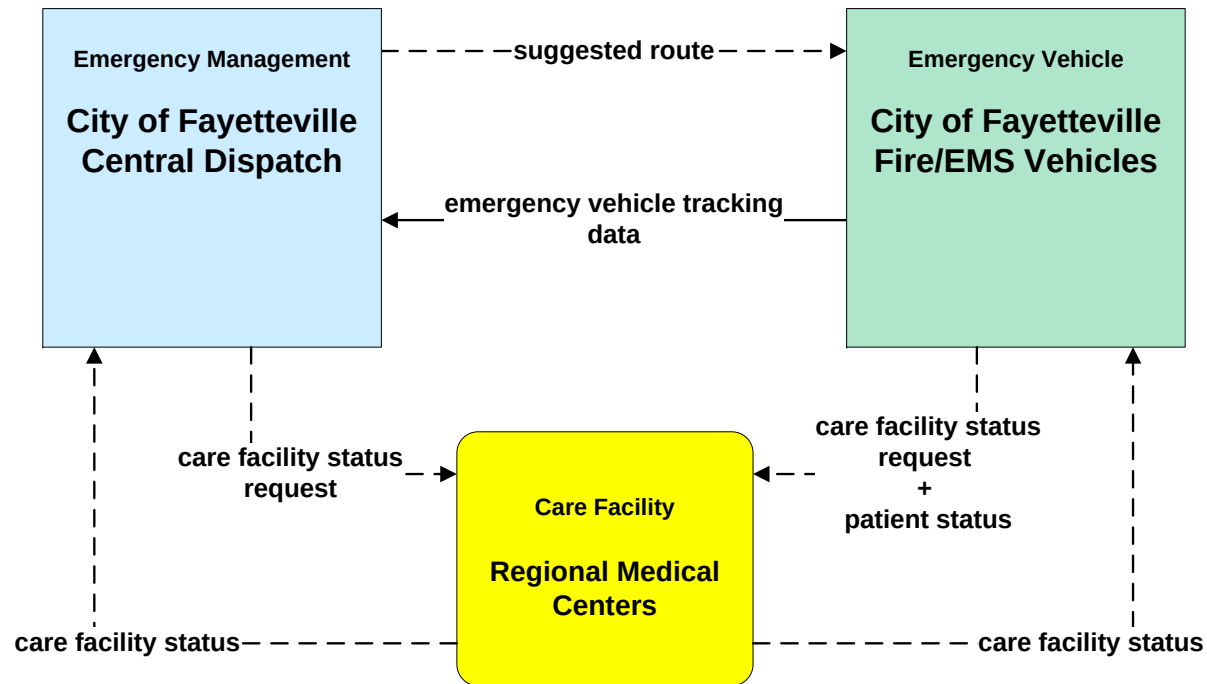
EM01 - Emergency Call Taking and Dispatch Fort Bragg



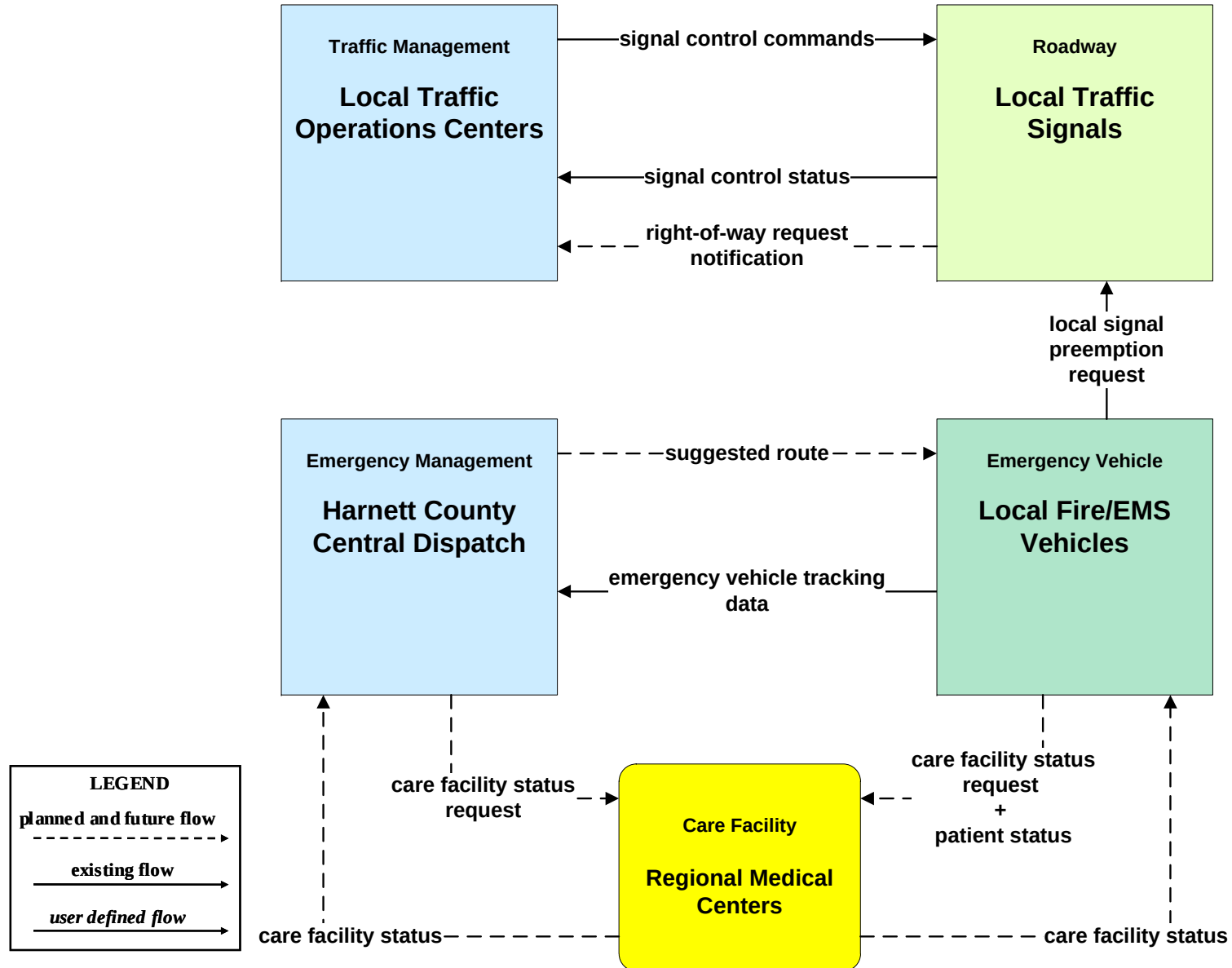
**EM01 - Emergency Call-Taking and Dispatch
North Carolina State Highway Patrol**



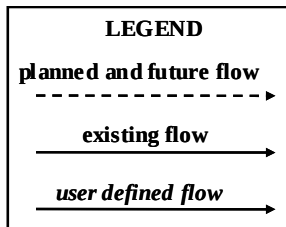
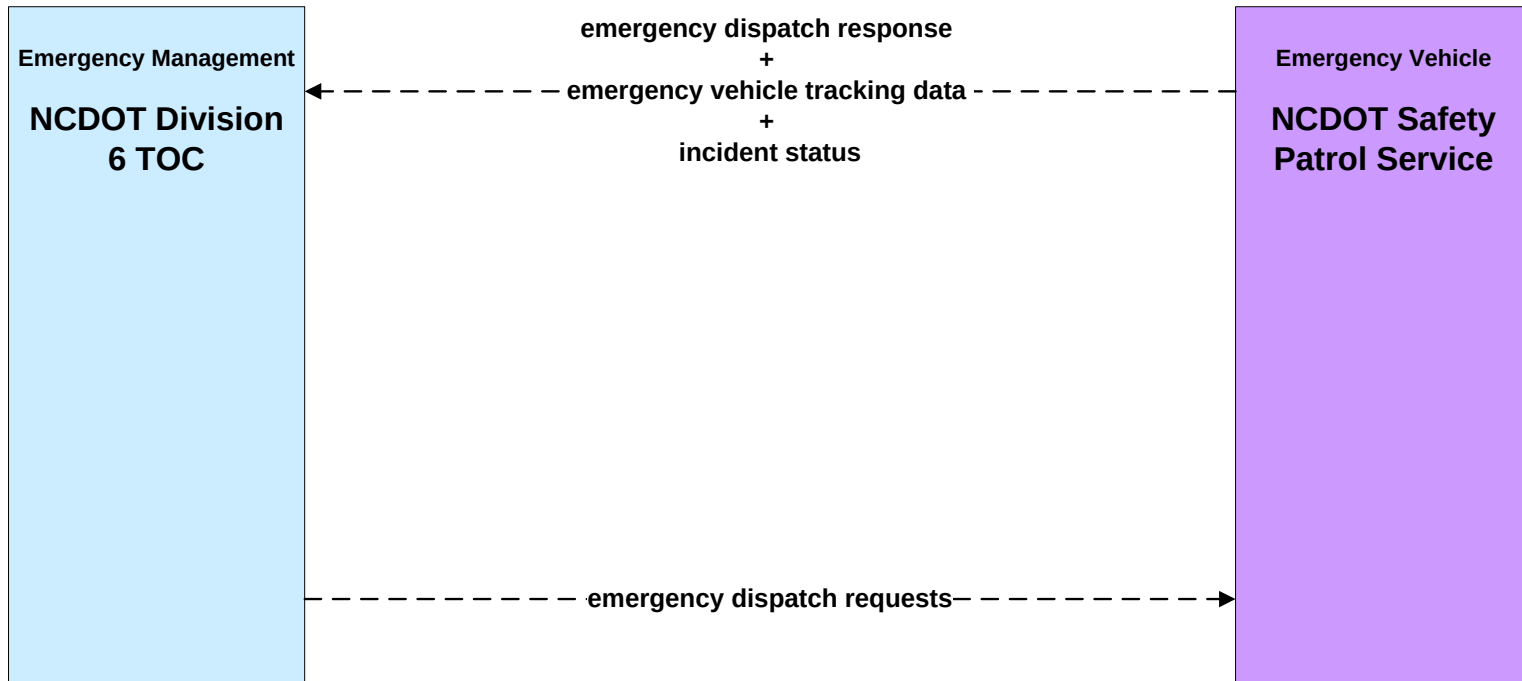
EM02 - Emergency Routing Fayetteville



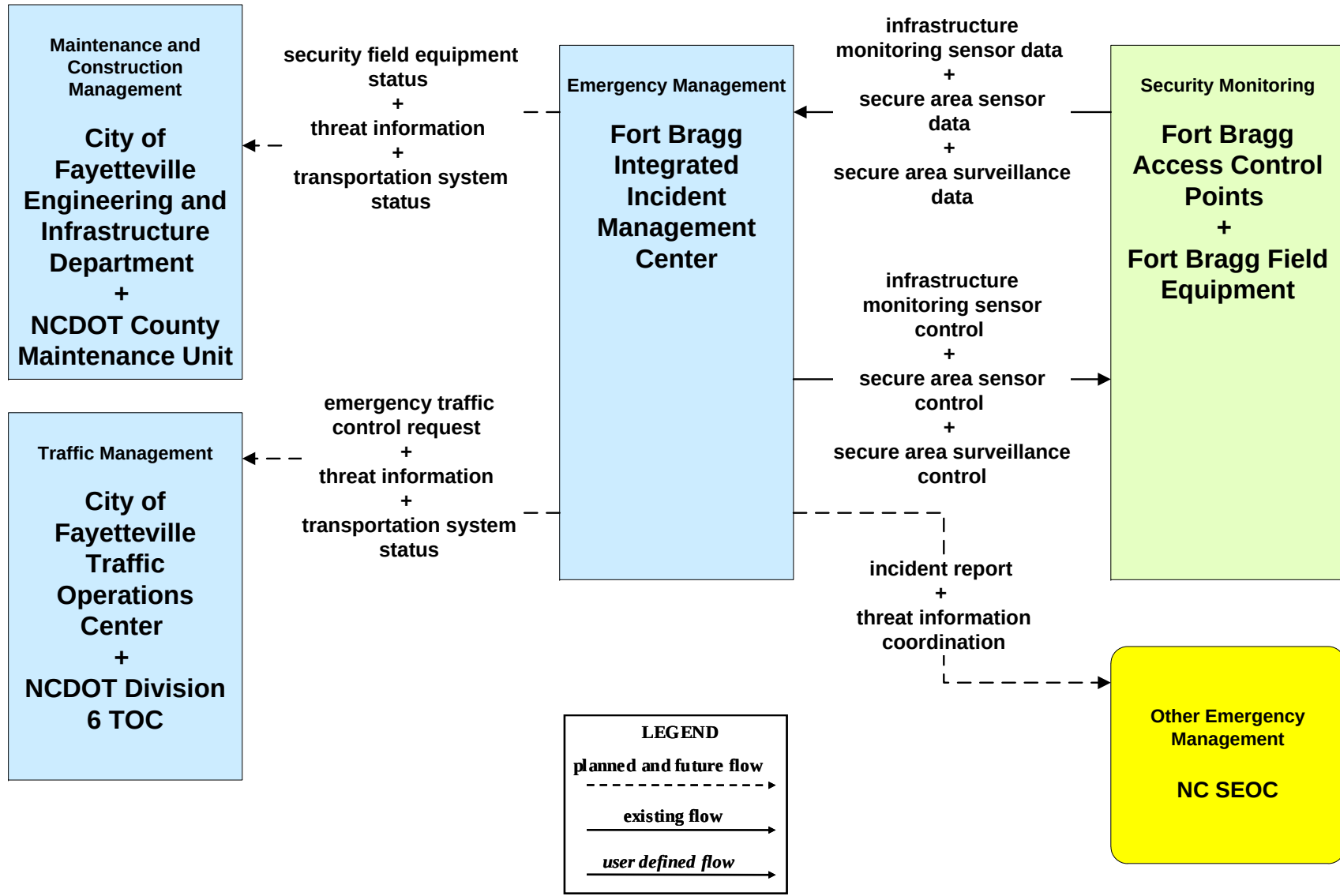
EM02 - Emergency Routing Harnett County



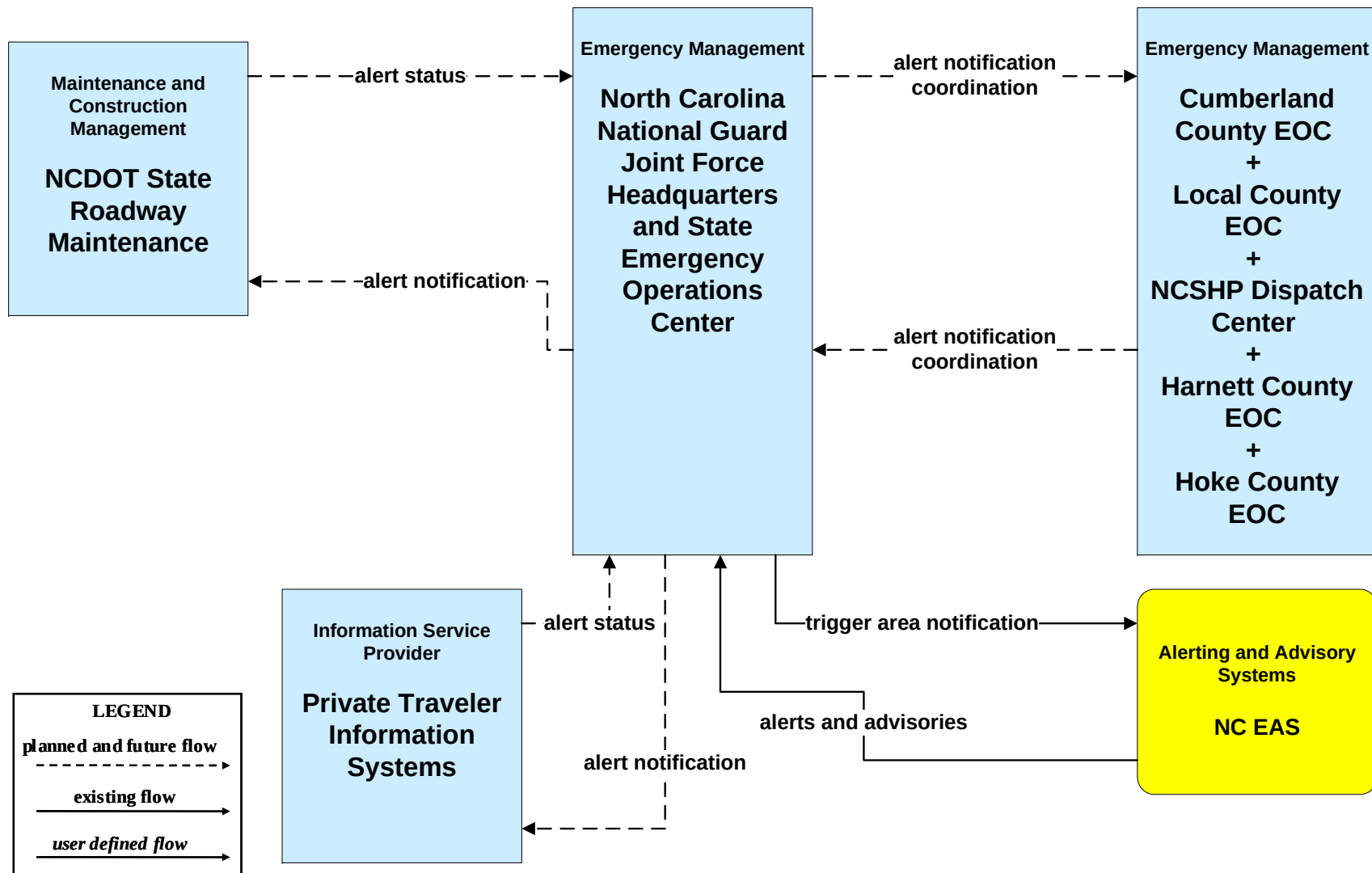
**EM04 - Roadway Service Patrols
NCDOT Safety Patrol Service**



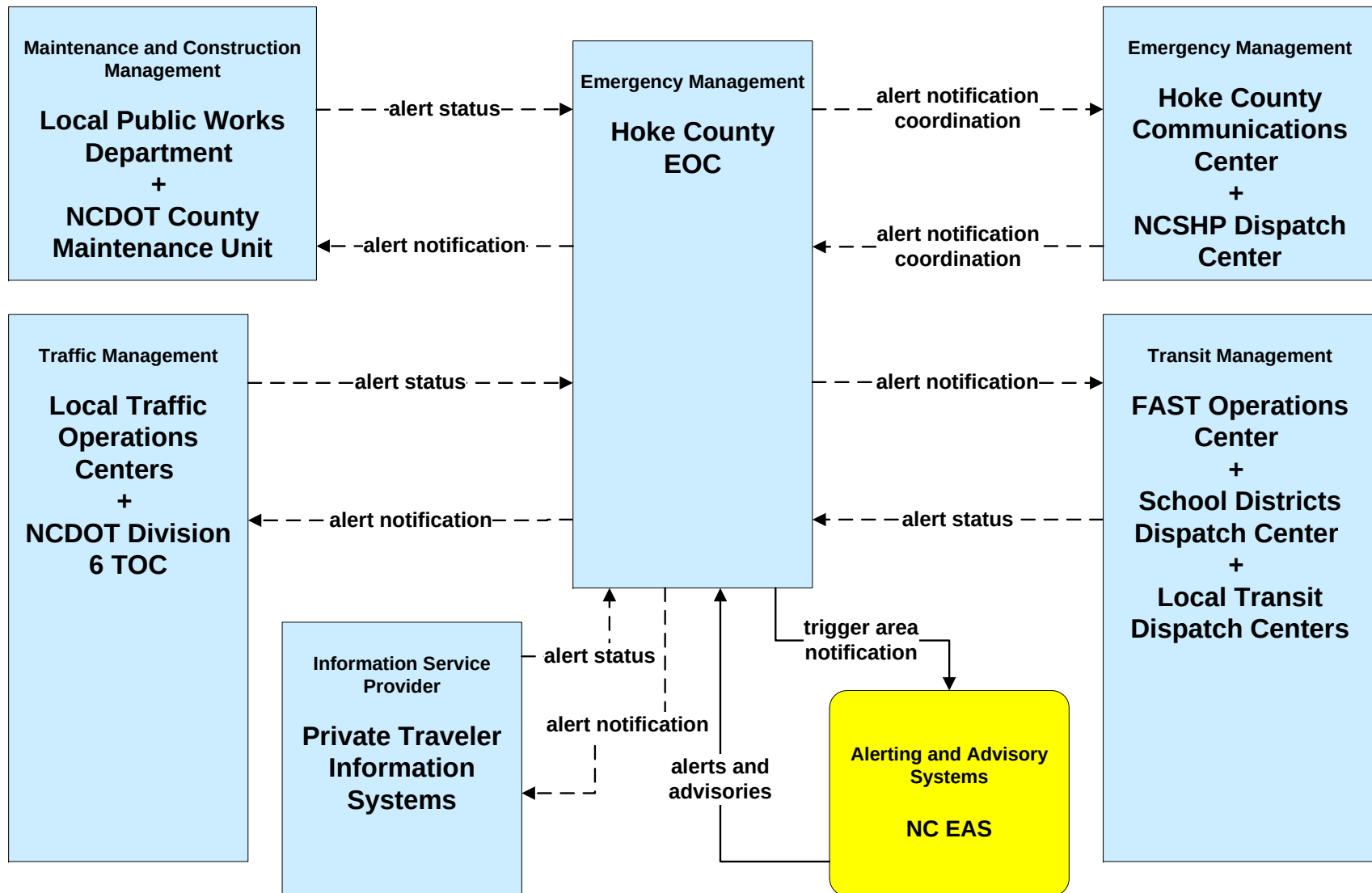
EM05 - Transportation Infrastructure Protection Fort Bragg



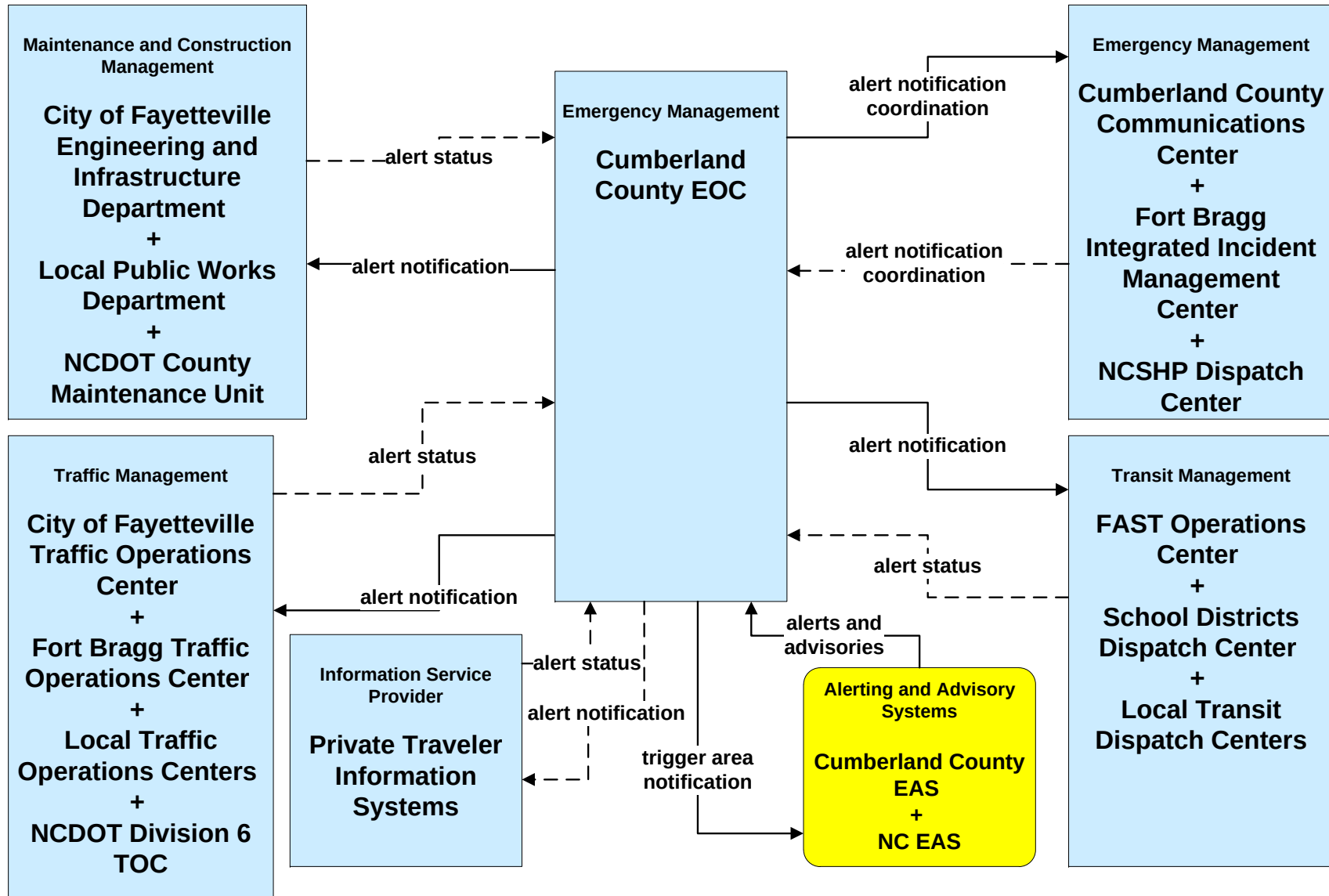
EM06 - Wide Area Alert State Level



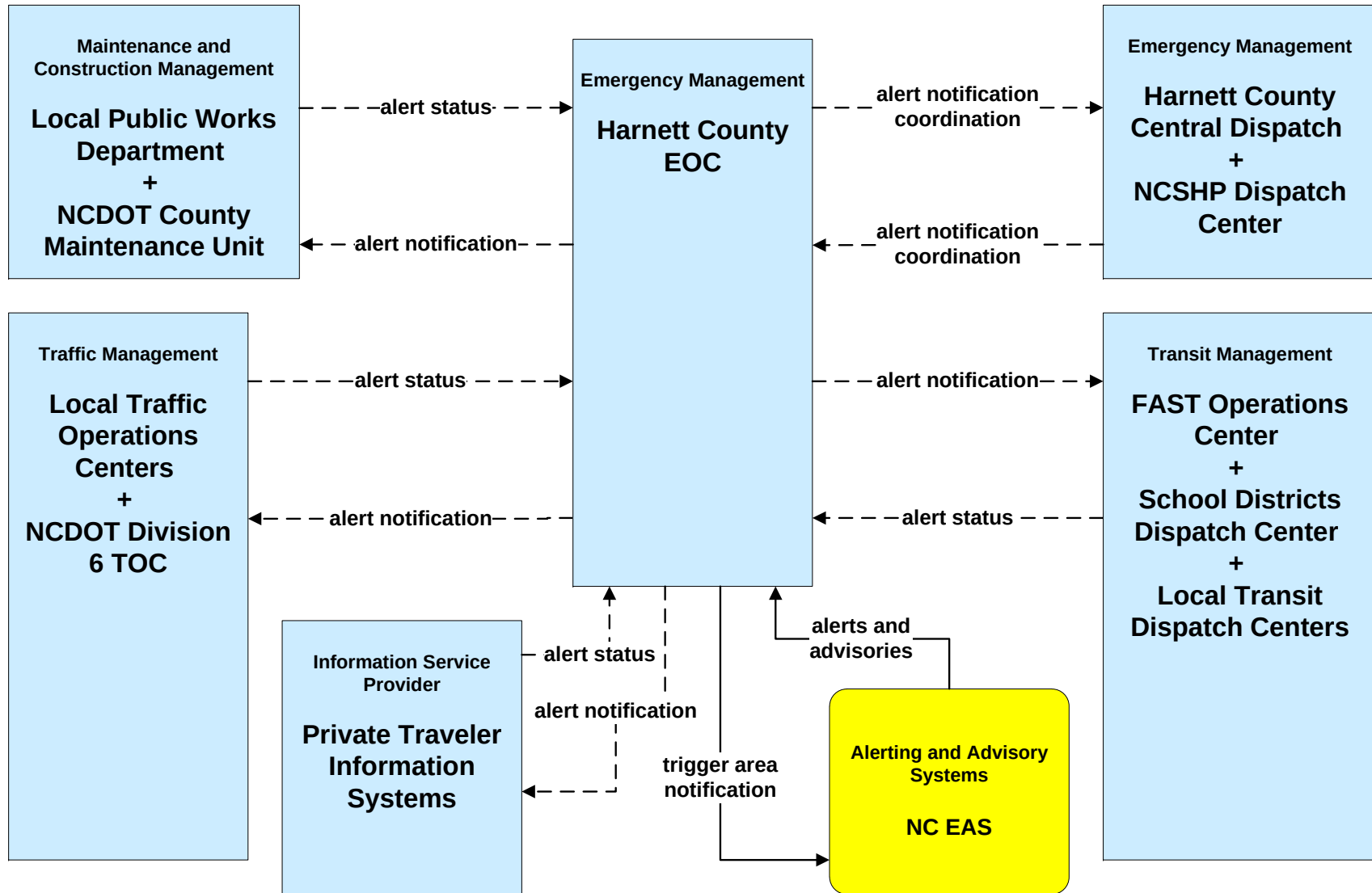
**EM06 - Wide Area Alert
Hoke County EOC**



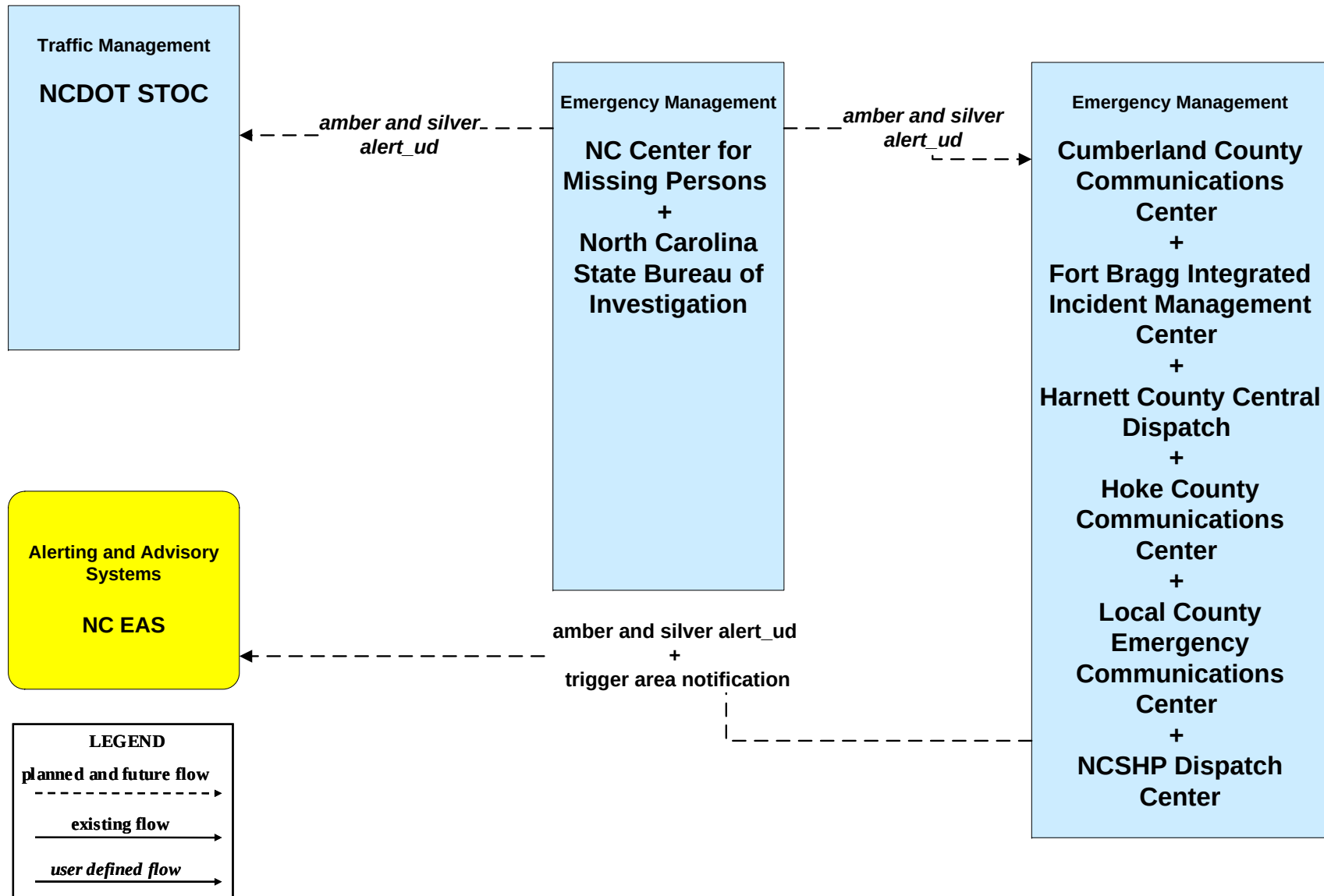
**EM06 - Wide Area Alert
Cumberland County EOC**



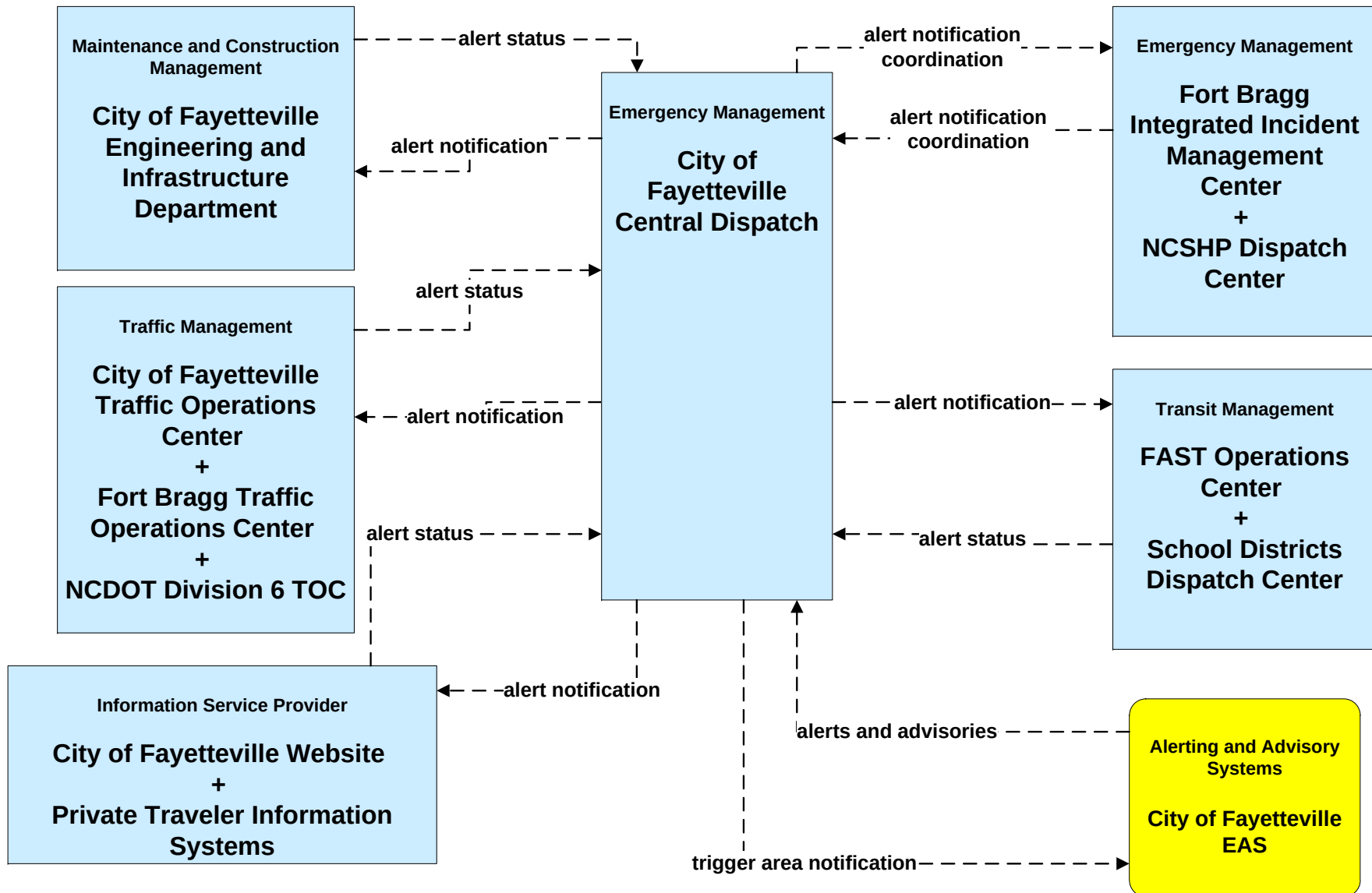
EM06 - Wide Area Alert Harnett County EOC



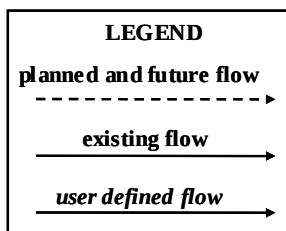
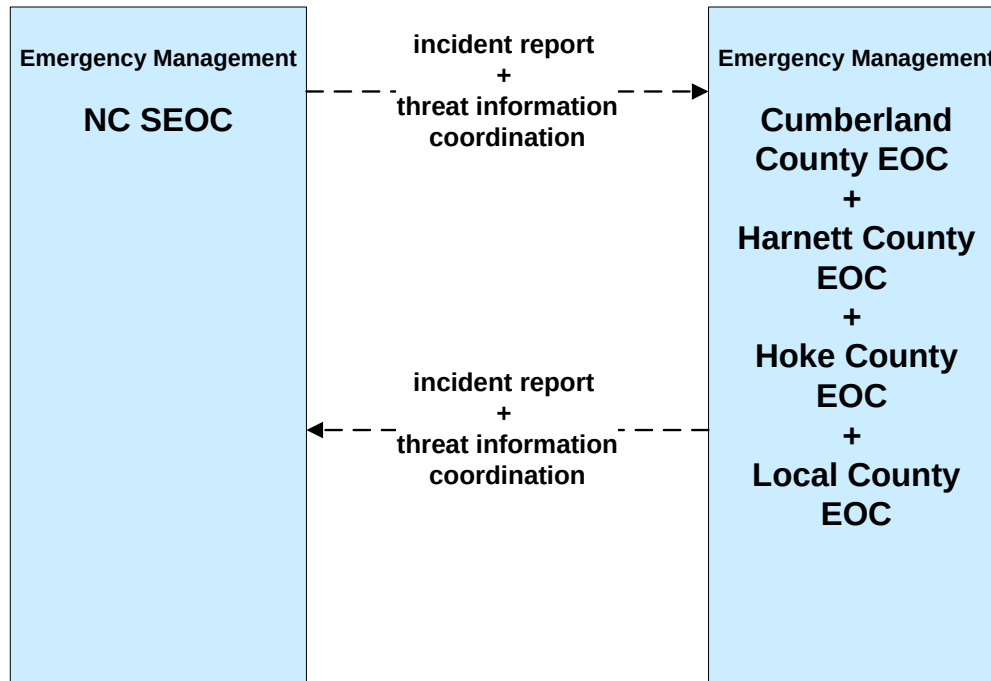
**EM06 - Wide Area Alert
Amber / Silver Alert**



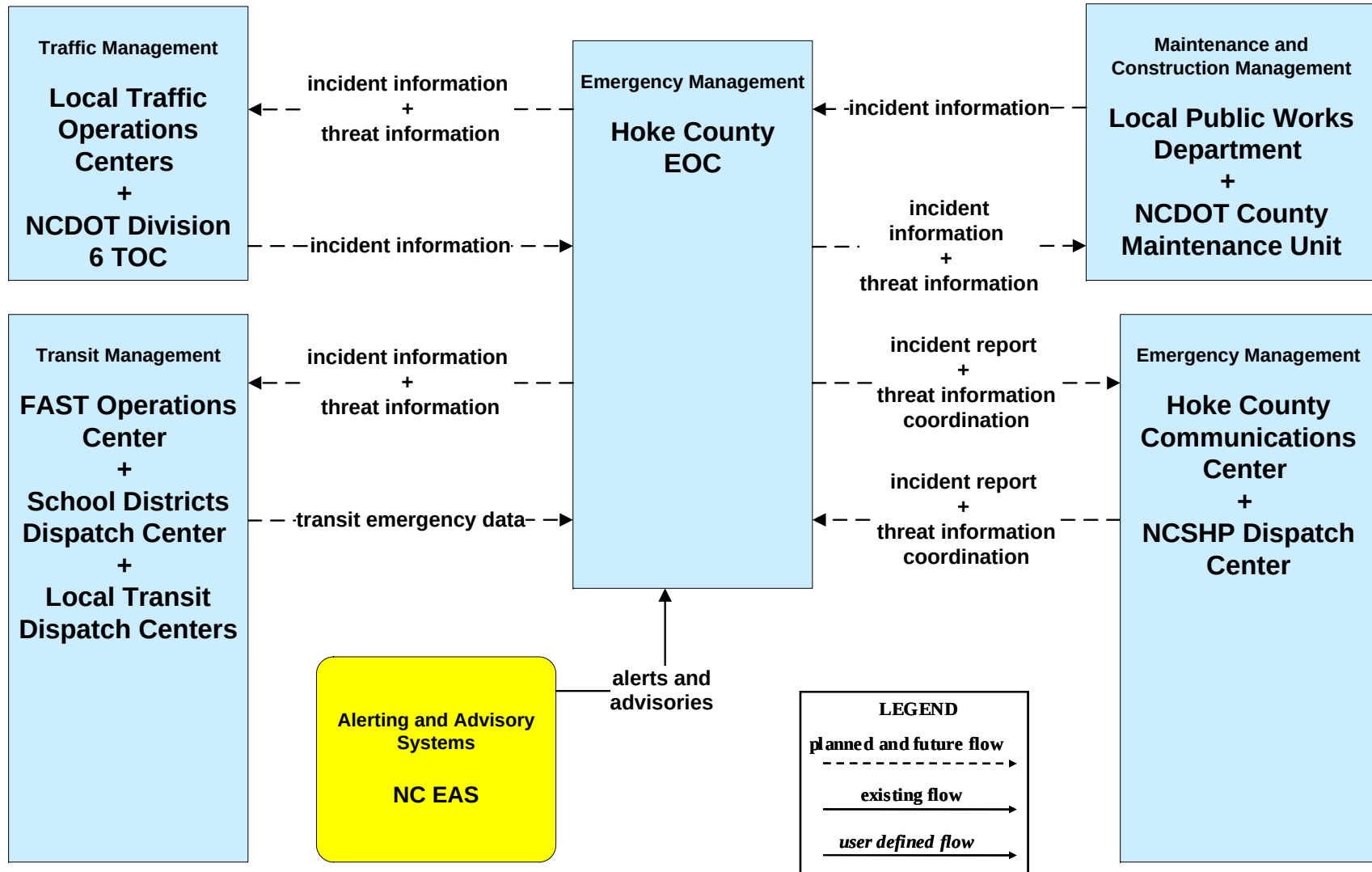
**EM06 - Wide Area Alert
City of Fayetteville Reverse 911 System**



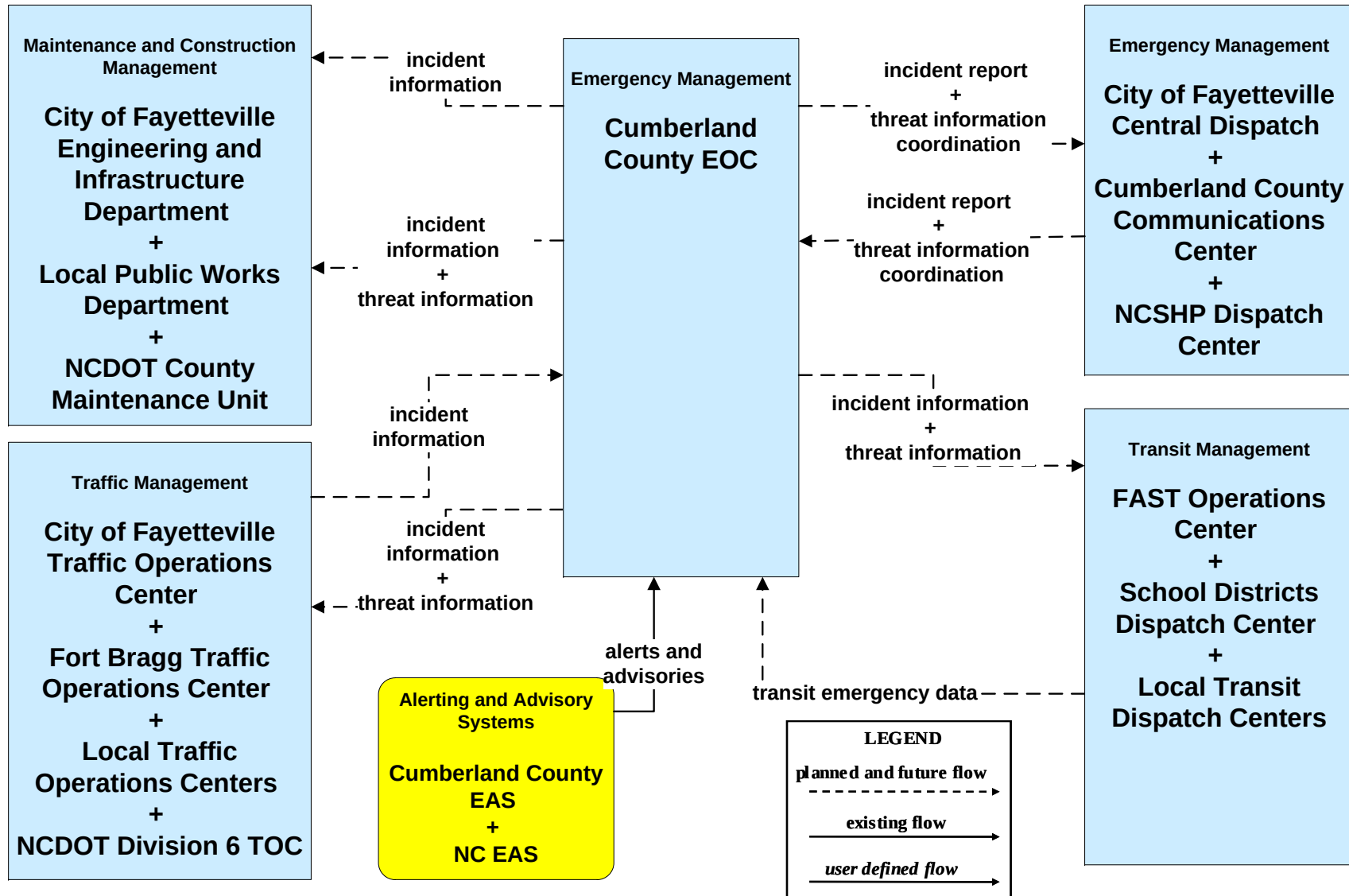
**EM07 - Early Warning System
NC State Emergency Operations Center**



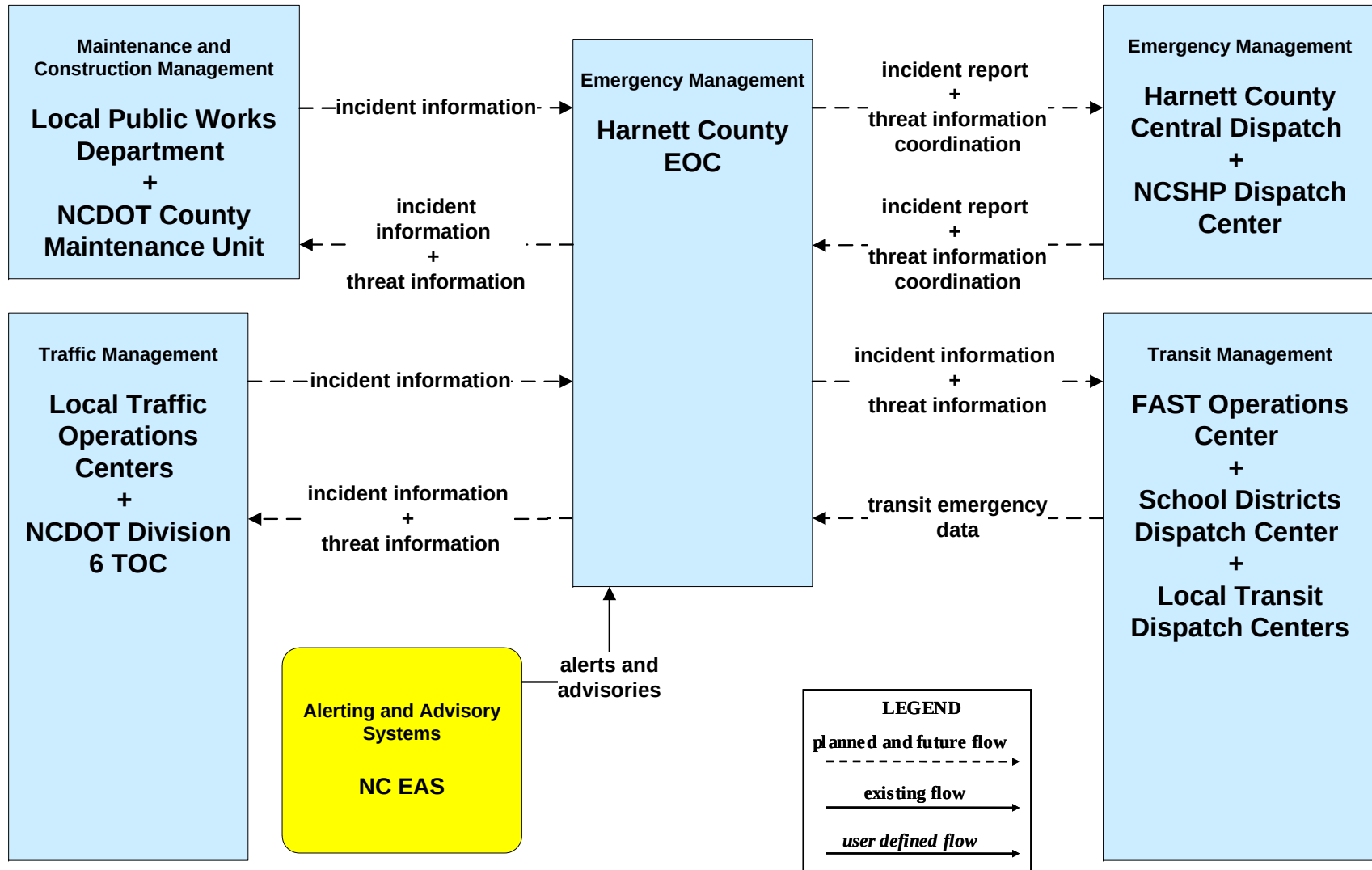
EM07 - Early Warning System Hoke County EOC



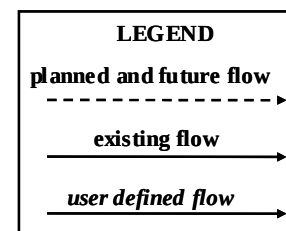
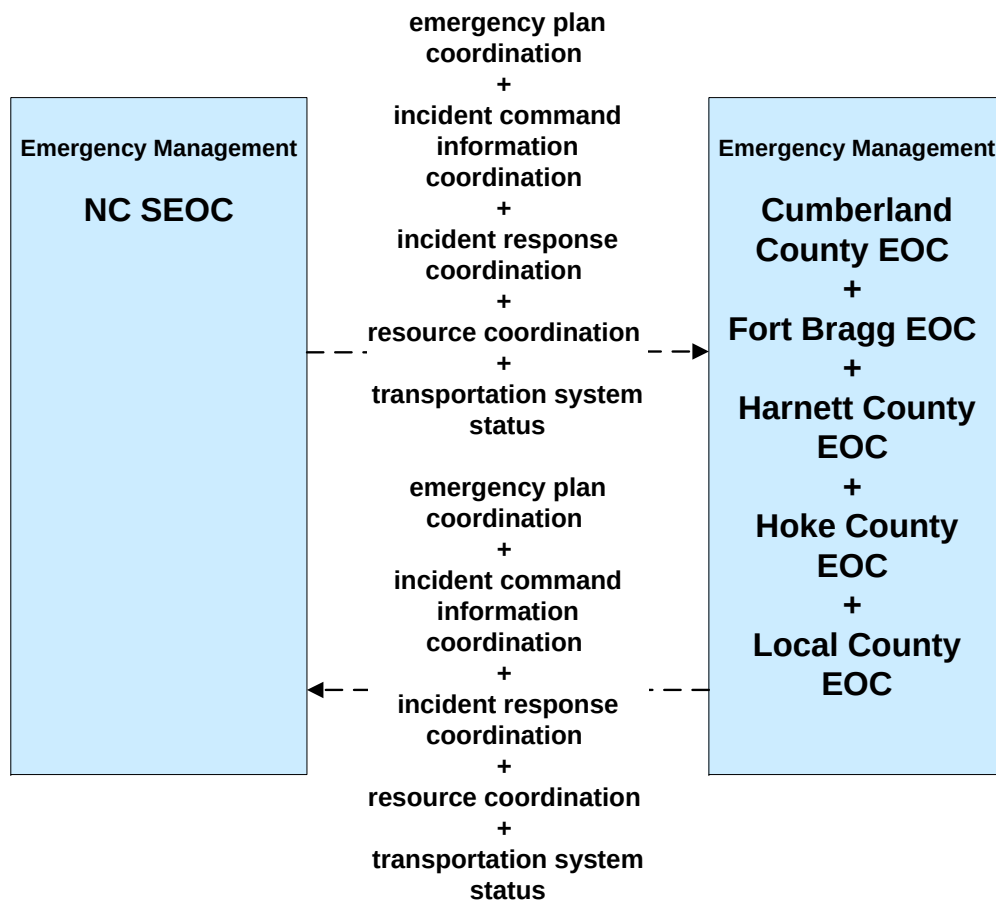
EM07 - Early Warning System Cumberland County EOC



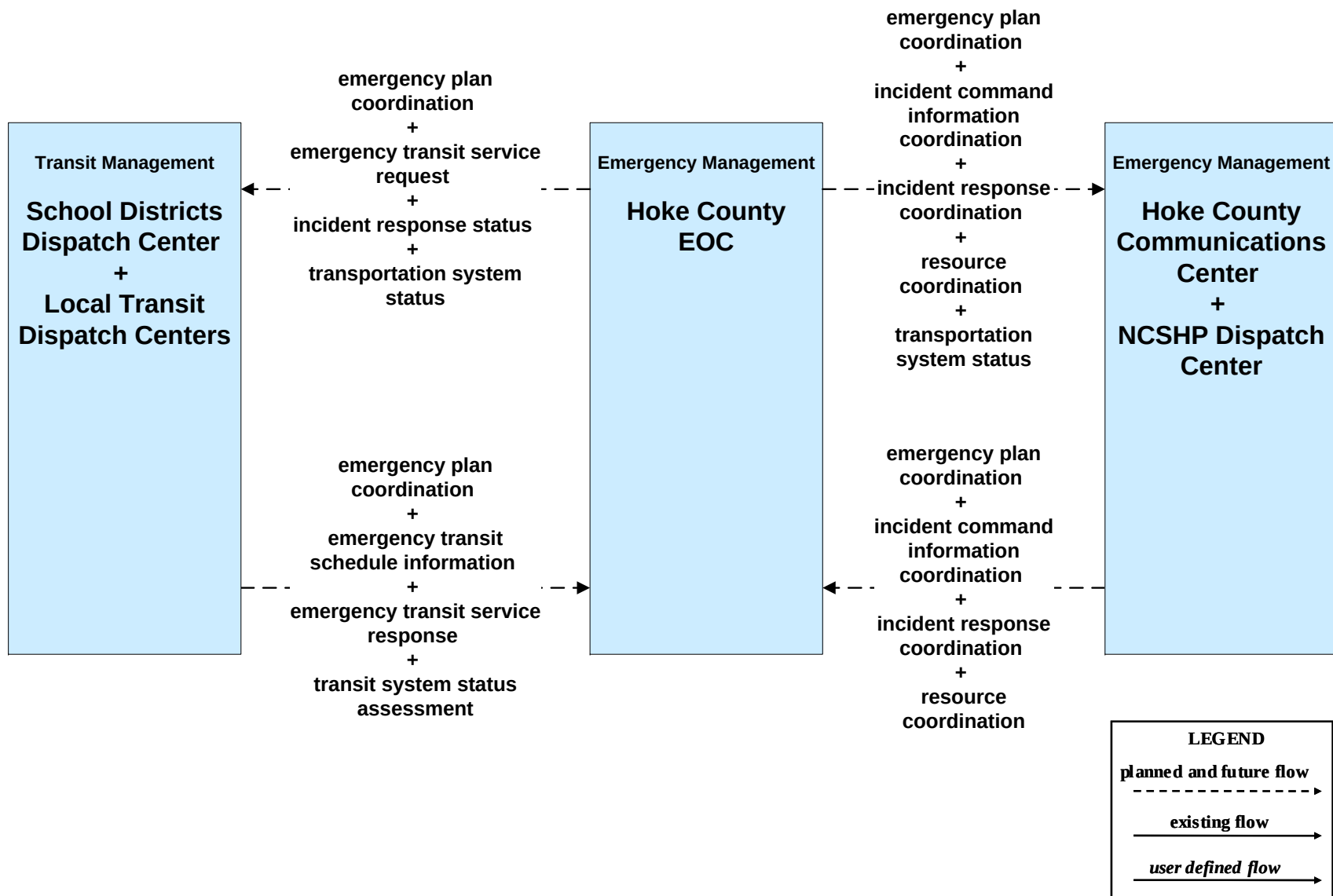
EM07 - Early Warning System Harnett County EOC



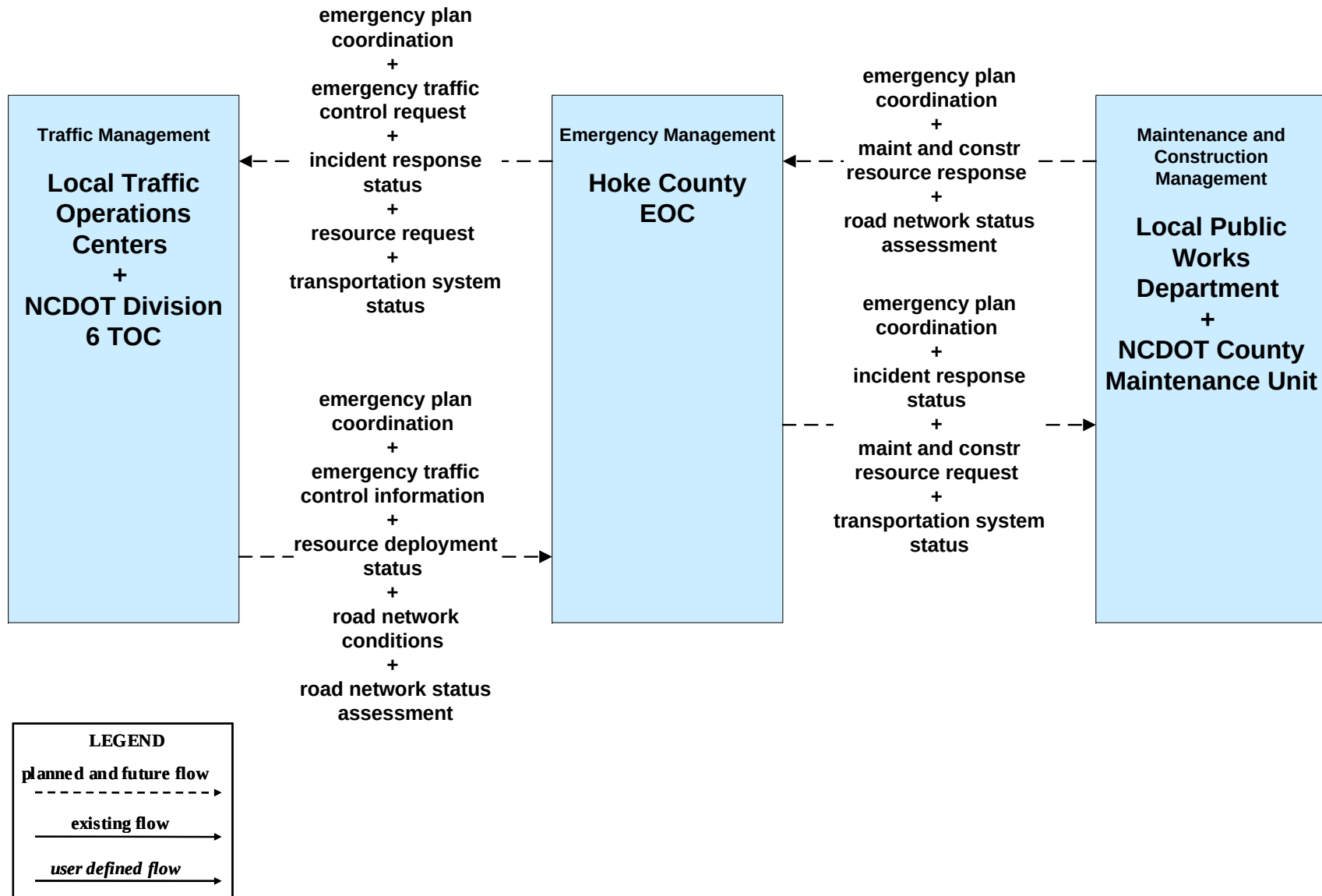
EM08 - Disaster Response and Recovery NC State Emergency Operations Center



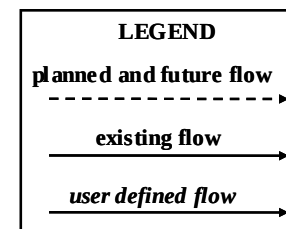
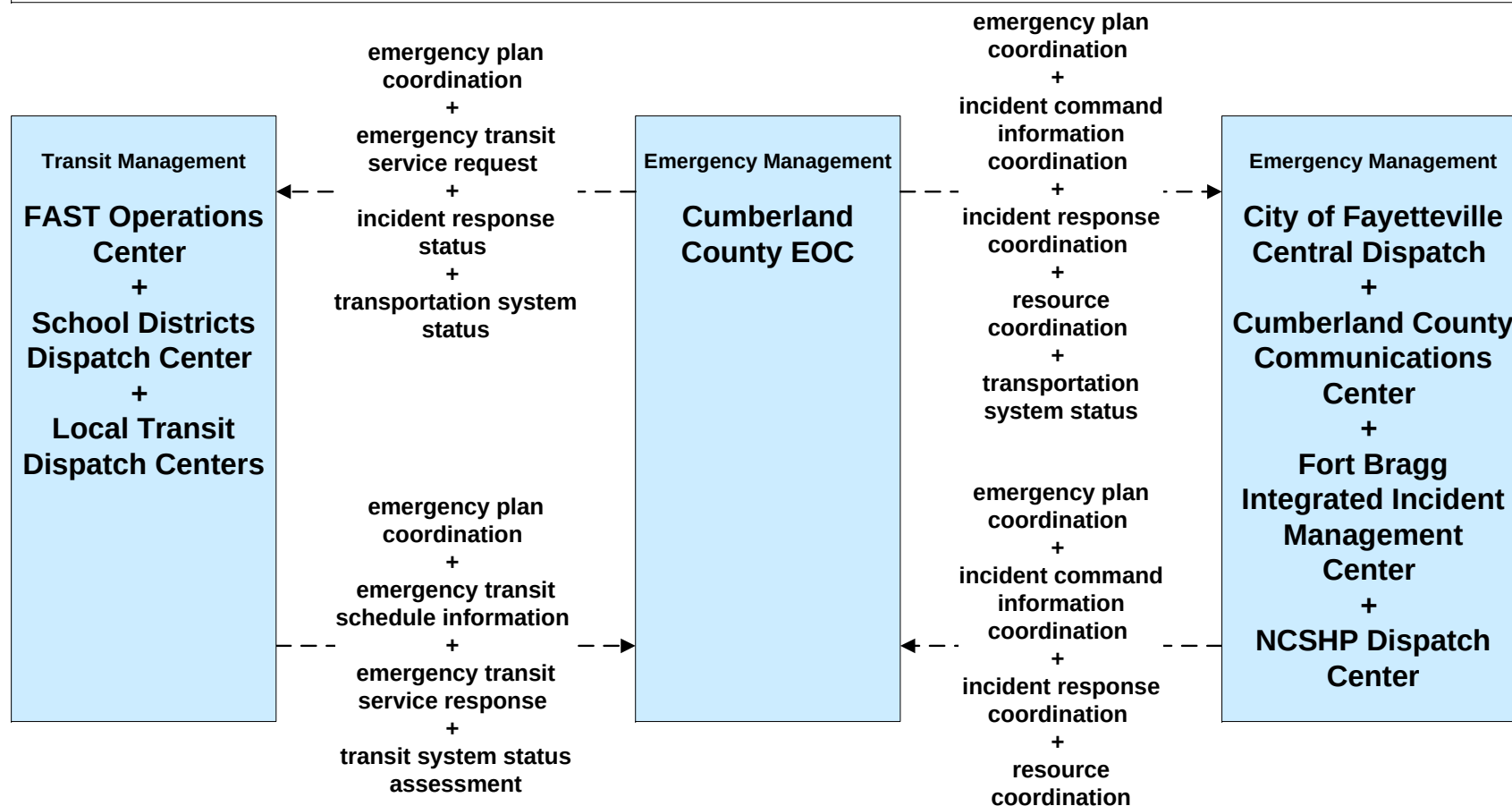
**EM08 - Disaster Response and Recovery
Hoke County EOC (1 of 2)**



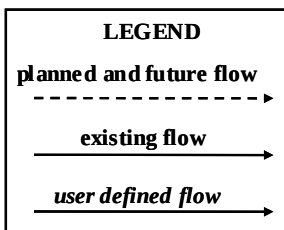
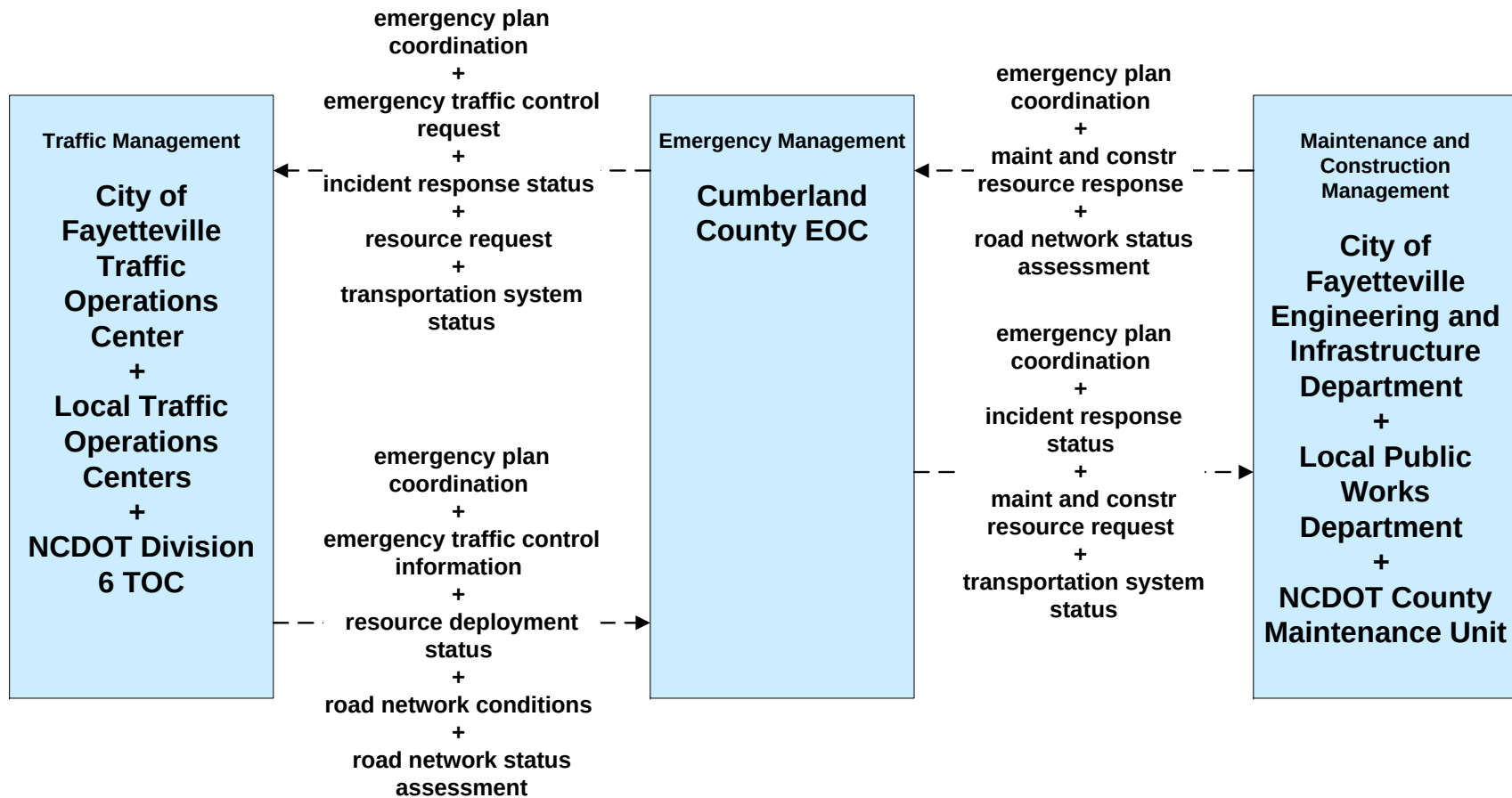
**EM08 - Disaster Response and Recovery
Hoke County EOC (2 of 2)**



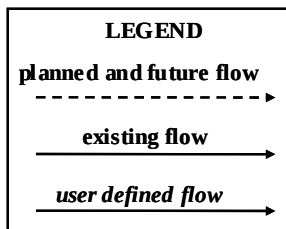
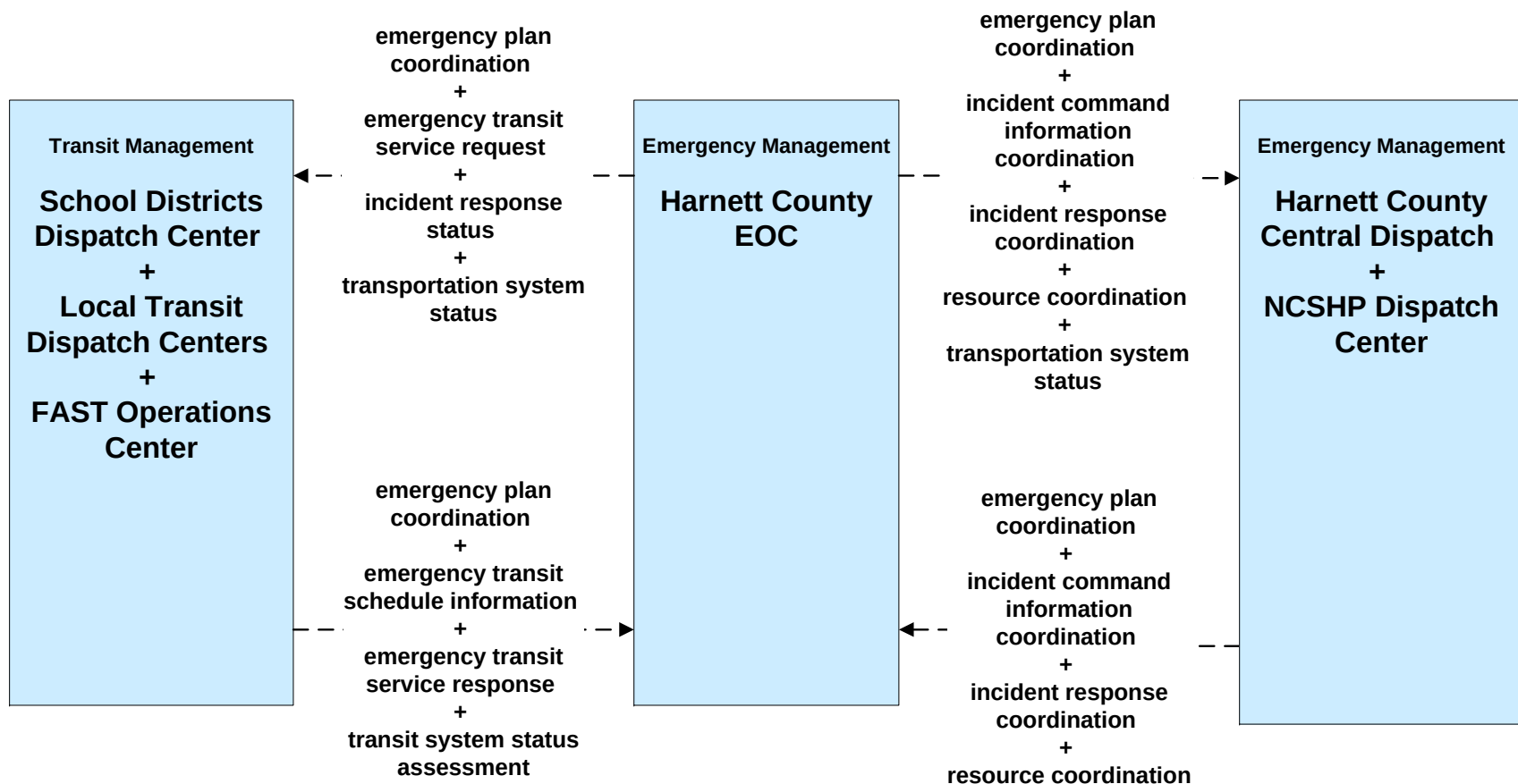
EM08 - Disaster Response and Recovery Cumberland County EOC (1 of 2)



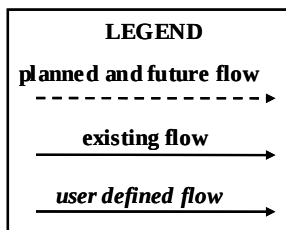
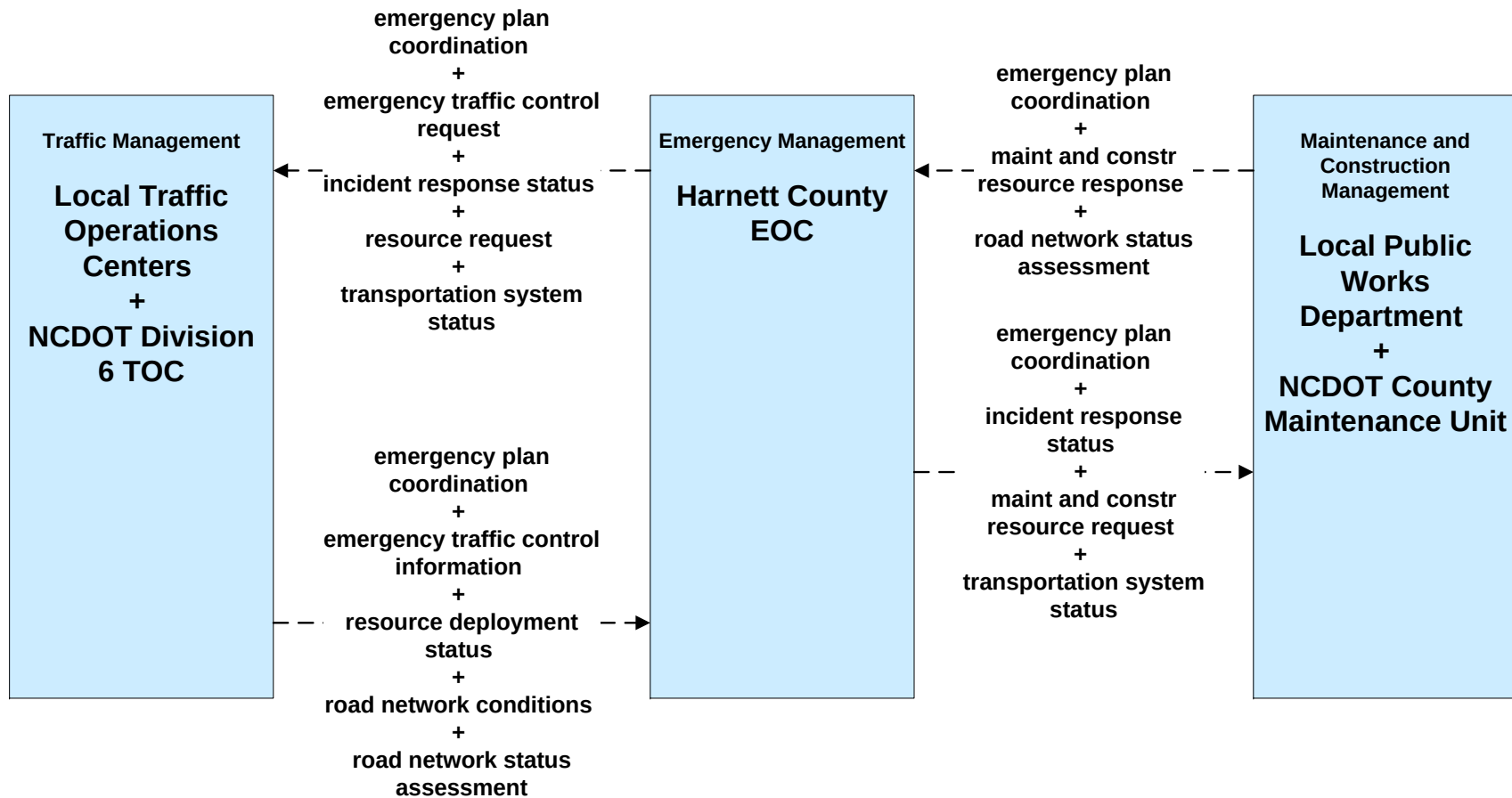
**EM08 - Disaster Response and Recovery
Cumberland County EOC (2 of 2)**



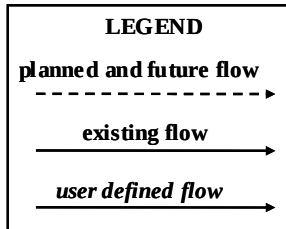
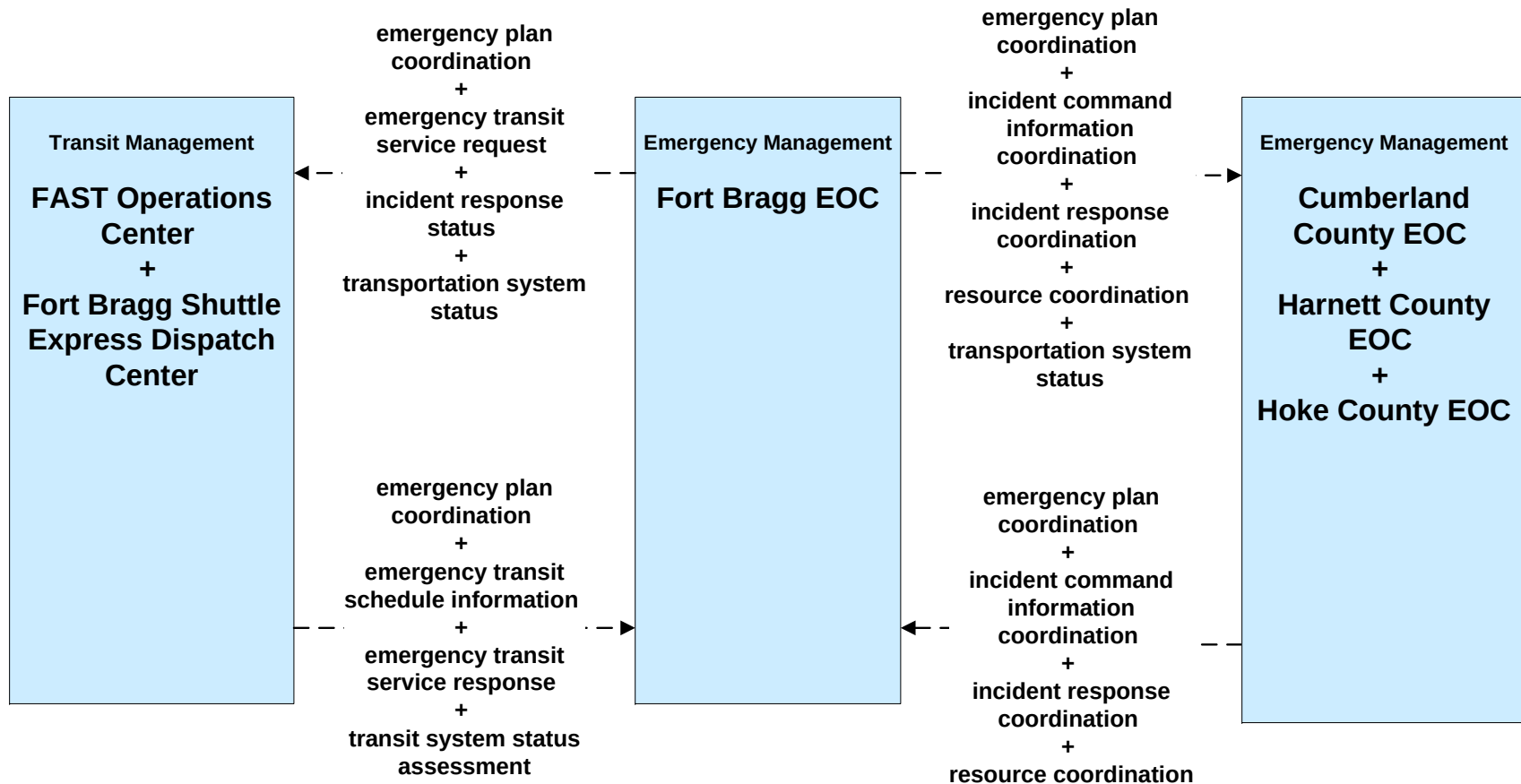
**EM08 - Disaster Response and Recovery
Harnett County EOC (1 of 2)**



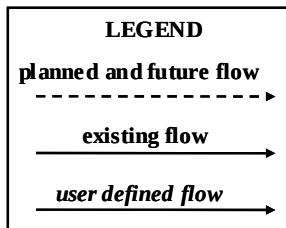
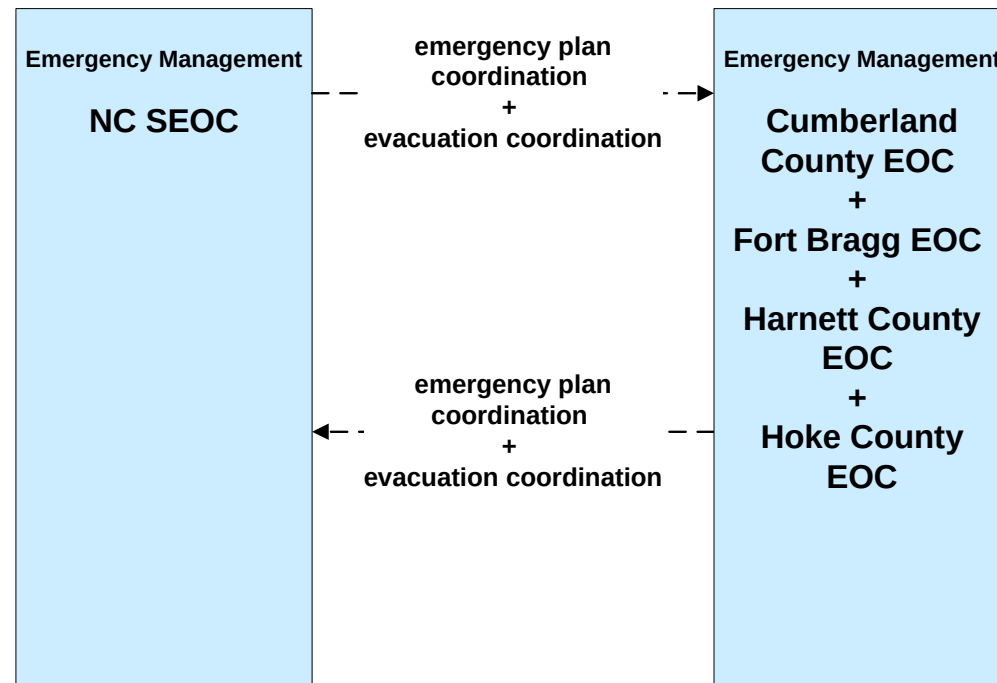
**EM08 - Disaster Response and Recovery
Harnett County EOC (2 of 2)**



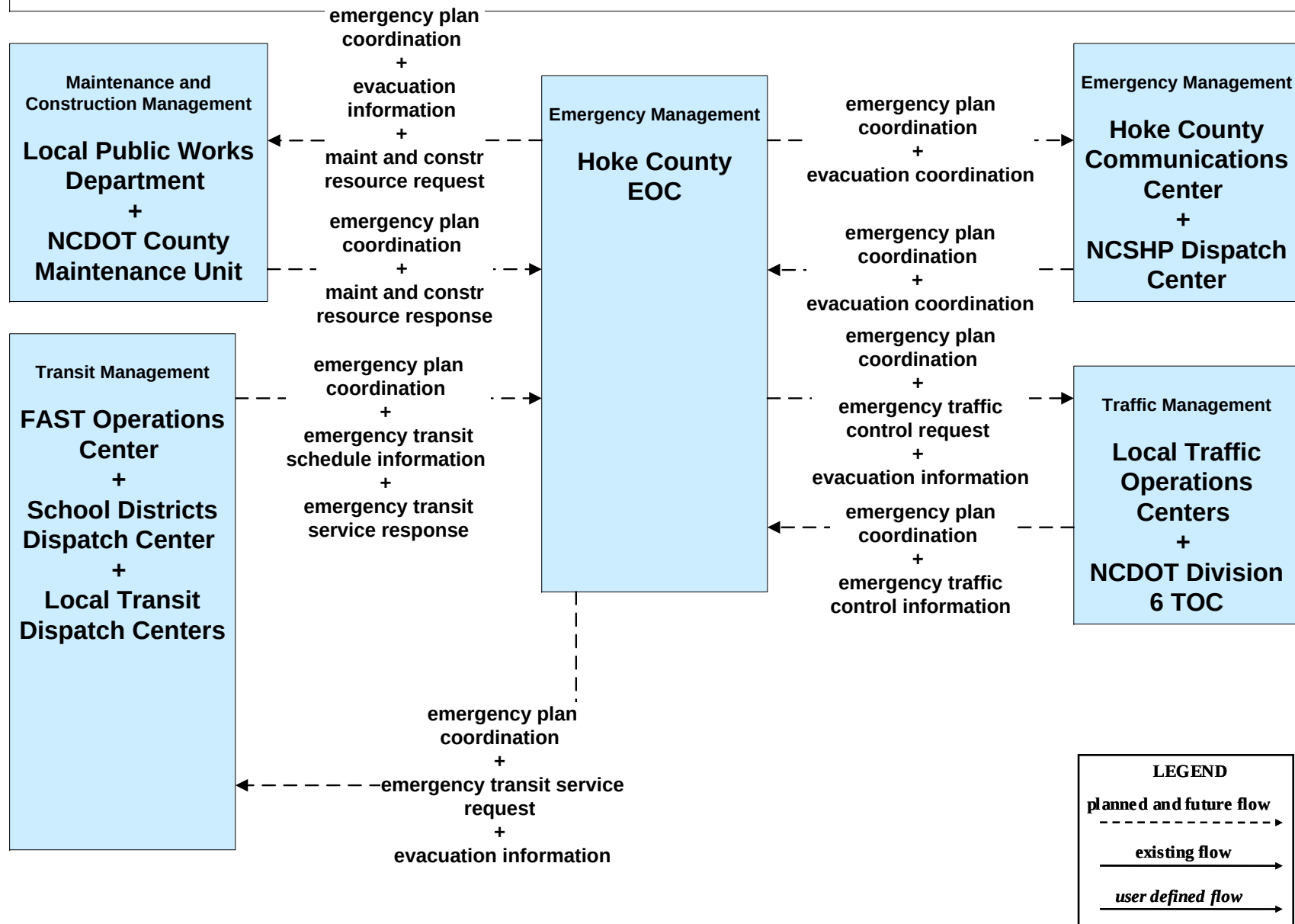
EM08 - Disaster Response and Recovery Fort Bragg EOC



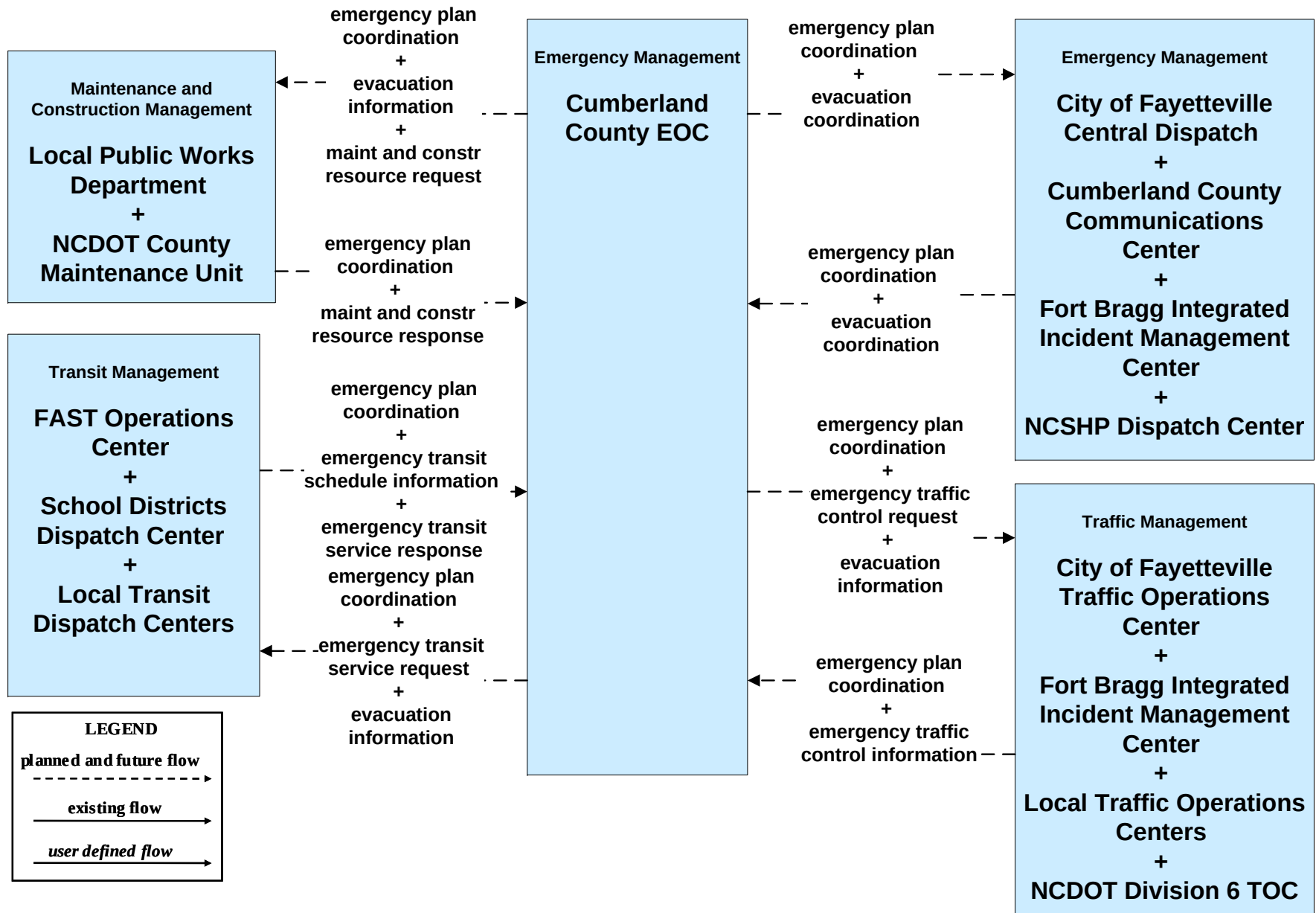
**EM09 – Evacuation and Reentry Management
NC State Emergency Operations Center**



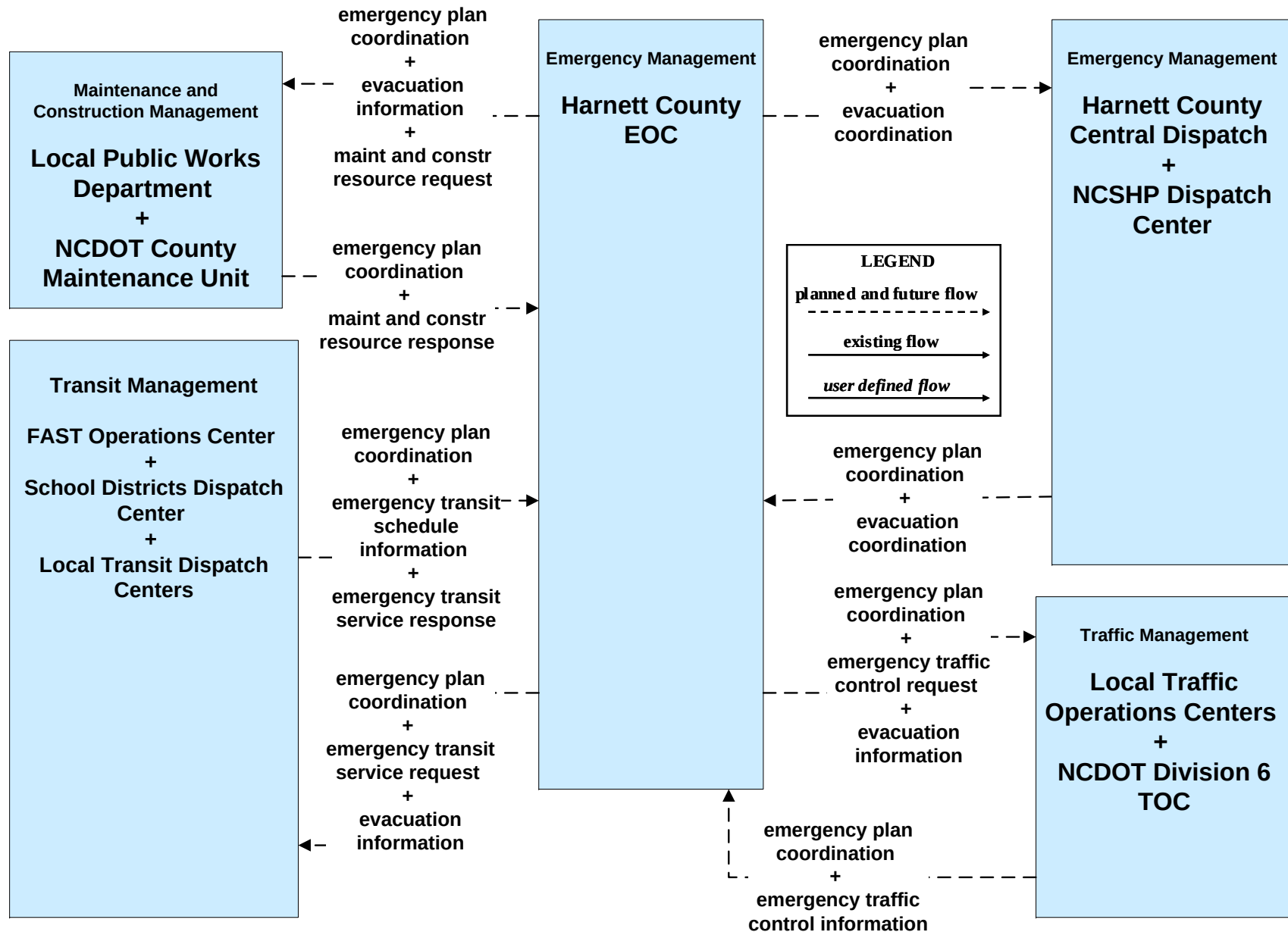
EM09 – Evacuation and Reentry Management Hoke County EOC



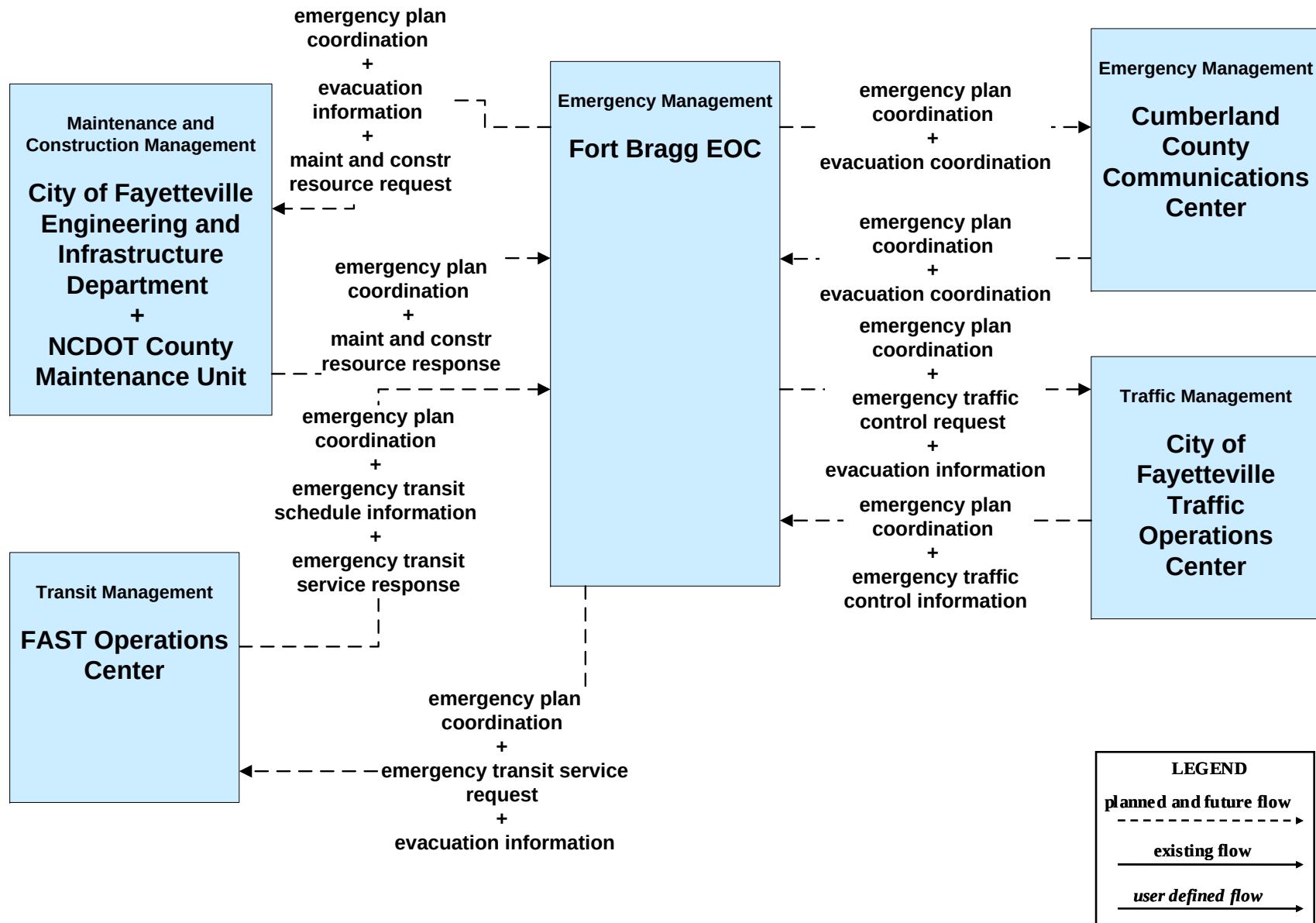
EM09 – Evacuation and Reentry Management Cumberland County EOC



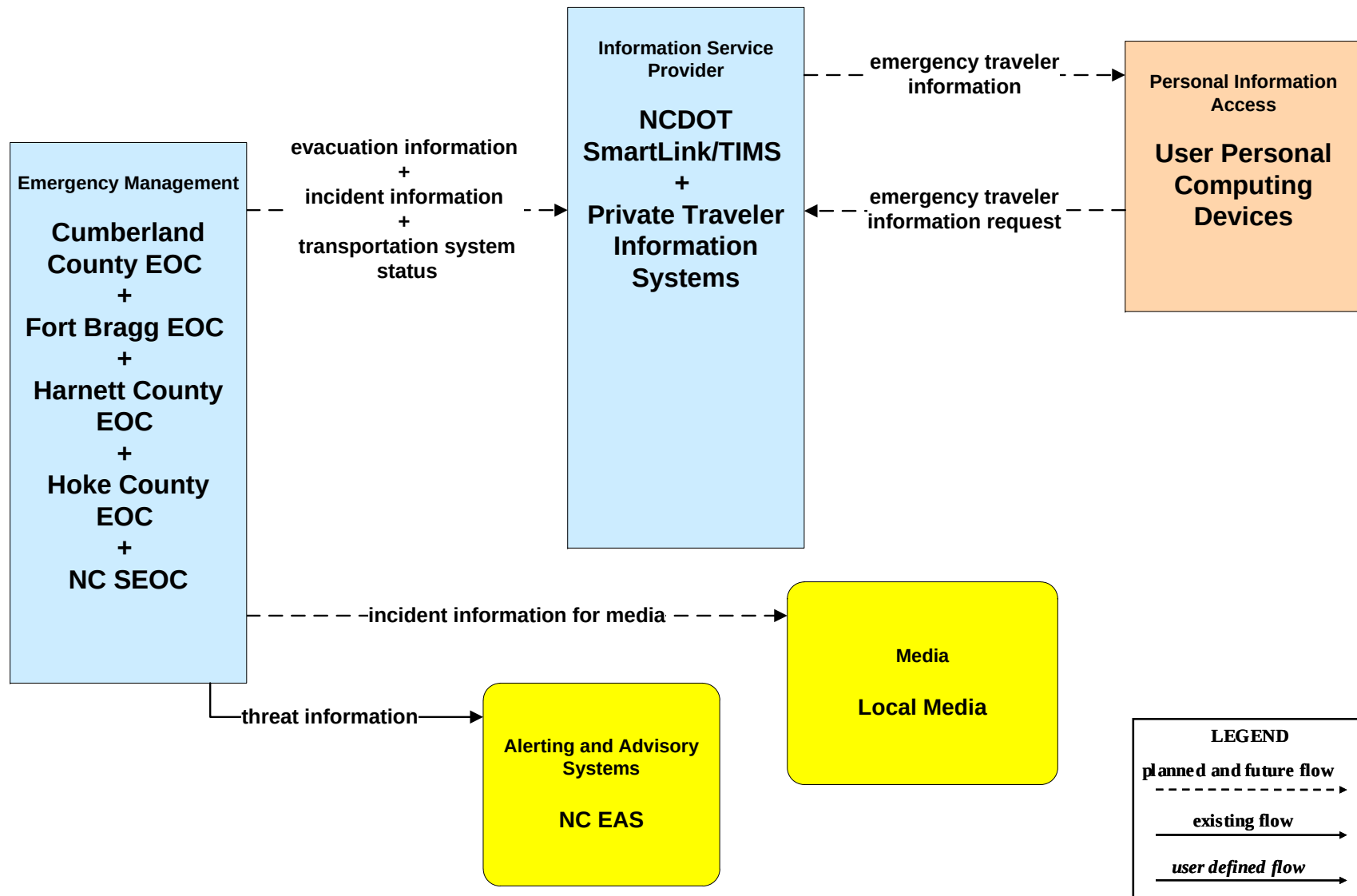
EM09 – Evacuation and Reentry Management Harnett County EOC



EM09 – Evacuation and Reentry Management Fort Bragg EOC



EM10 - Disaster Traveler Information NCDOT SmartLink

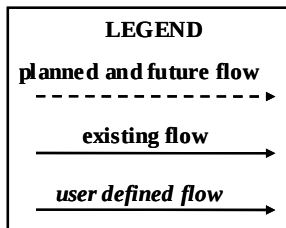
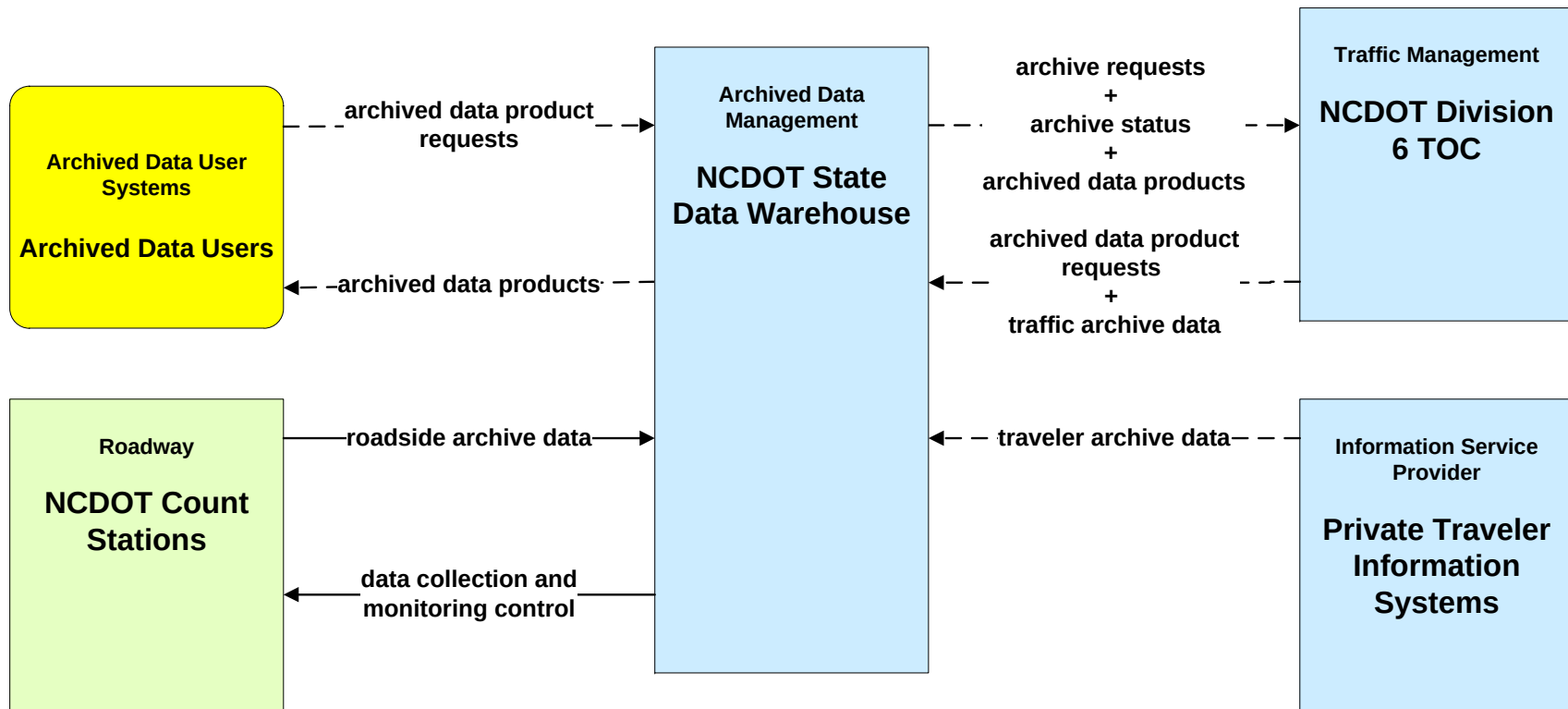


FAMPO Regional ITS Architecture

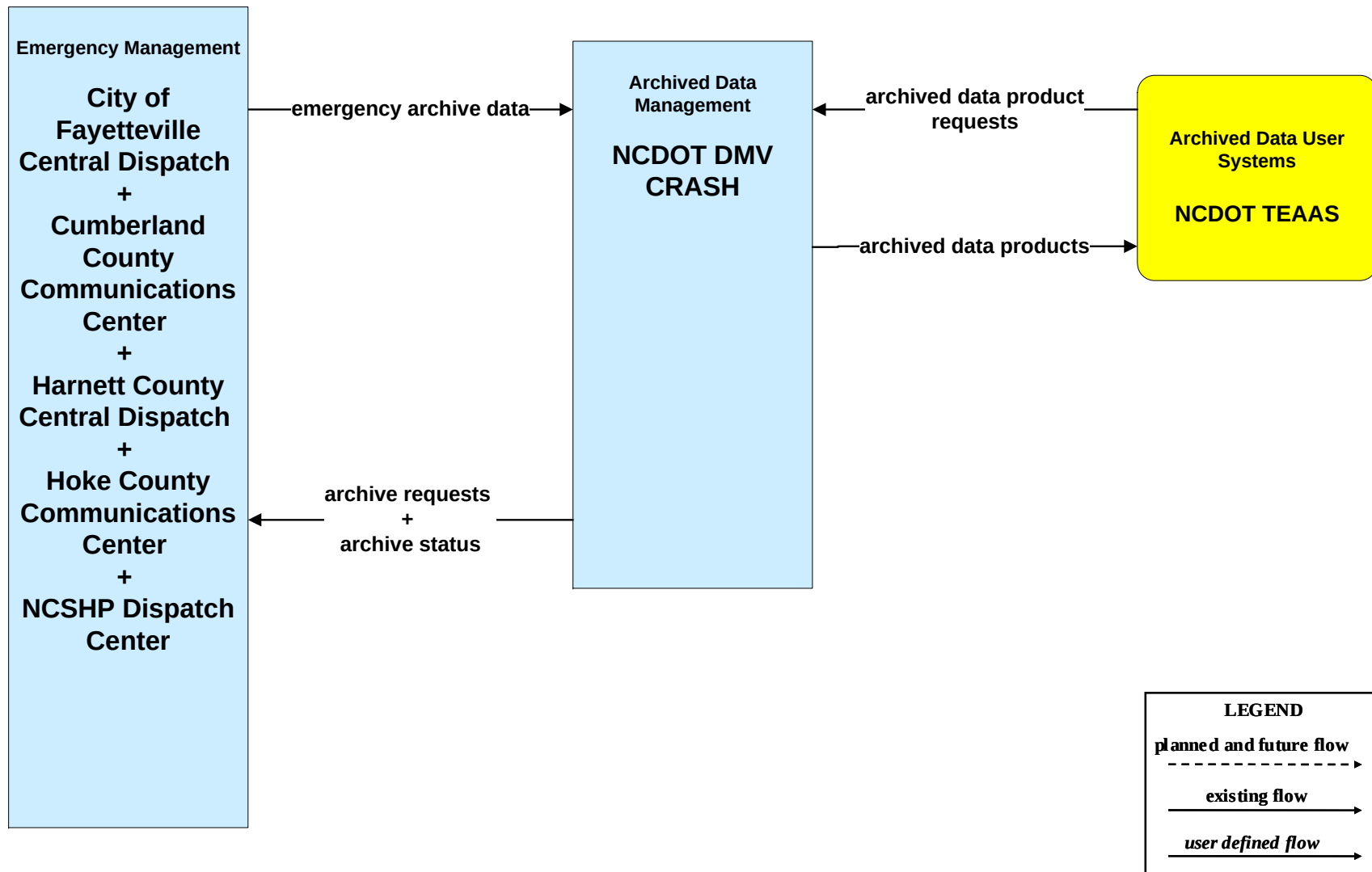
Customized Service Package Diagrams

Archived Data (AD)

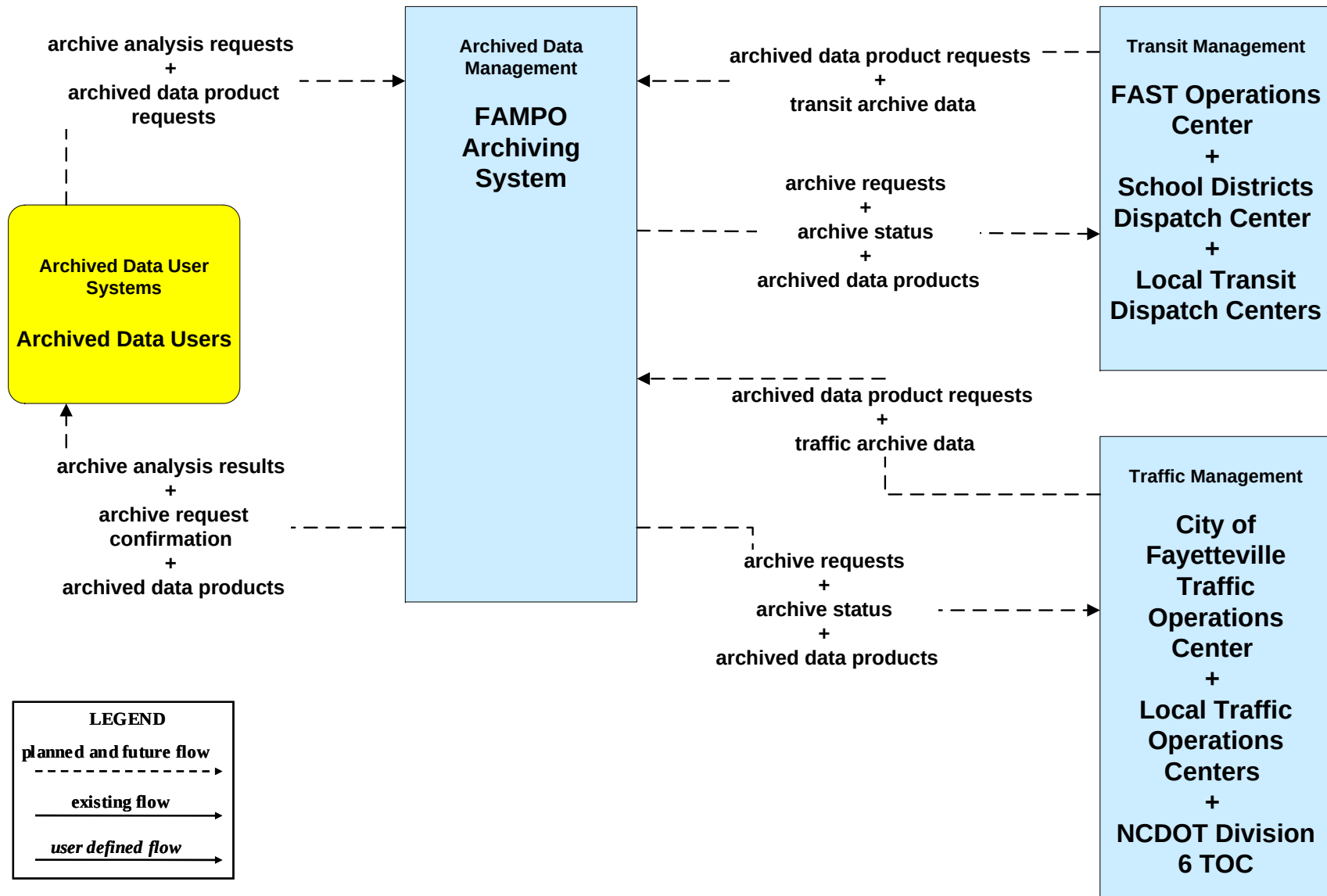
AD1 - ITS Data Mart NCDOT



**AD1 - ITS Data Mart
NCDOT DMV CRS**



AD2 - ITS Data Warehouse FAMPO Archiving System

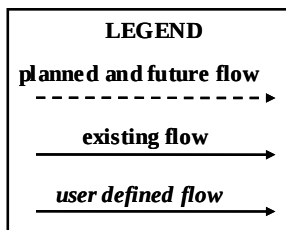
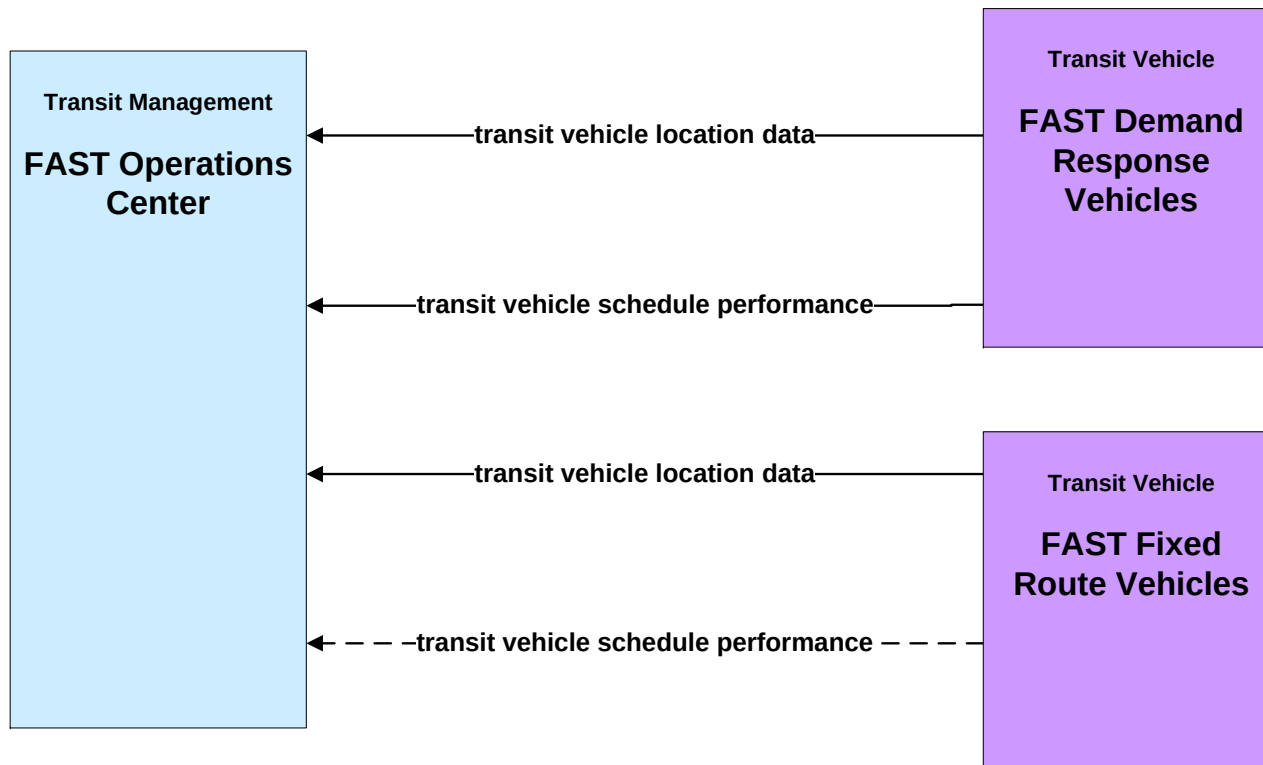


FAMPO Regional ITS Architecture

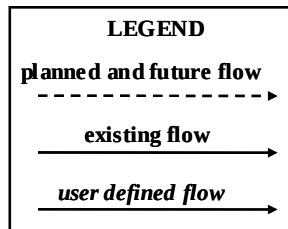
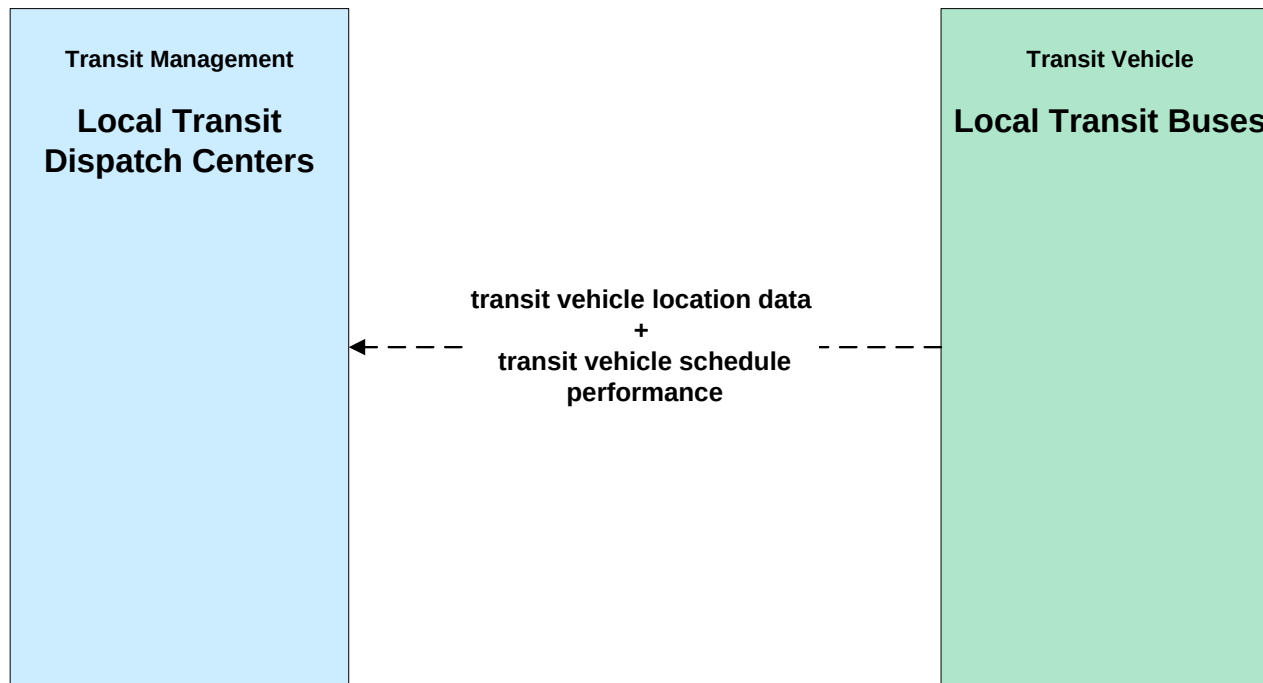
Customized Service Package Diagrams

**Advanced Public Transportation Systems
(APTS)**

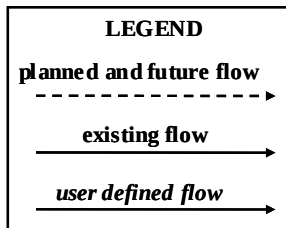
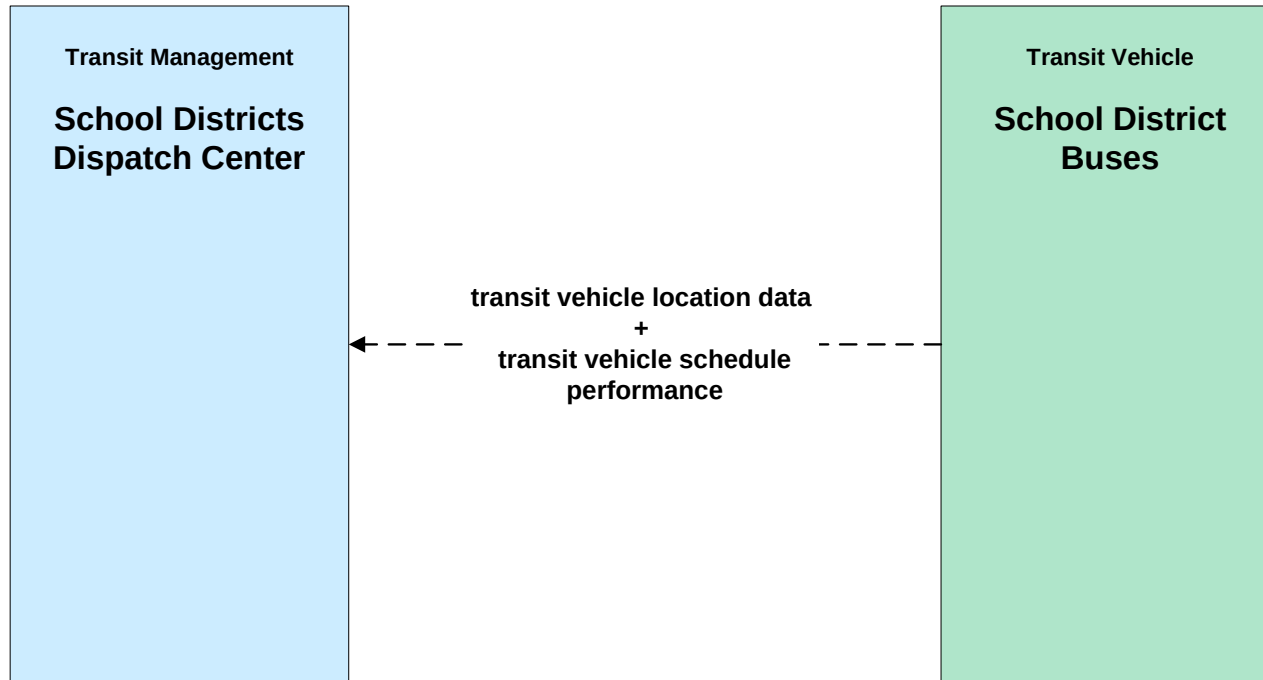
APTS01 - Transit Vehicle Tracking FAST



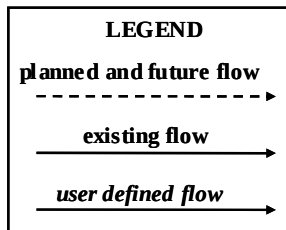
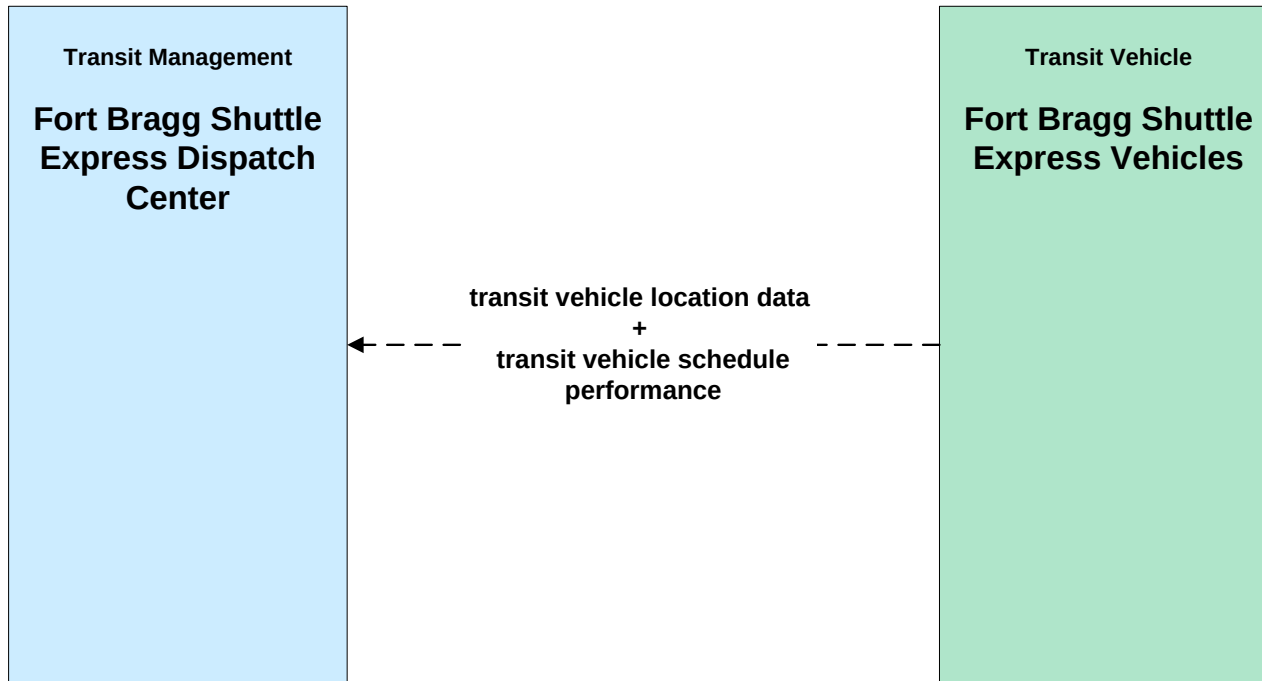
APTS01 - Transit Vehicle Tracking Local Transit Systems



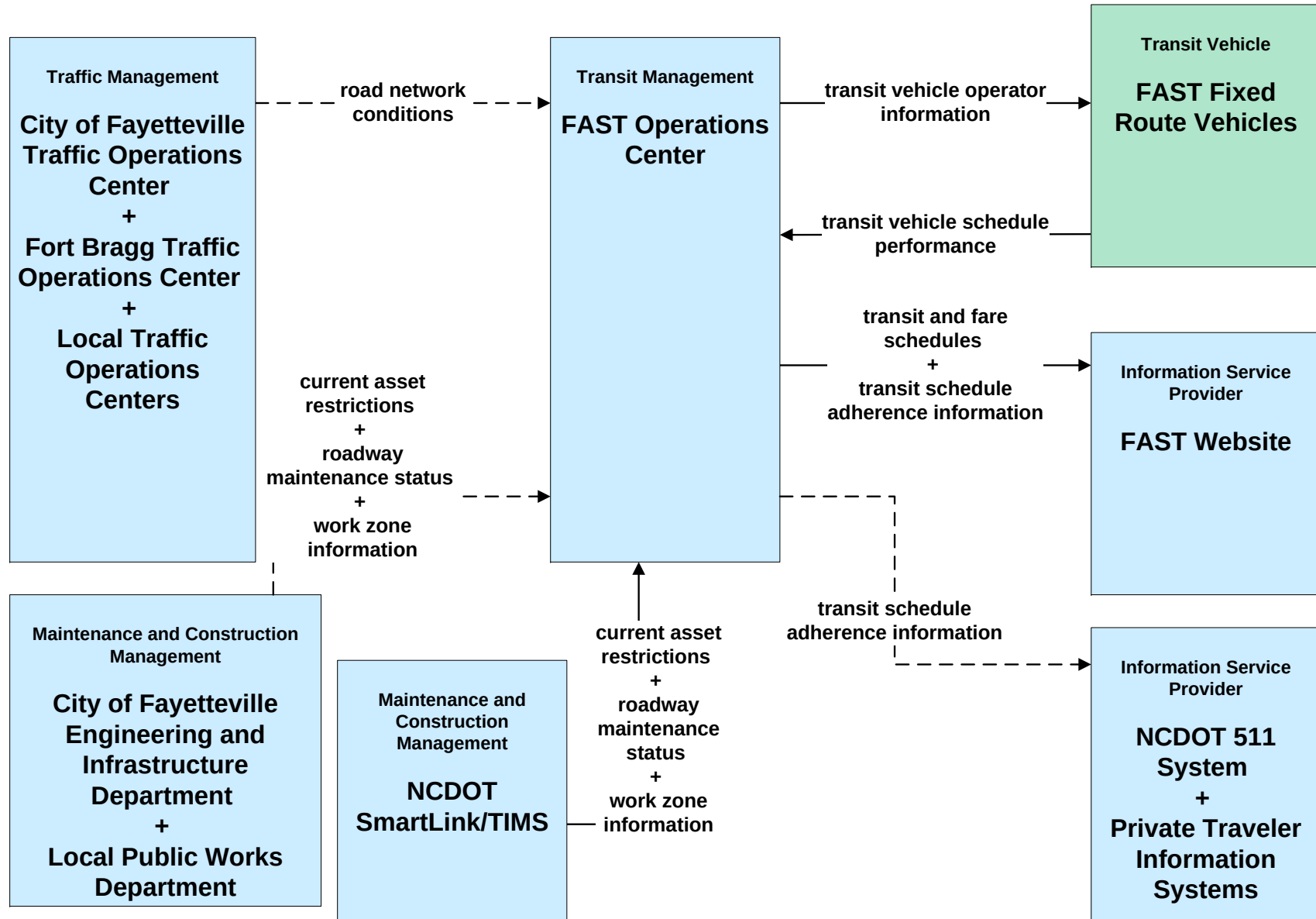
**APTS01 - Transit Vehicle Tracking
Independent School Districts**



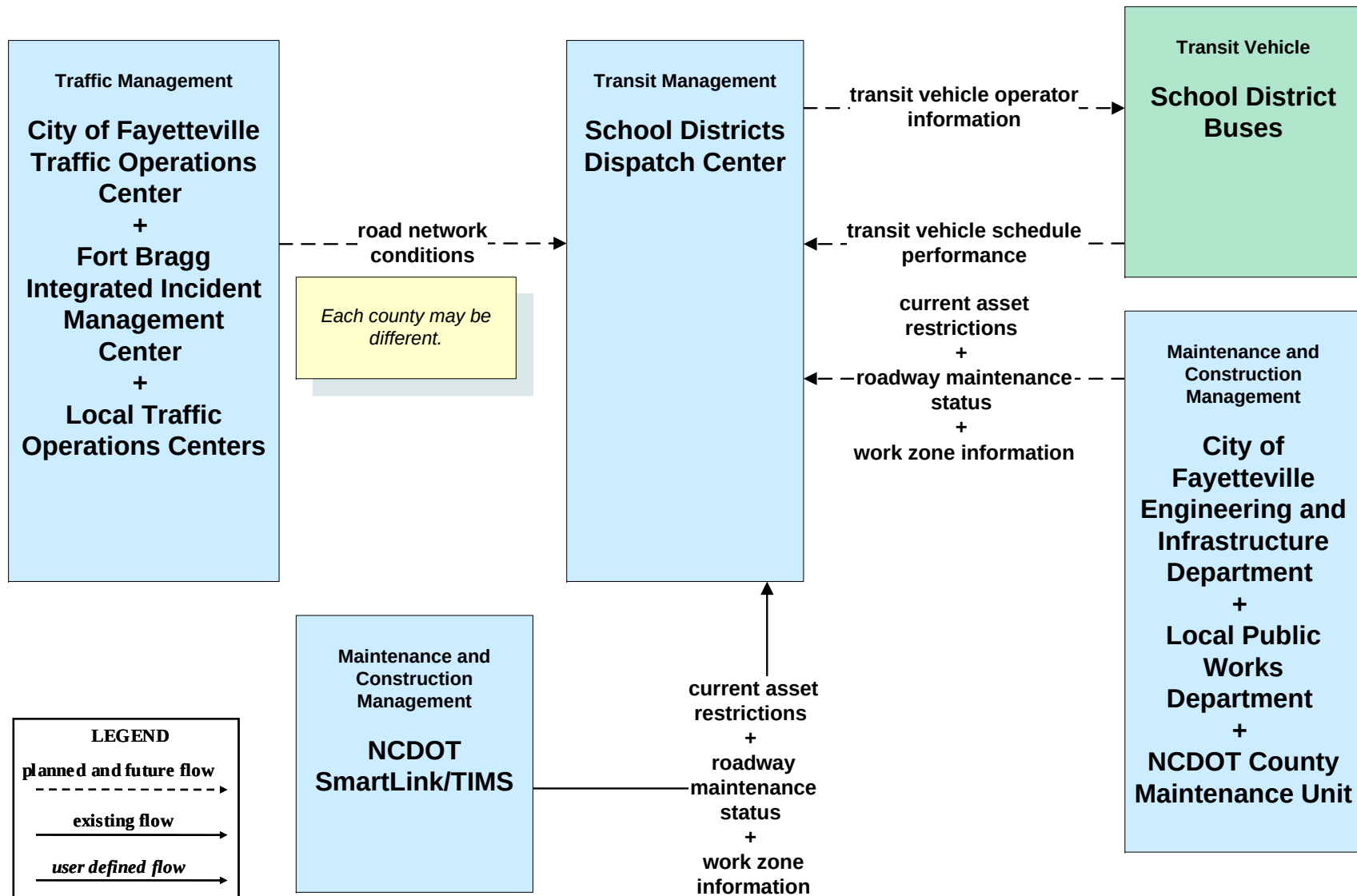
APTS01 - Transit Vehicle Tracking Fort Bragg Shuttle Express



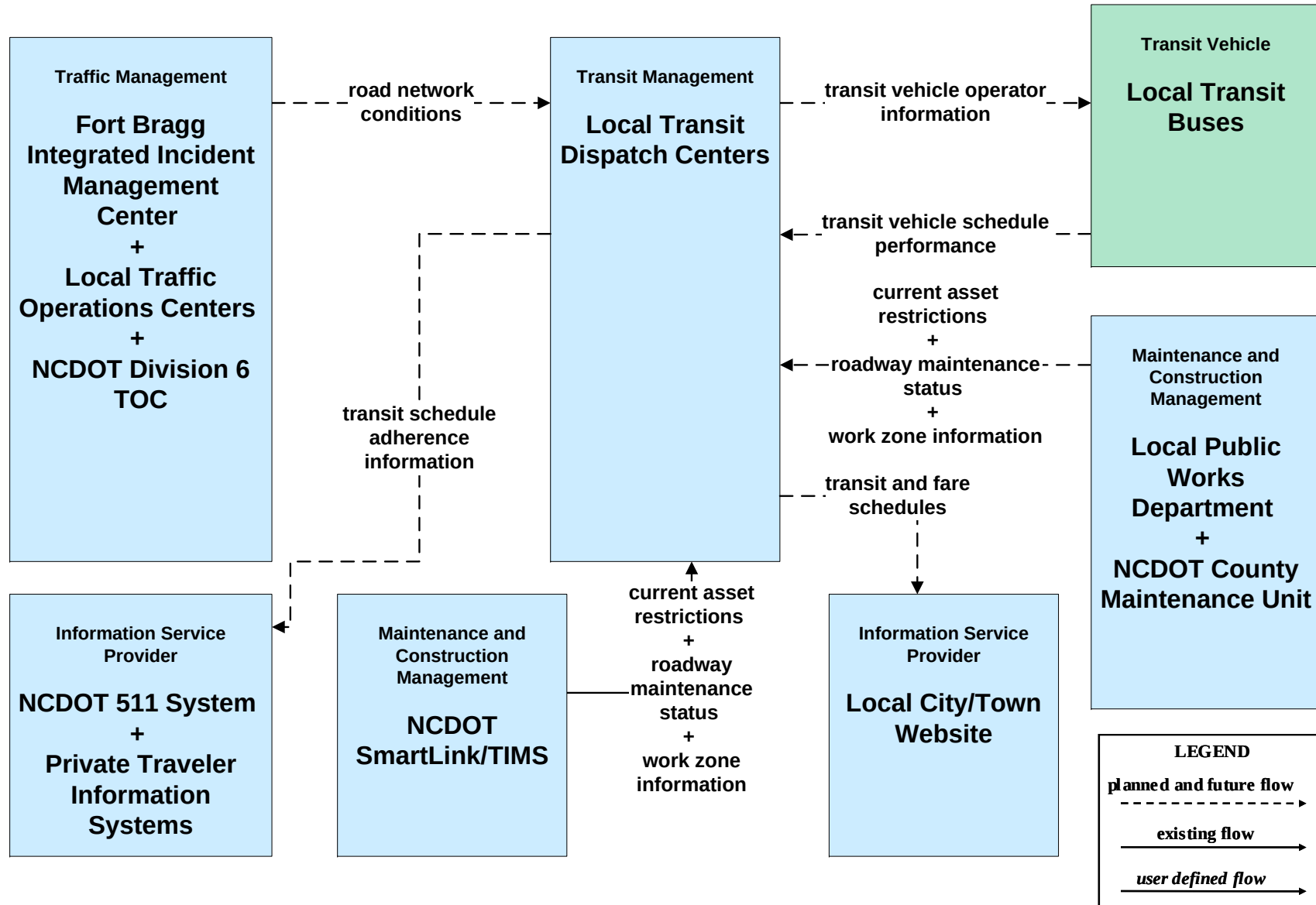
APTS02 - Transit Fixed-Route Operations FAST



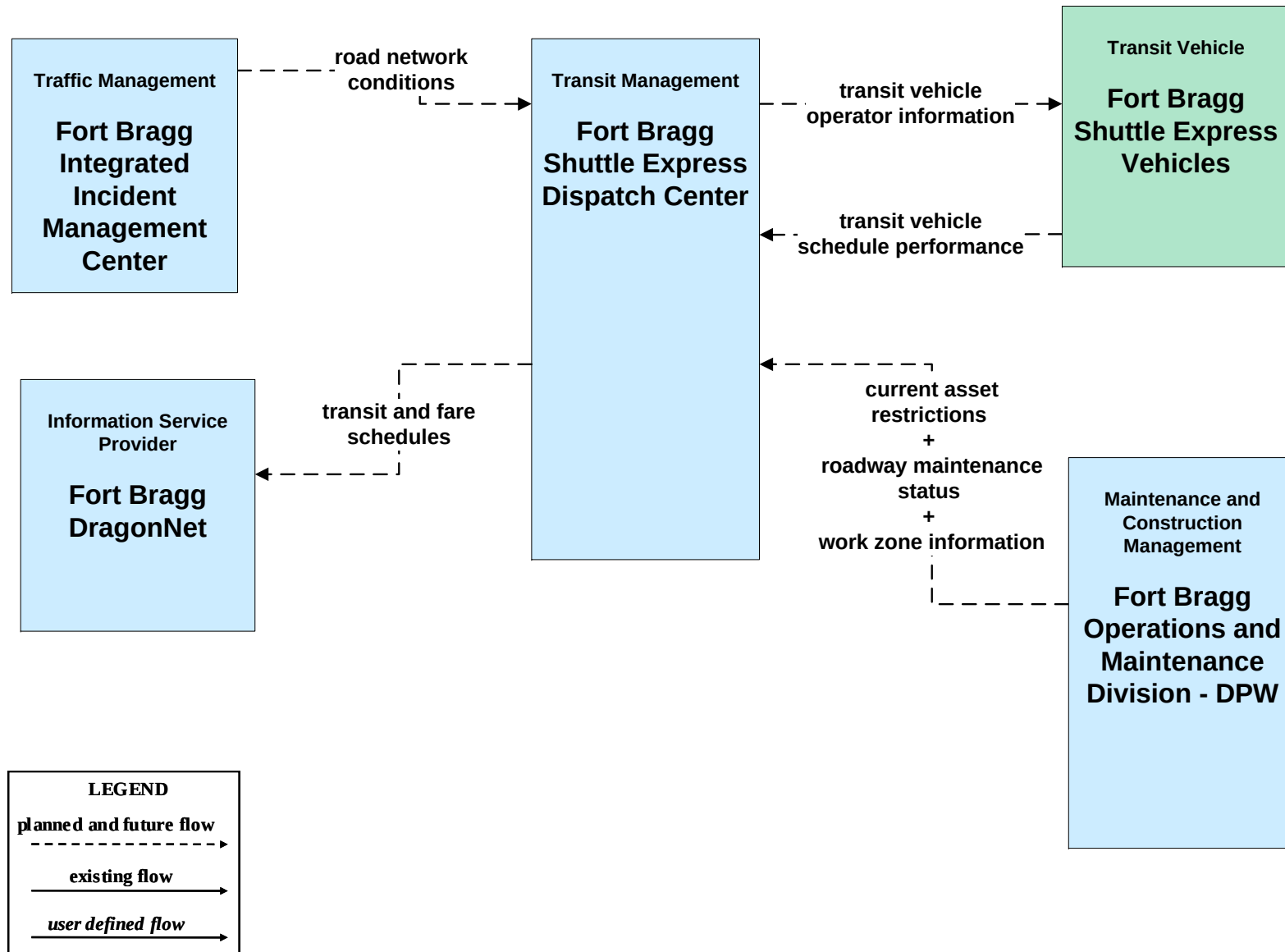
APTS02 - Transit Fixed-Route Operations Independent School Districts



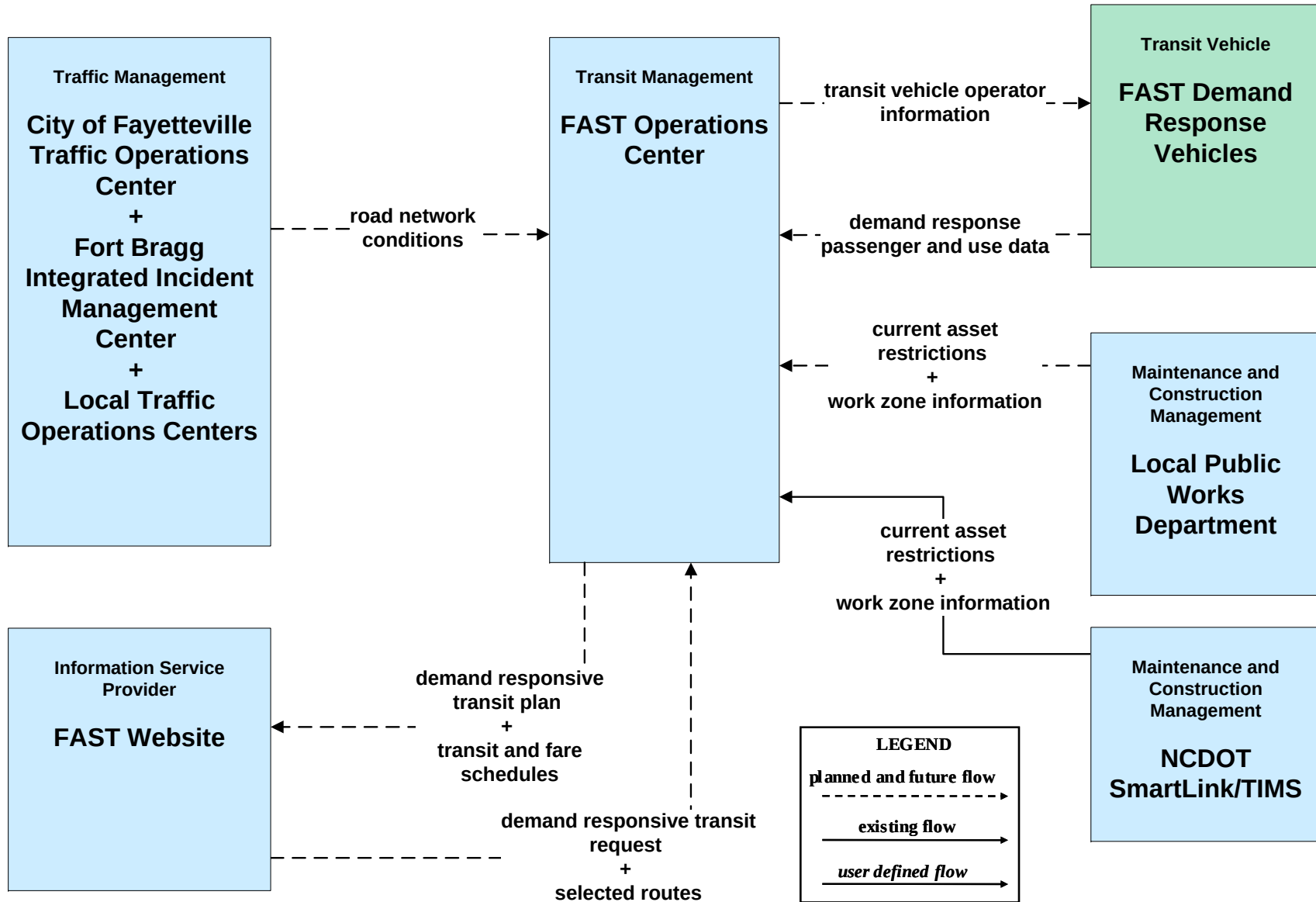
APTS02 - Transit Fixed-Route Operations Local Transit Systems



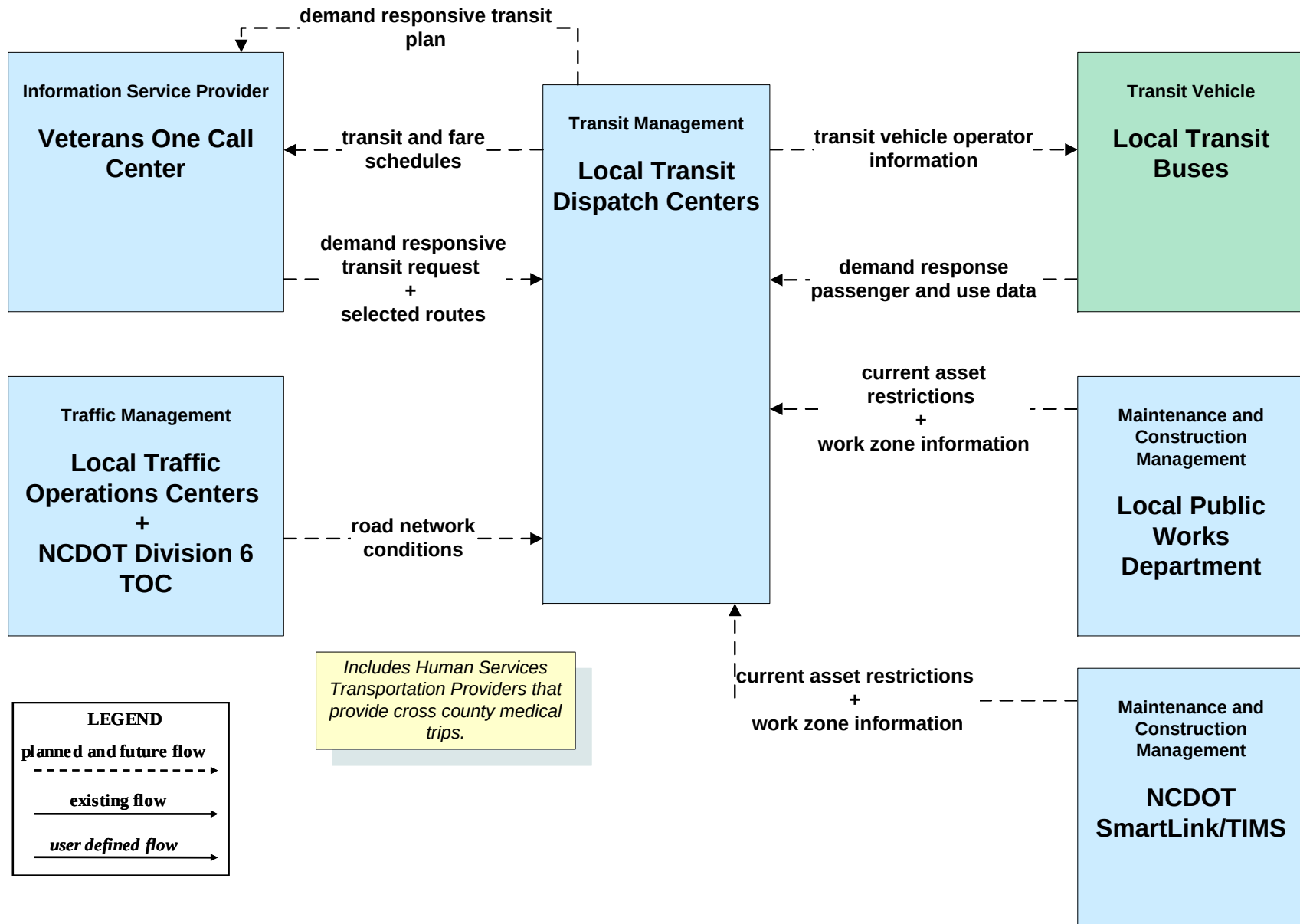
APTS02 - Transit Fixed-Route Operations Fort Bragg Shuttle Express



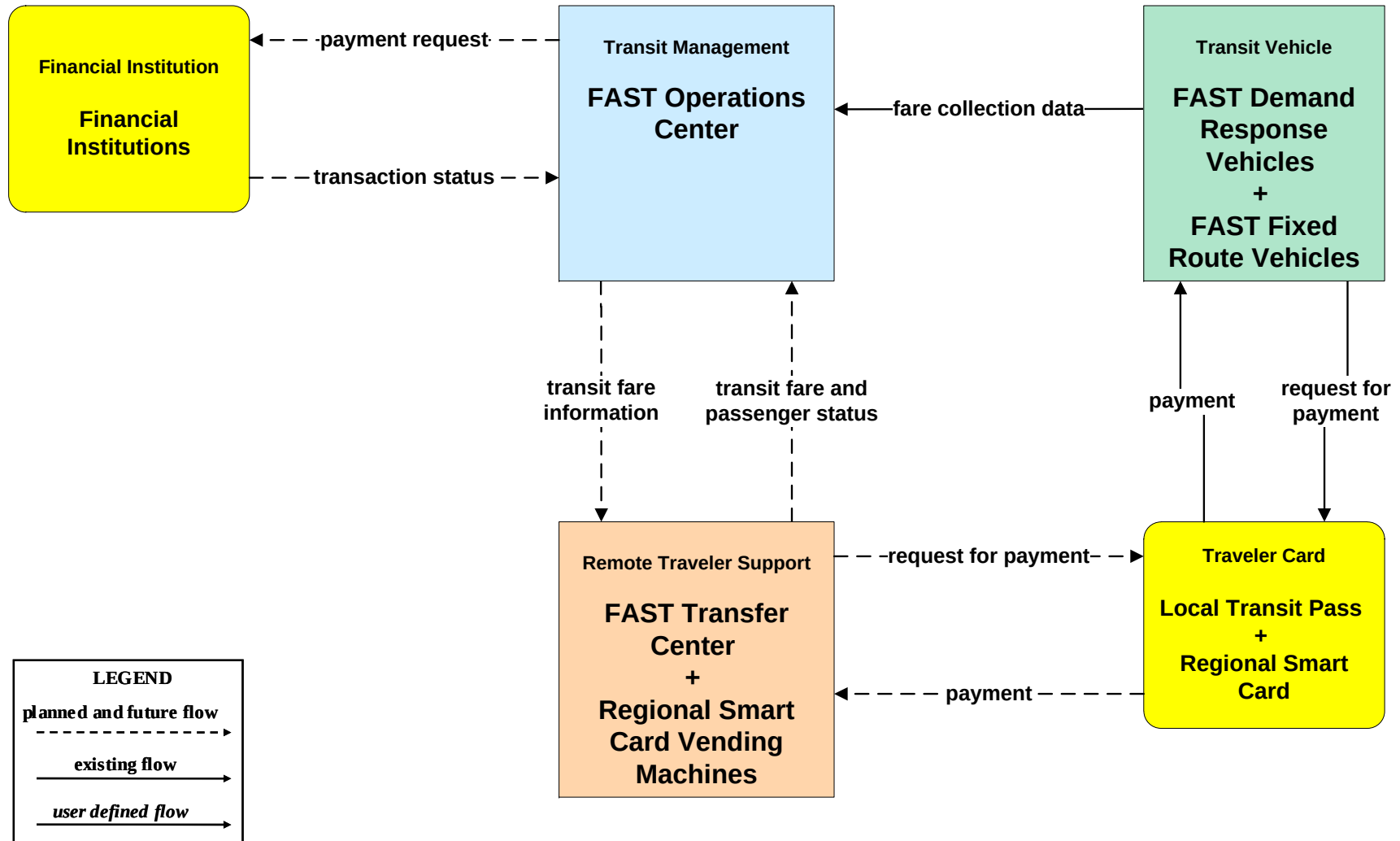
APTS03 - Demand Response FAST



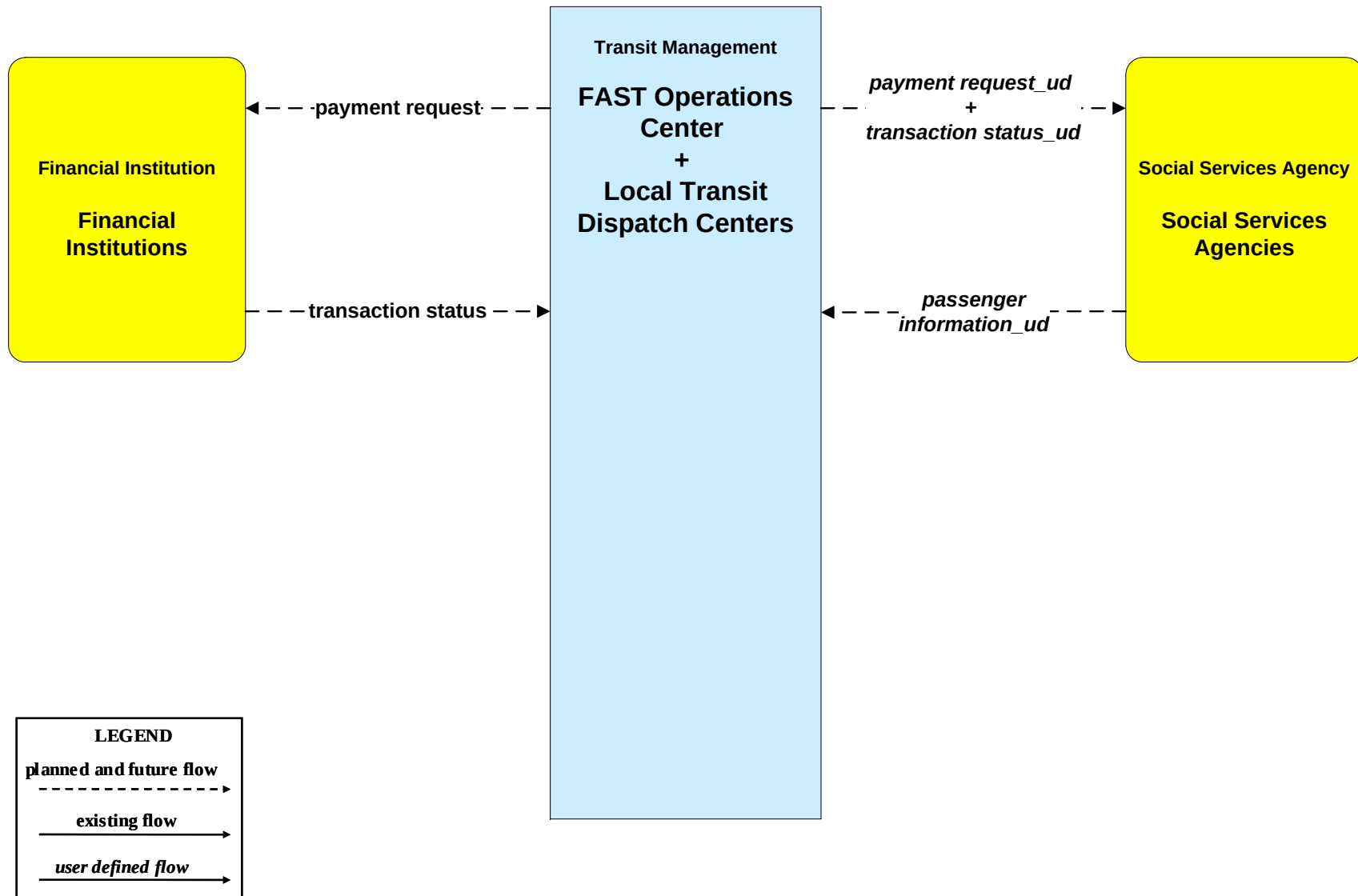
APTS03 - Demand Response Local Transit Systems



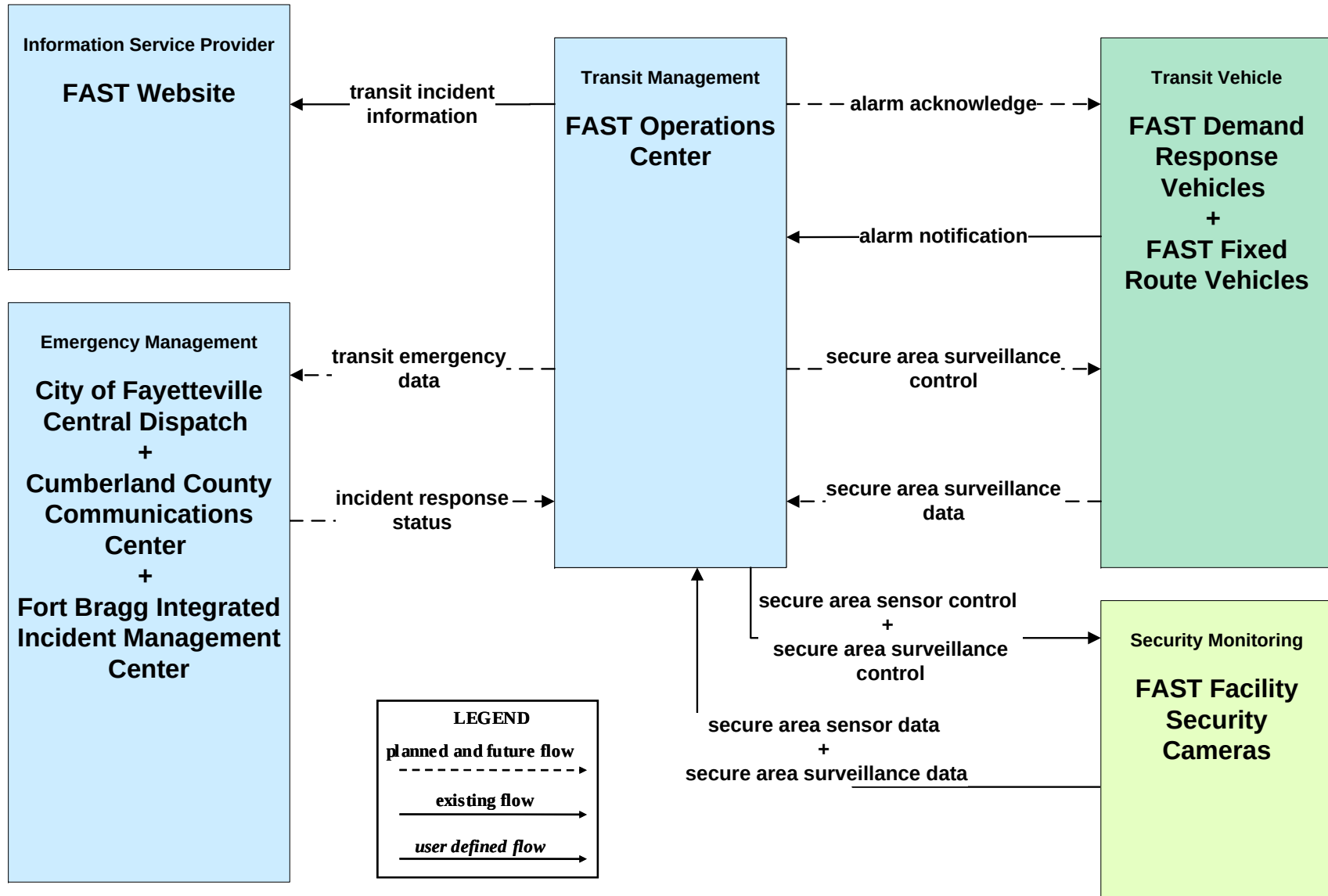
APTS04 - Transit Passenger and Fare Management FAST



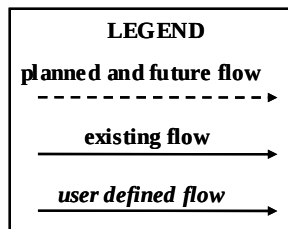
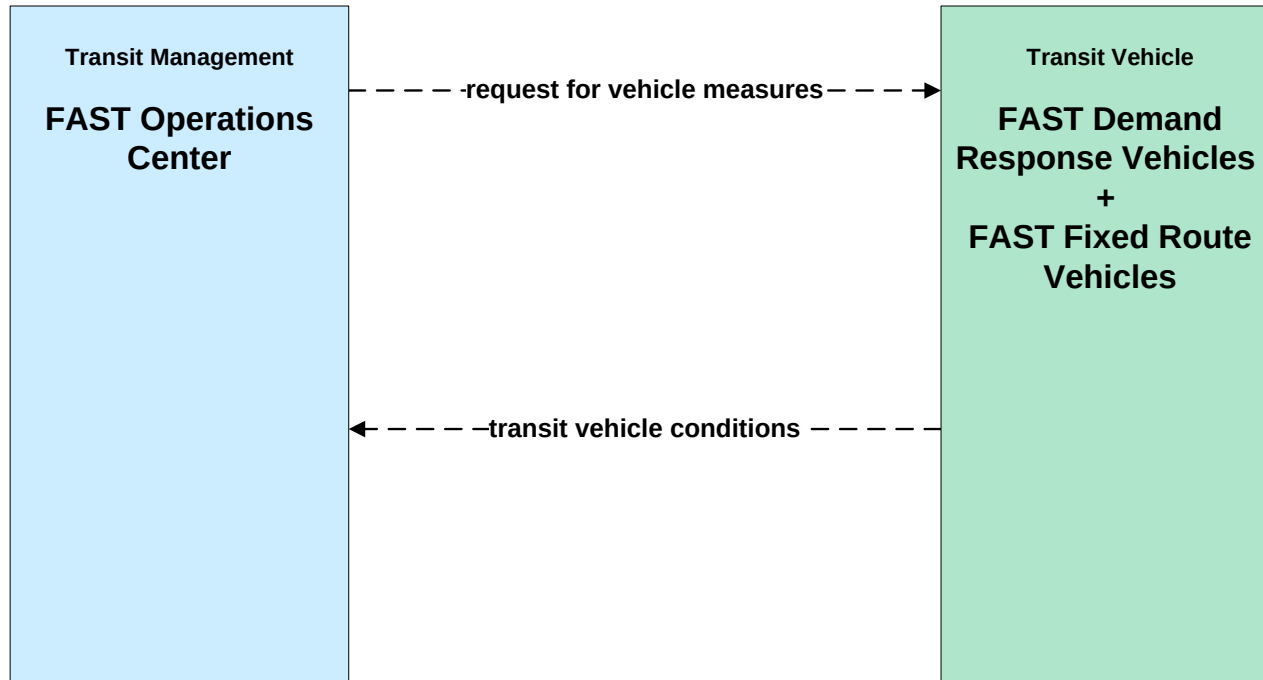
**APTS04 - Transit Passenger and Fare Management
Demand Responsive and Paratransit Agencies**



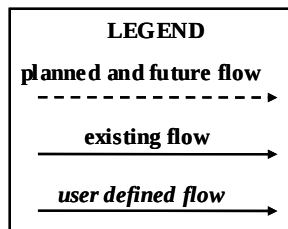
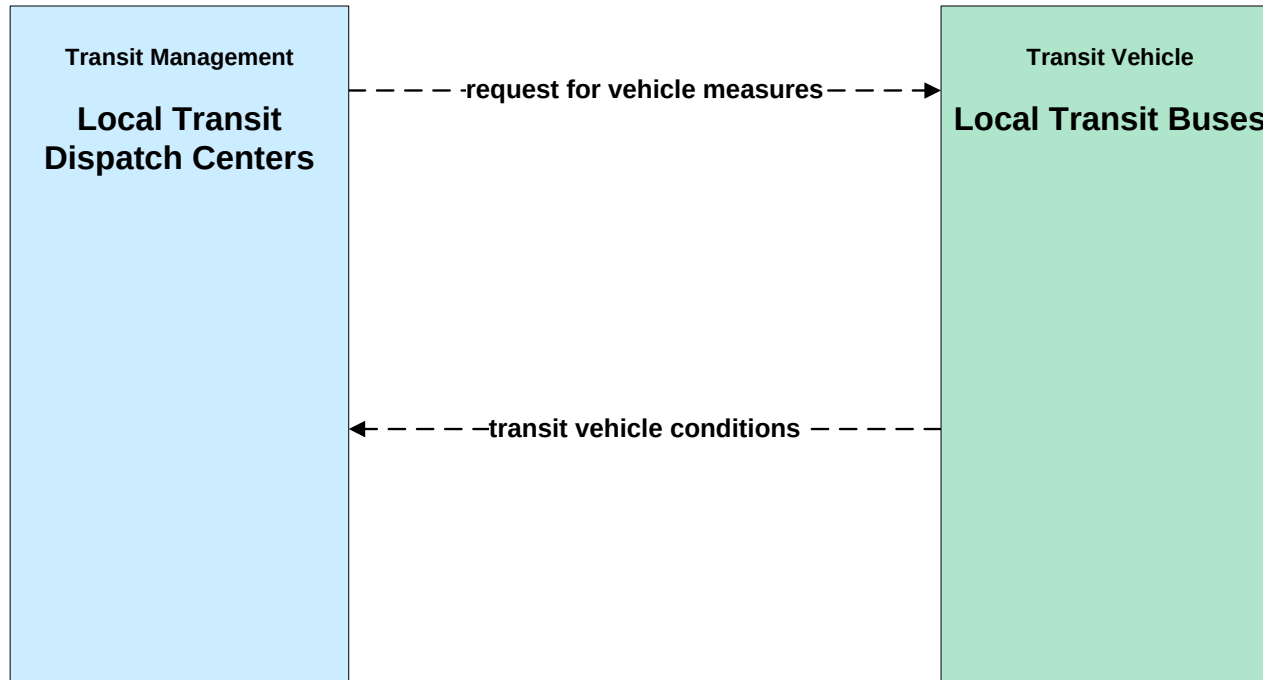
APTS05 - Transit Security FAST



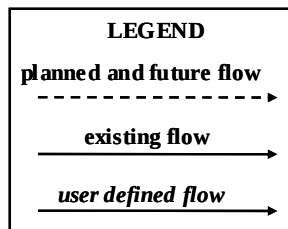
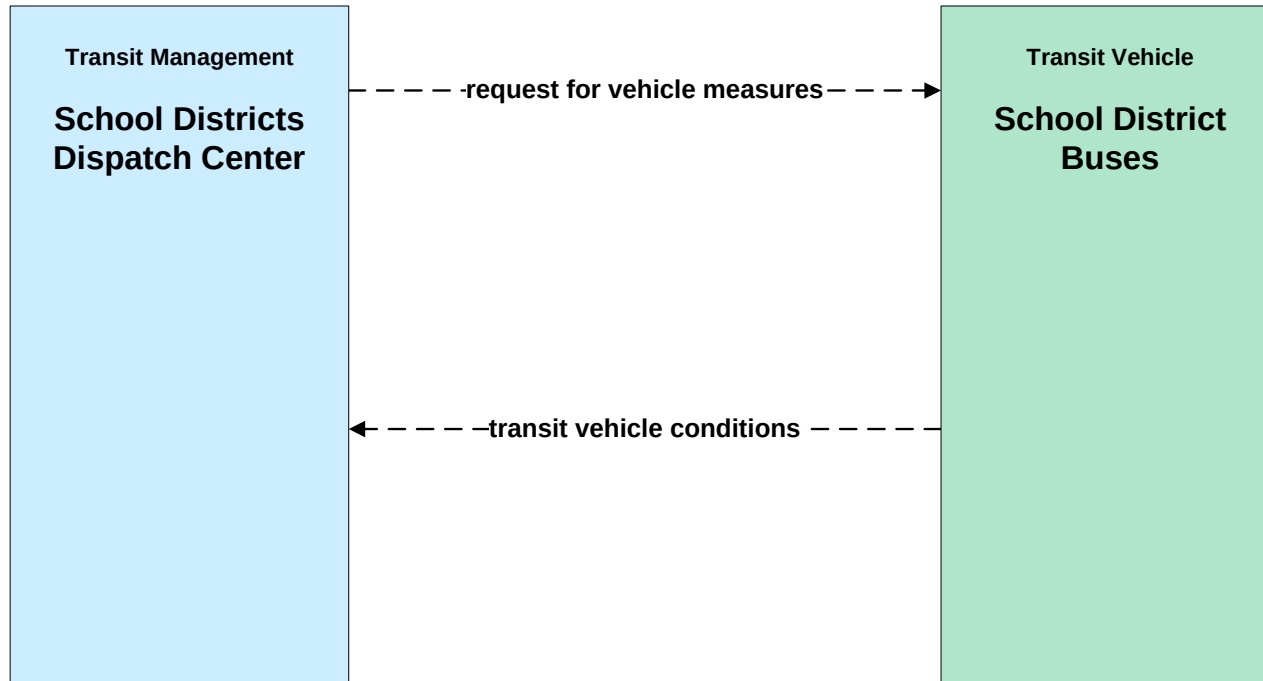
**APTS06 - Transit Maintenance
FAST**



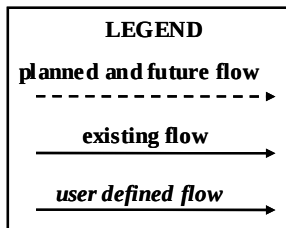
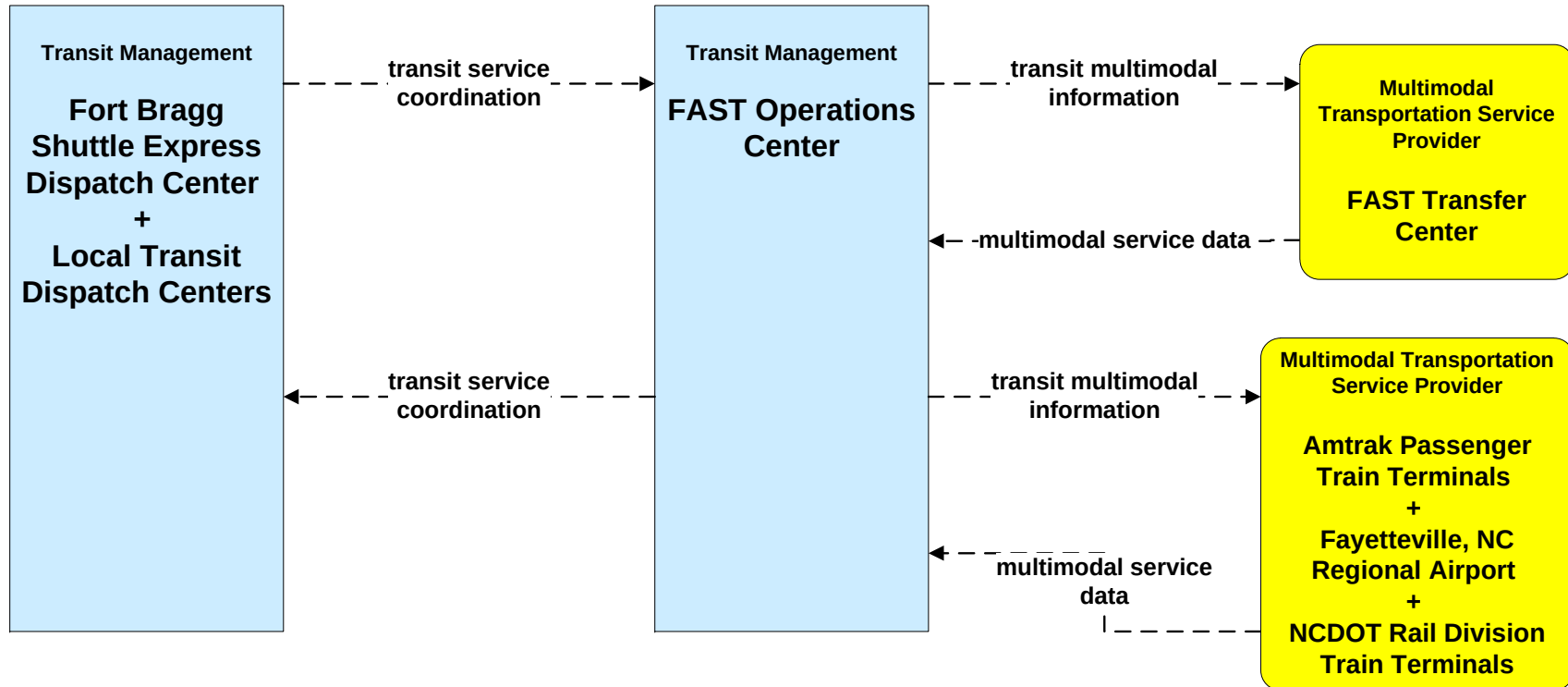
APTS06 - Transit Maintenance Local Transit Systems



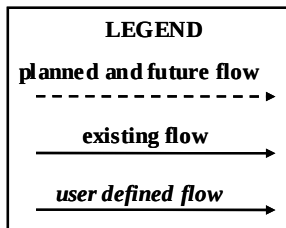
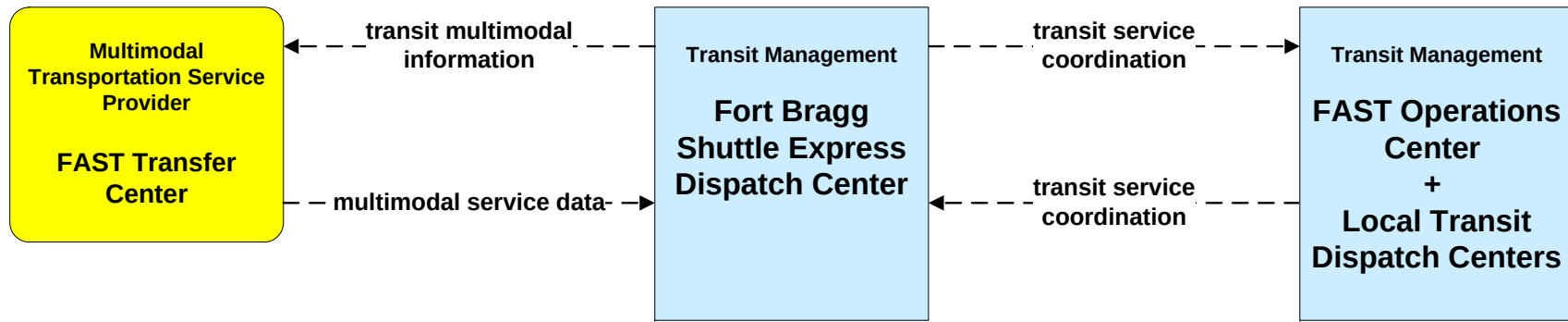
**APTS06 - Transit Maintenance
Independent School Districts**



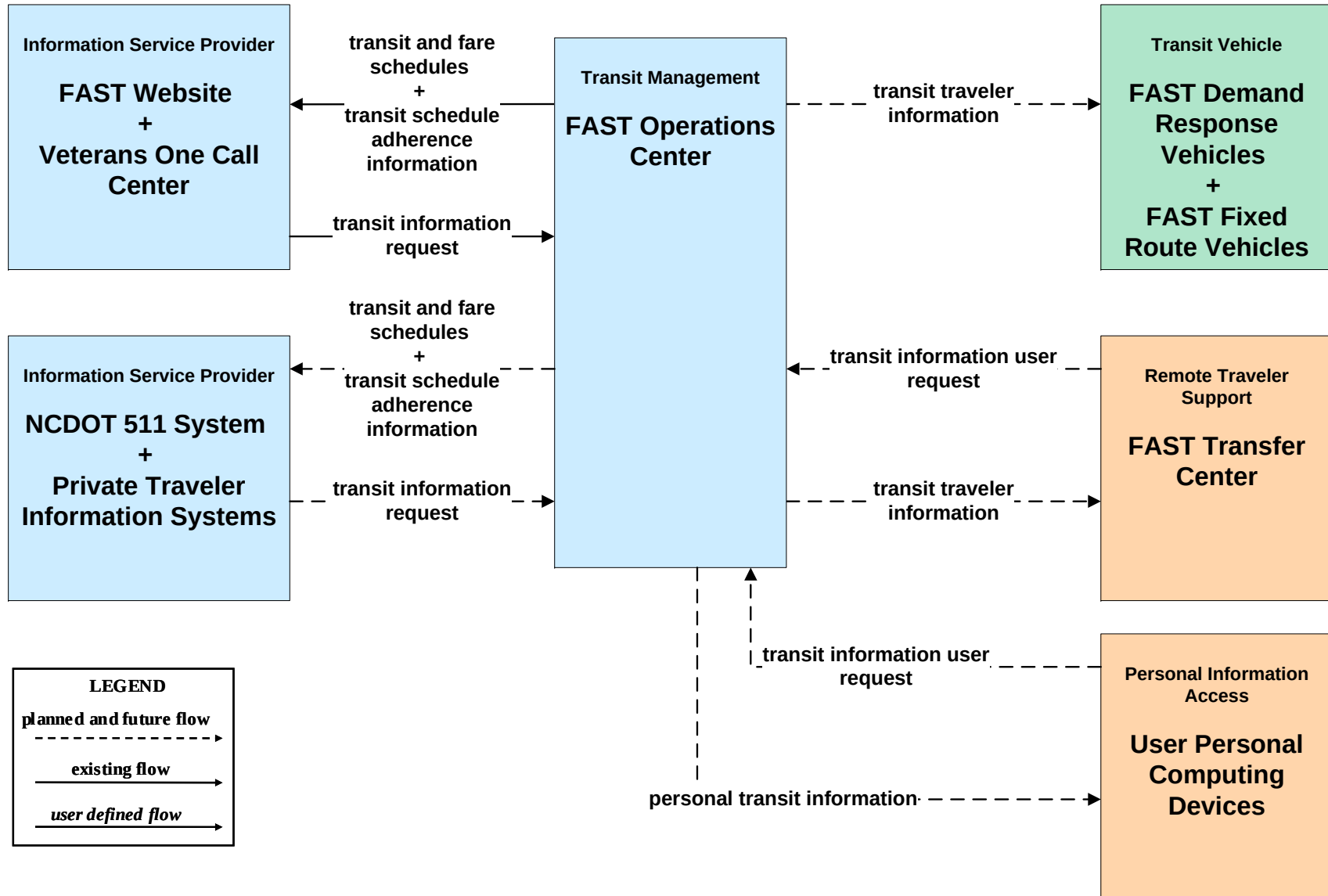
APTS07 - Multi-modal Coordination FAST



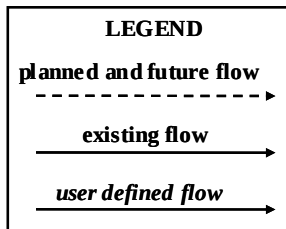
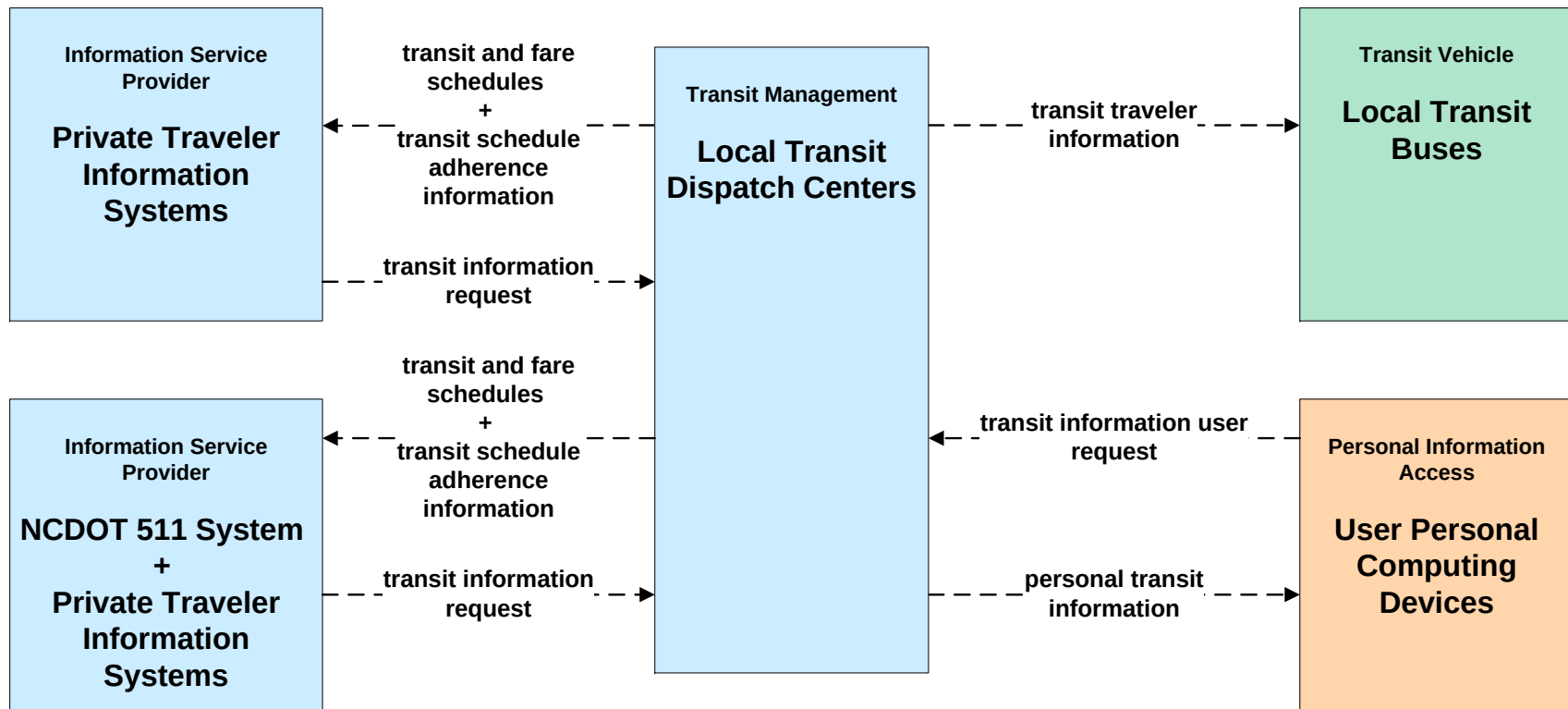
**APTS07 - Multimodal Coordination
Fort Bragg Shuttle Express**



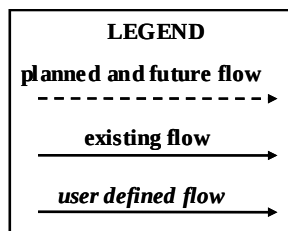
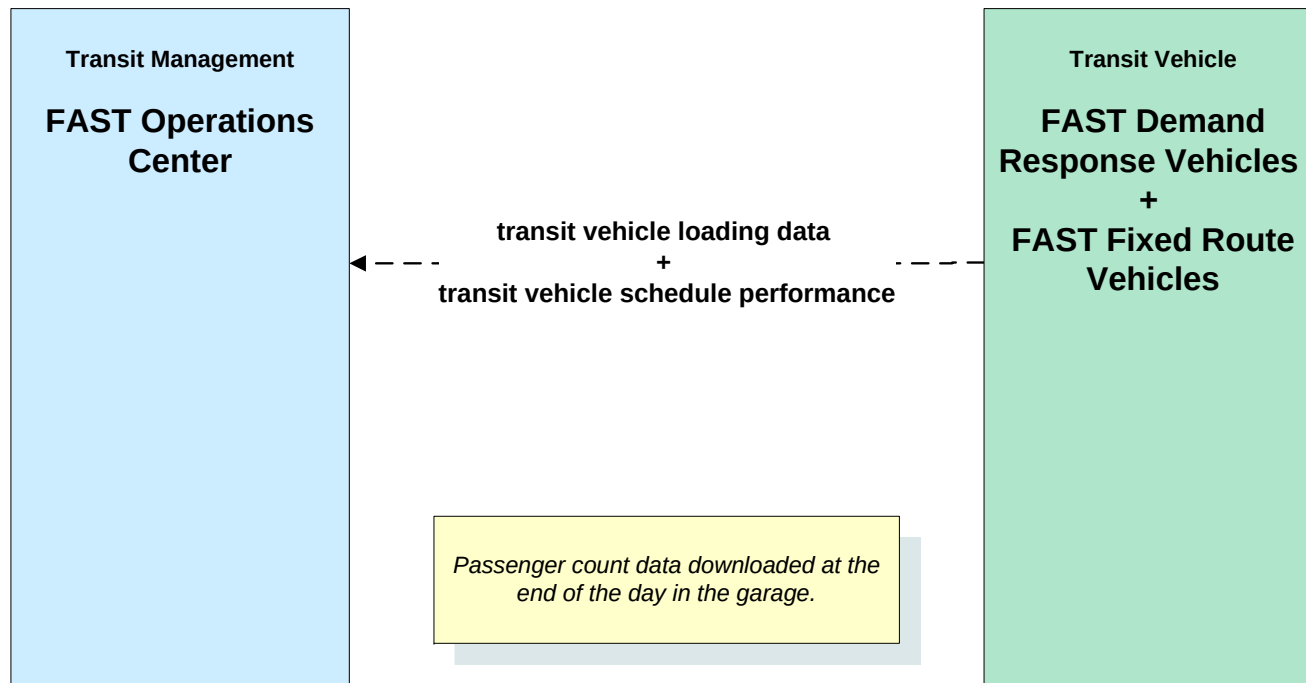
APTS08 - Transit Traveler Information FAST



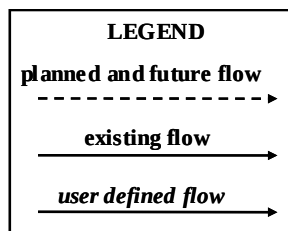
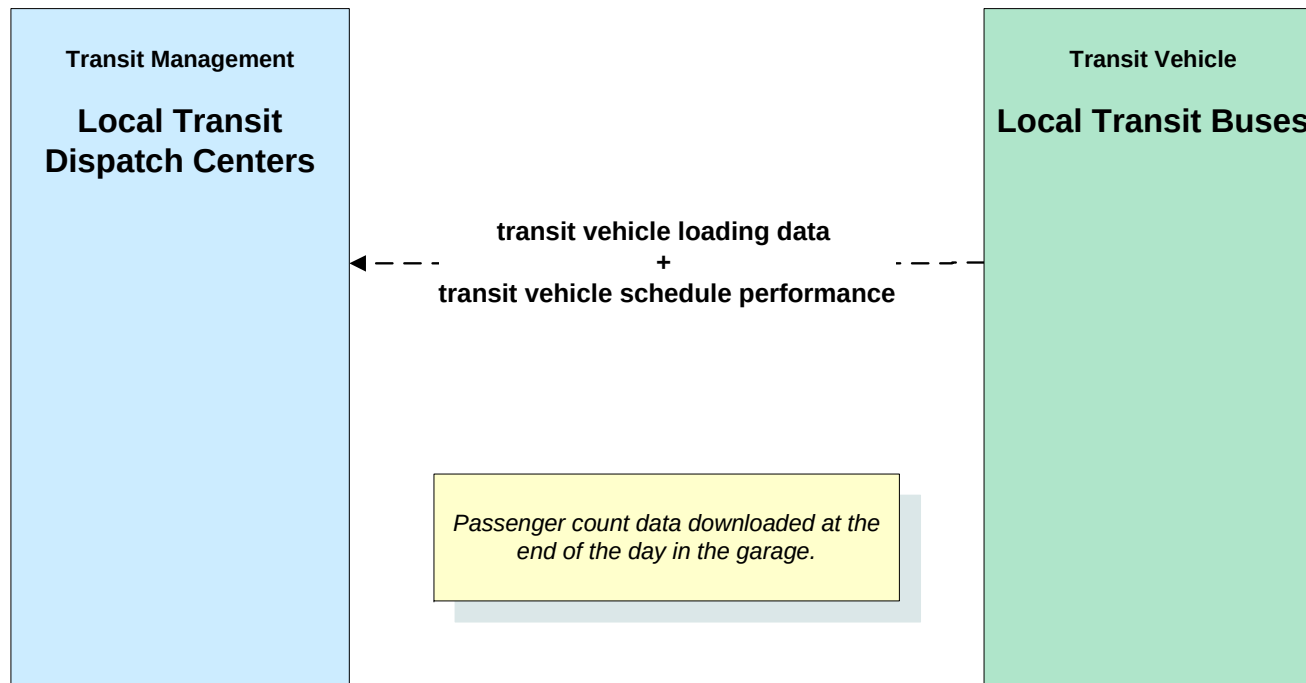
APTS08 - Transit Traveler Information Local Transit Systems



APTS10 – Transit Passenger Counting FAST



APTS10 – Transit Passenger Counting Local Transit Systems

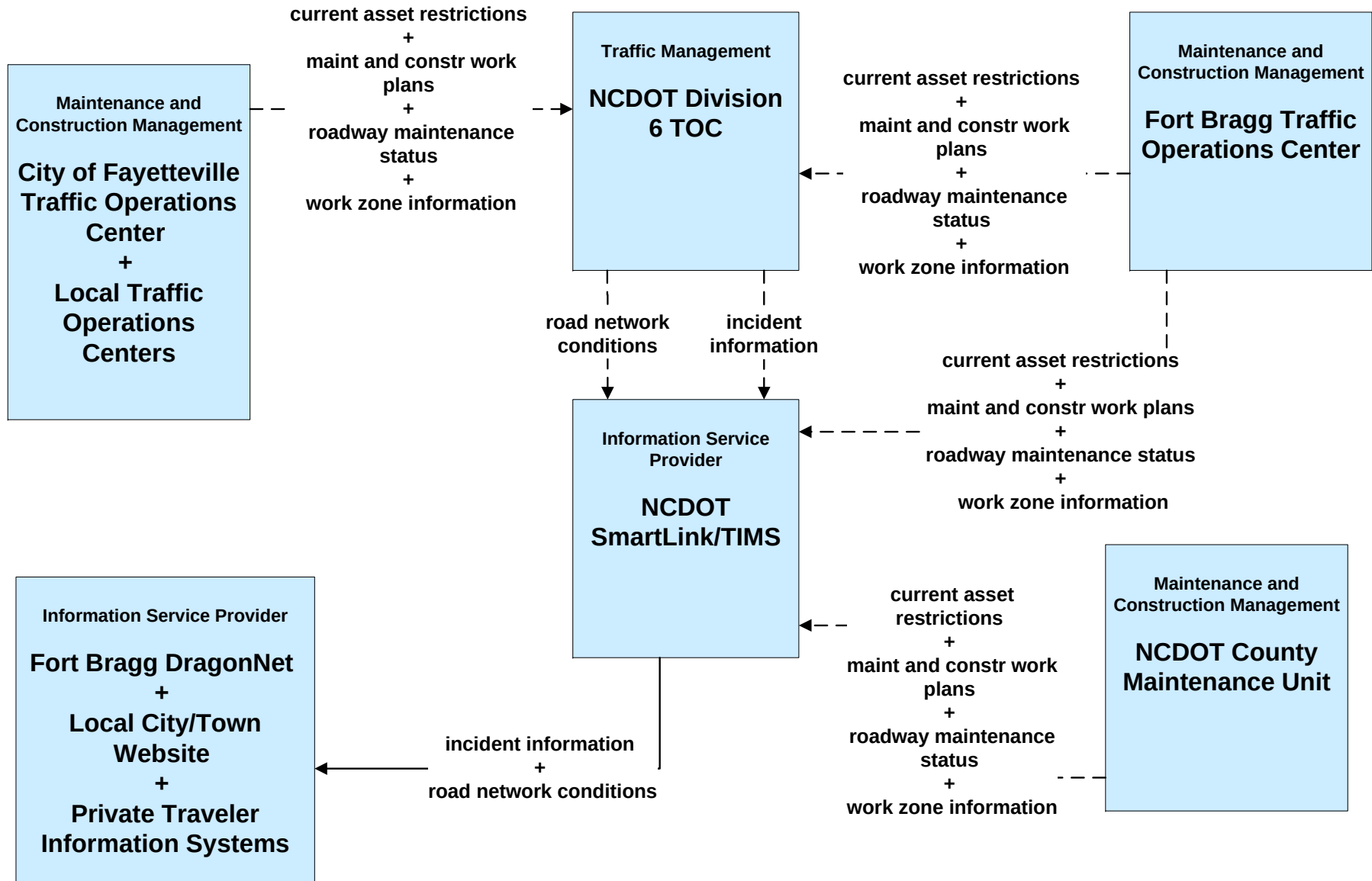


FAMPO Regional ITS Architecture

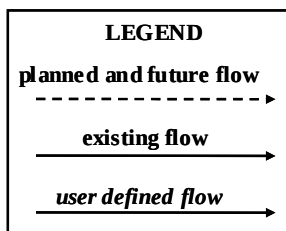
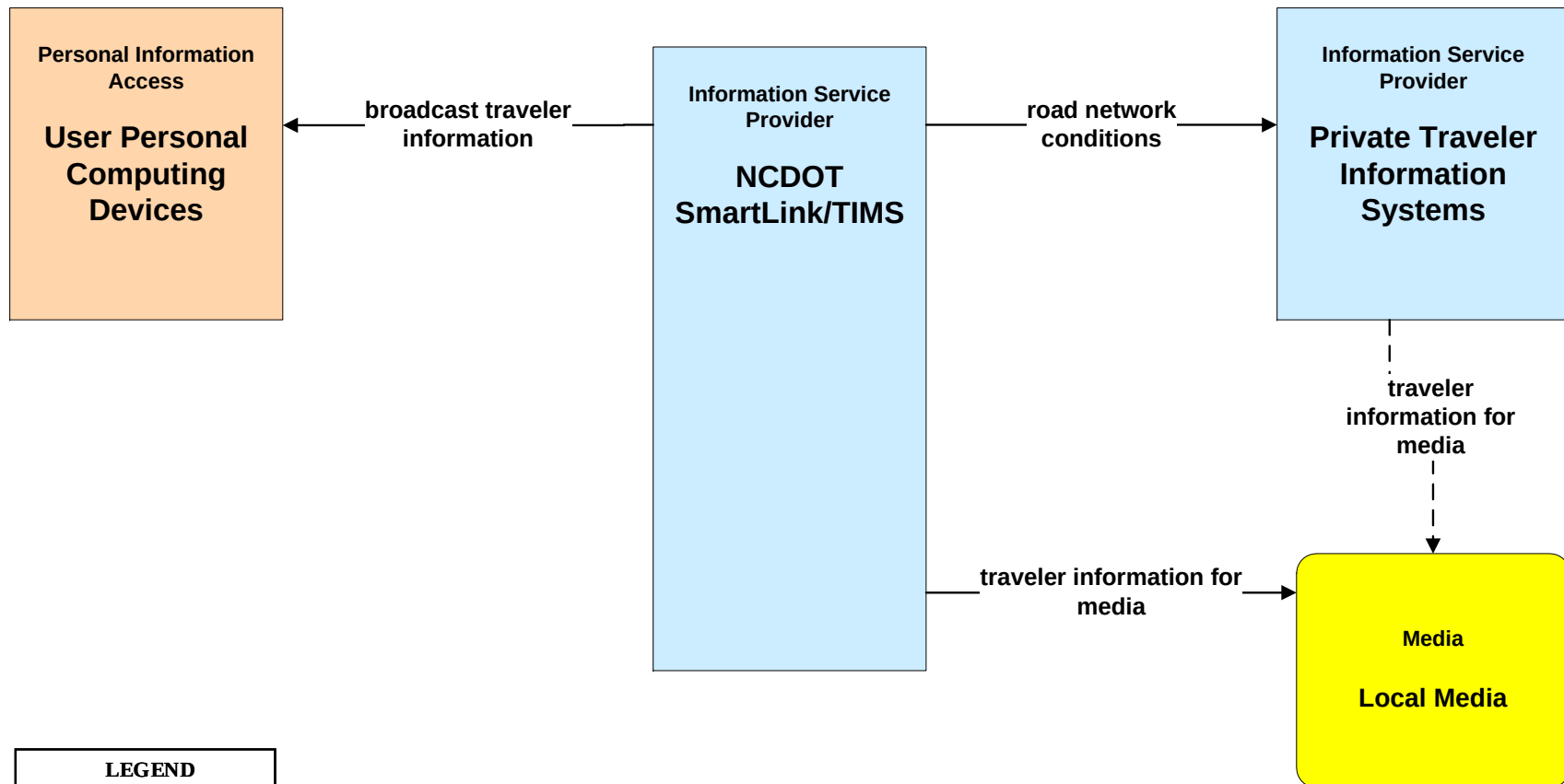
Customized Service Package Diagrams

Advanced Traveler Information Systems (ATIS)

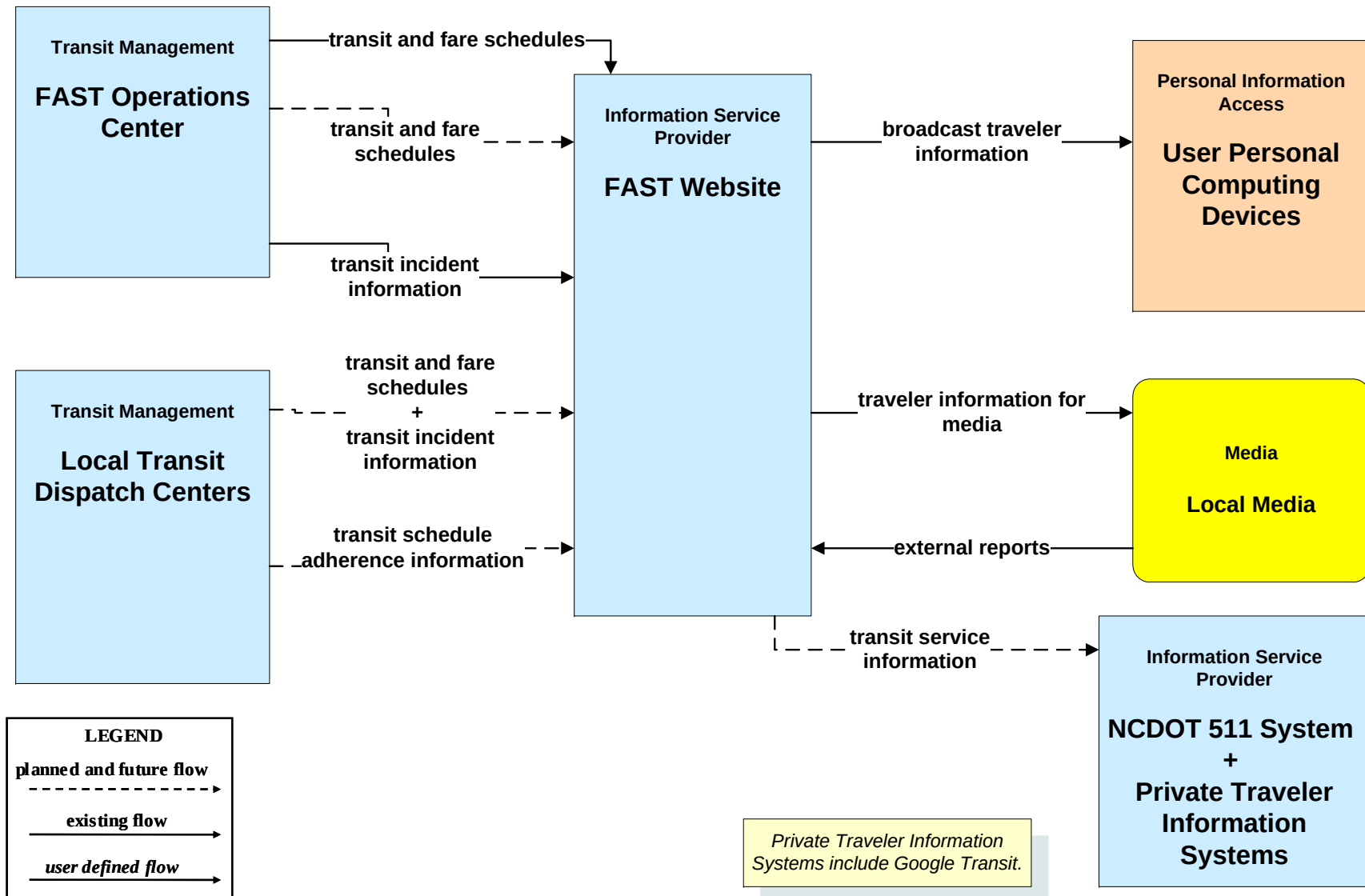
**ATIS01 - Broadcast Traveler Information
NCDOT SmartLink/TIMS (1 of 2)**



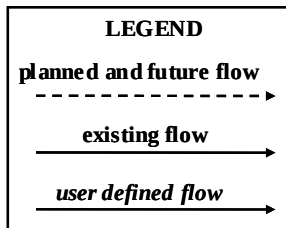
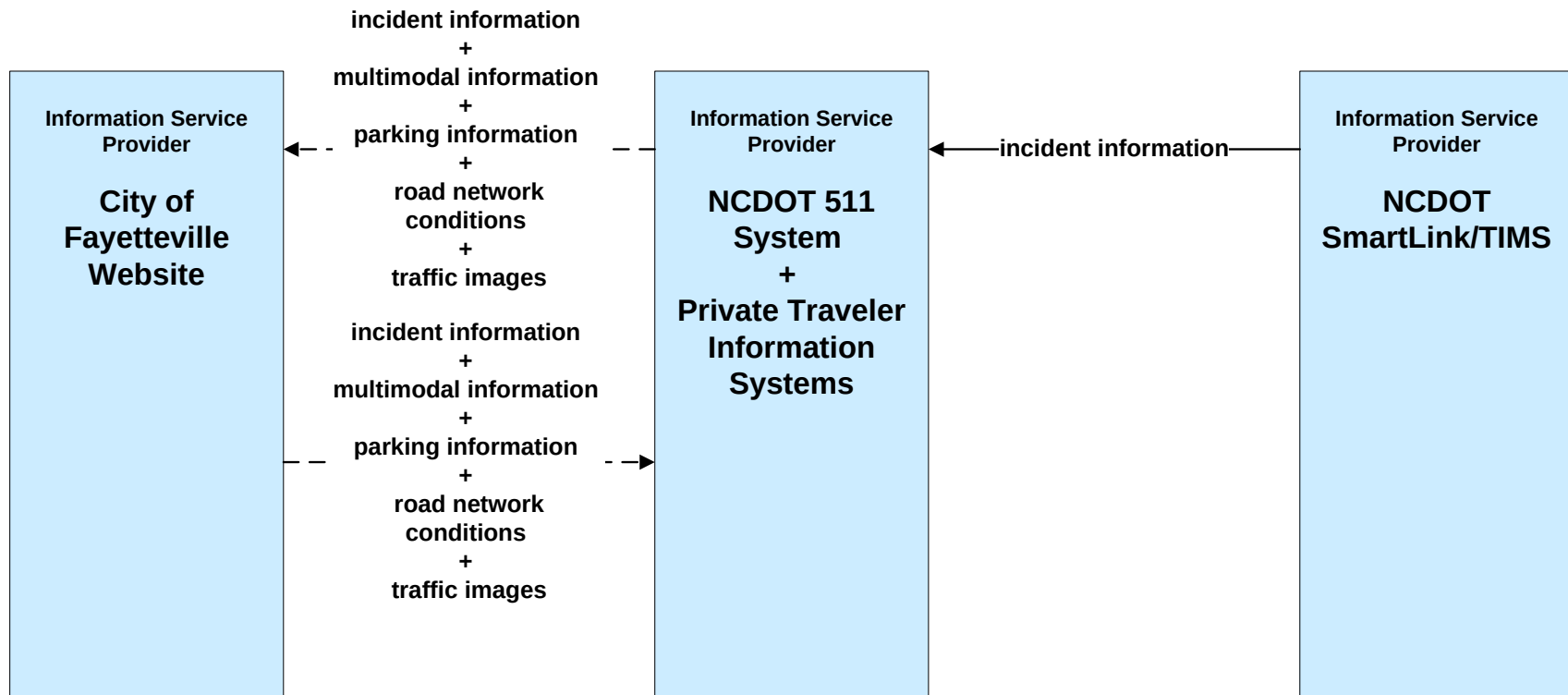
**ATIS01 - Broadcast Traveler Information
NCDOT SmartLink/TIMS (2 of 2)**



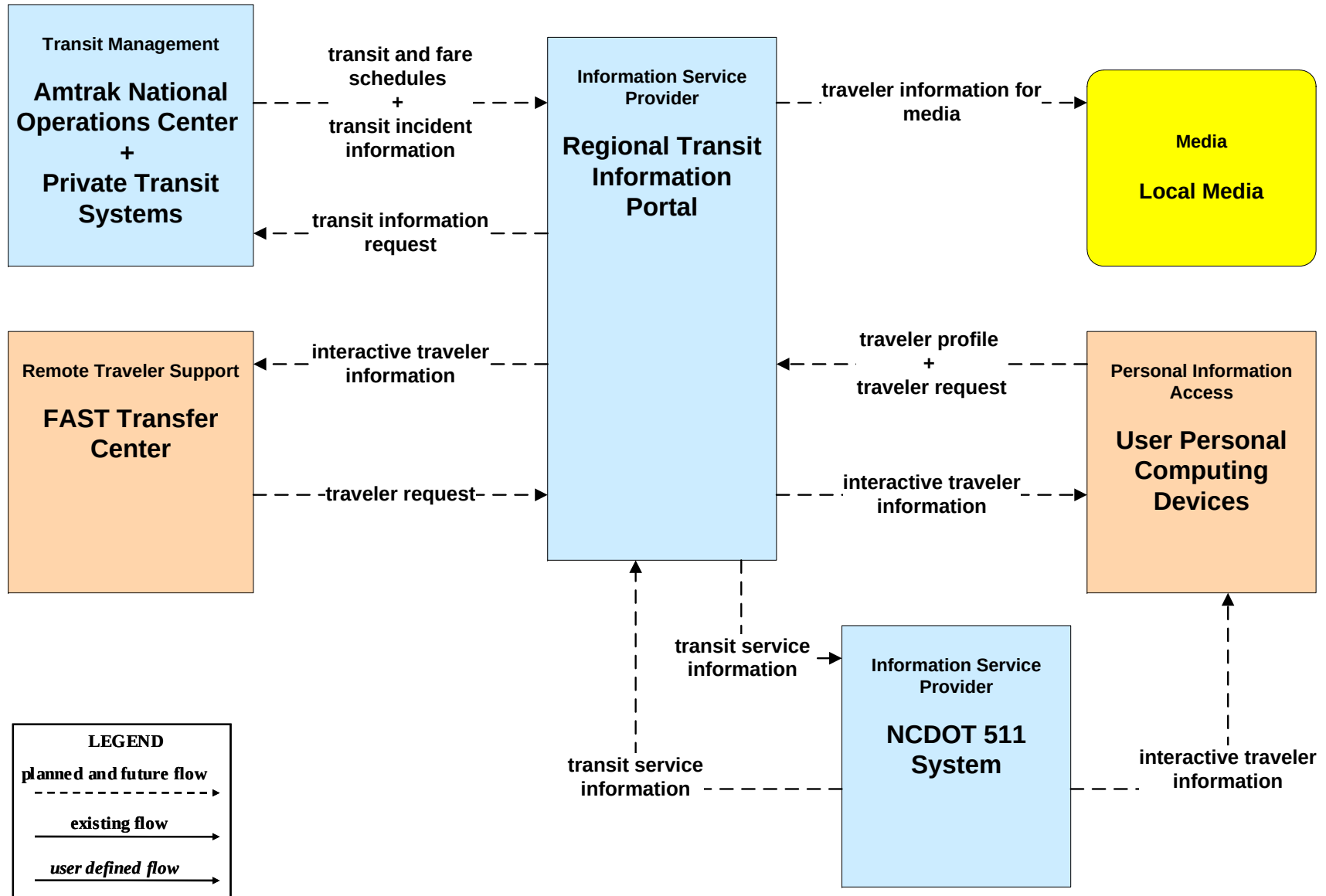
ATIS01 - Broadcast Traveler Information FAST



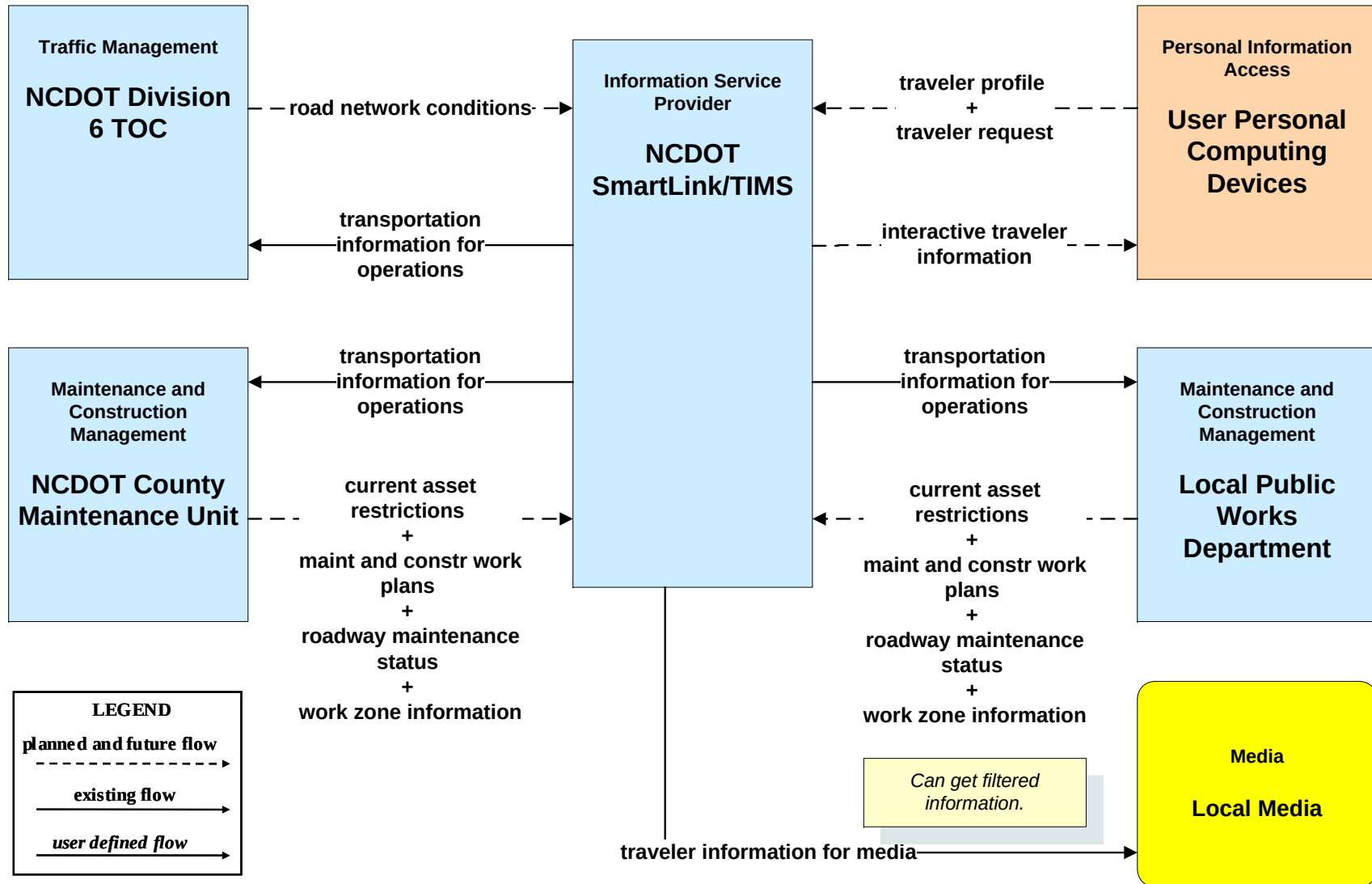
ATIS01 - Broadcast Traveler Information NC 511



ATIS02 - Interactive Traveler Information Regional Transit Information Portal



ATIS02 - Interactive Traveler Information NCDOT TIMS

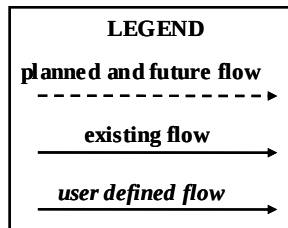
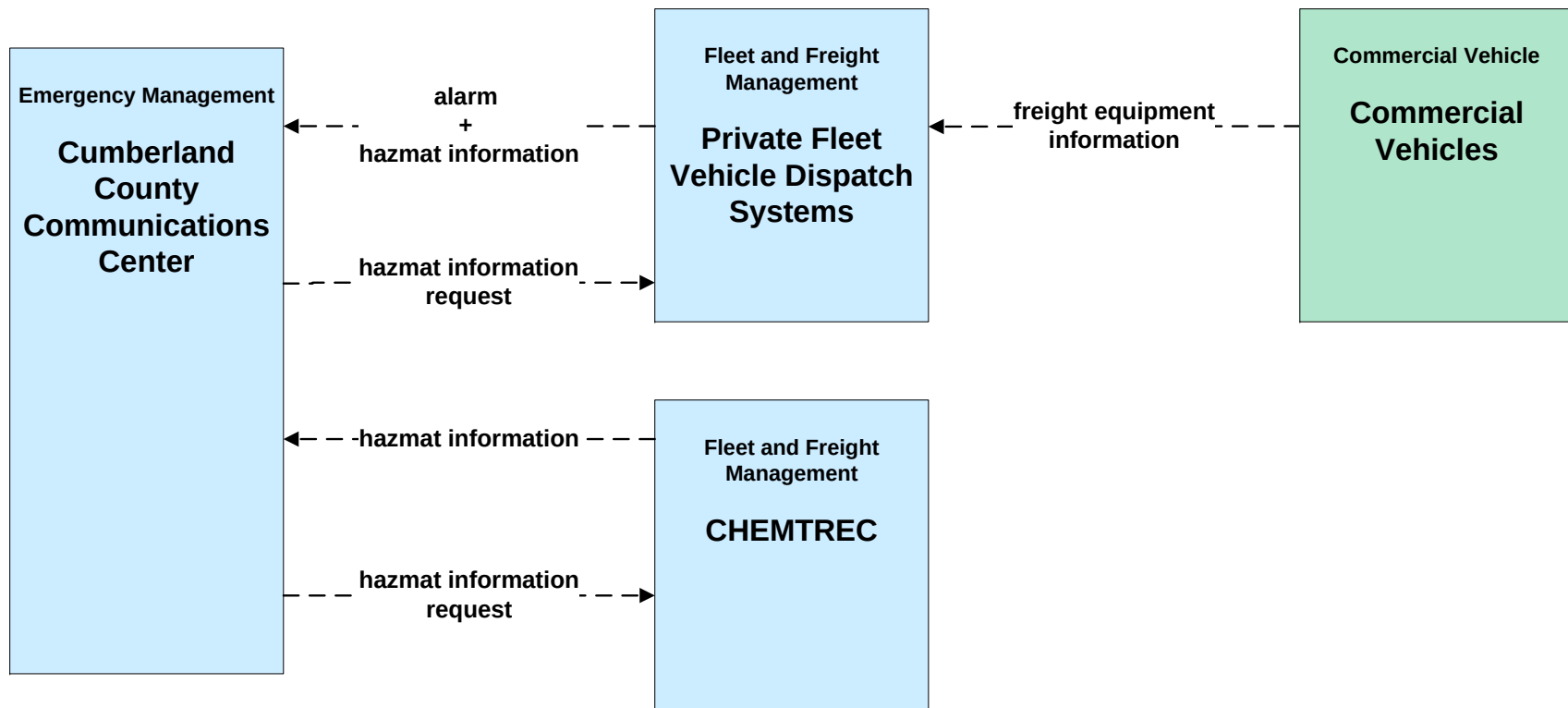


FAMPO Regional ITS Architecture

Customized Service Package Diagrams

Commercial Vehicles Operations (CVO)

**CVO10 - HAZMAT
HAZMAT Team**





Maintenance Change Request (MCR) Form to be Completed by the Stakeholder

To Be Completed by Stakeholder(s) Requesting Changes

Agency	
Agency Contact Person	
Telephone	
Fax	
E-Mail	
Change Request (CR) Information	
Please indicate the type of change: ☐ Level 1: Basic changes that do not affect the structure of the architecture Examples include: Changes to stakeholder or element name, element status, or data flow status ☐ Level 2: Structural changes that impact only one agency Examples include: Addition of a new market package or modifications to an existing market package that affects only your agency ☐ Level 3: Structural changes that have the potential to impact multiple agencies Examples include: Addition of a new market package or modifications to an existing market package that involves multiple agencies, incorporation of a new stakeholder into the architecture	
Describe requested change	



What, if any, market packages are impacted by the proposed change? Note: If the proposed change involves creating or modifying a market package please attach a sketch of the new or modified market package.			
Does the proposed change affect any additional stakeholders?	Affected Agency	Authorized Representative	Date of Agency Concurrence
Applicable Baseline Document Versions	Website:		Turbo Architecture:
	Market Packages:		Architecture Document:



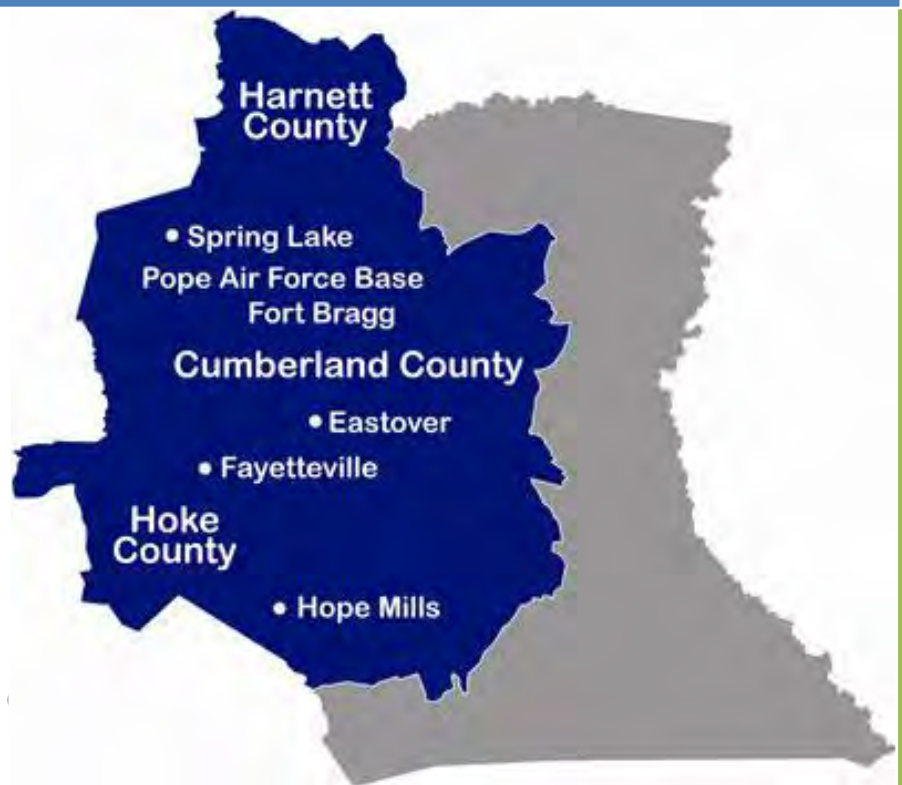
Maintenance Change Request (MCR) Form to be Completed by Maintenance Manager

Date CR Received:		Date CR Logged:		CR Number:	
Date of Review:	Performed By:	Recommendation: ☐ Approve and Include ☐ More Information Required		Comments:	
Documents Affected: ☐ Market Packages ☐ Turbo Architecture ☐ Architecture Document					
Do changes necessitate immediate revision and distribution of architecture document? ☐ Yes ☐ No					
Document Update Record					
Document	Market Packages	Turbo Database	Document		
Change Required	☐	☐	☐		
Timeframe	☐ Immediate	☐ Immediate	☐ Immediate		
	☐ Next Update	☐ Next Update	☐ Next Update		
Date Completed					

FAMPO Regional ITS Strategic Deployment Plan Update

Final Document

Turbo Architecture Procedures Manual



Prepared for:

Fayetteville Area Metropolitan Planning
(FAMPO)

Prepared by:

Consensus Systems Technologies

ConSysTec 

In Association with:



May, 2013

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Note: This document is a minor update to the following document developed as part of the Triangle effort: Turbo Architecture Procedures Manual, March 2010. The update was performed to incorporate changes arising from the update of Turbo Architecture.

1. Document Overview

The Fayetteville Area Metropolitan Planning Organization (FAMPO) Regional Intelligent Transportation Systems (ITS) Architecture is a roadmap for the integration of transportation systems for the FAMPO Regional ITS Communications Partners over the next 25 years. This document provides guidance on how the regional ITS architecture was developed and how it can be edited, expanded, revised, and maintained to stay accurate as the regional ITS footprint grows. In addition, this document also is intended to guide stakeholders in:

- Updating the regional ITS architecture;
- Creating project architectures; and
- Creating reports to satisfy portions of FHWA and FTA requirements for ITS projects.

The architecture has been developed through a cooperative effort by the region's transportation agencies, covering all surface transportation modes and roads in the region. The architecture represents a shared vision of how each agency's systems will work together in the future by sharing information and resources to provide a safer, more efficient, transportation system for travelers in the state.

The architecture is an important tool that will be used by:

- Operating agencies to recognize and plan for transportation integration opportunities in the region
- Planning agencies to better reflect integration opportunities and operational needs into the transportation planning process
- Other organizations and individuals that use the transportation system in the region

The architecture provides an overarching framework that spans all of these organizations and individual transportation projects. Using the architecture, each transportation project can be viewed as an element of the overall transportation system, providing visibility into the relationship between individual transportation projects and ways to cost-effectively build an integrated transportation system over time. The architecture is a live document that will be revised and updated as plans change, ITS projects are implemented, and the ITS needs and services evolve in the region.

This document is an update to the following document developed as part of the Triangle effort: Turbo Architecture Procedures Manual, March 2010. The update was performed to incorporate changes arising from the update of Turbo Architecture version. The procedures in this document are based on Version 7.0 of the United States National ITS Architecture. Turbo Architecture is a high-level, interactive software program that assists transportation planners and system integrators, both in the public and private sectors, in the development of regional and project architectures using the U.S. National ITS Architecture as a starting point.

1.1 Document Organization

This procedures guide is organized into seven sections.

Section 1, Document Overview – Provides introductory information on the FAMPO Regional ITS Architecture, the organization of this procedures manual, and how this procedures manual relates to other available documents and other documents submitted as part of this project.

Section 2, Regional ITS Architectures – Introduces the U.S. National ITS Architecture, examines the federal requirements for ITS architectures, and summarizes the process that was used to develop the FAMPO Regional ITS Architecture.

Section 3, Getting Started – Introduces the initial steps for generating a regional ITS architecture and project architectures. This section provides step-by-step procedures for creating and editing the scope and stakeholders for a regional ITS architecture and project architecture.

Section 4, Gathering Data – Discusses the information that needs to be collected and documented for a regional ITS architecture and project architecture. This section provides step-by-step procedures for creating and editing the inventory, the ITS services, operational concepts, and functional requirements for a Regional ITS Architecture and project architecture.

Section 5, Defining Interfaces – Defines the interconnects between the ITS elements and the information that must flow to these elements to support the desired ITS services. This section provides step-by-step procedures for creating and editing the interconnects and architecture flows for a Regional ITS Architecture and project architecture.

Section 6, Implementation Definition – Defines the additional products that bridge the gap between the information that comprises the Regional ITS Architecture and the deployment of ITS systems. This section provides step-by-step procedures for creating and editing ITS Standards information and agreements information for a regional ITS architecture or project architecture as well as the sequencing of ITS projects for a Regional ITS Architecture.

Section 7, Developing Project Systems Engineering Analyses – Examines the federal requirements for ITS projects, and describes how to use Turbo Architecture to satisfy some of those federal requirements.

1.2 References

Although this procedures manual is intended to be a standalone document for editing and creating Regional ITS Architectures and project architectures, the manual will refer to other documents for additional background information.

- *FAMPO ITS Strategic Plan Update, FAMPO Regional ITS Architecture Final Document*
- *Turbo Architecture Version 7.0 User's Manual,*

<http://www.iteris.com/itsarch/html/turbo/turbomain.htm>

- *U.S. National ITS Architecture Version 7.0*, <http://www.iteris.com/itsarch>
- *Regional ITS Architecture Guidance, Version 2.0, 2006*.

2 Regional ITS Architectures

2.1 What are Intelligent Transportation Systems (ITS)?

Until recently, the building and improvement of a transportation infrastructure meant the civil and mechanical construction or enlargement of roads, bridges and tunnels, as well as the associated enterprises that provide the vehicles (including public and private transit agencies, trucking, public safety and personal) that travel on the infrastructure. The use of ITS technologies to more efficiently operate and manage a region's transportation systems is increasingly important as travel demand steadily increases and the opportunities to build new infrastructure become prohibitively expensive because of high costs and lack of available resources, including land space. This makes the deployment of ITS technologies to make more efficient use of the existing transportation network an attractive alternative.

As one component of a larger transportation infrastructure, ITS refers to the application of data processing, data communications, and systems engineering methodologies with the purpose of improved management, safety, and efficiency of the surface and public transportation network. These ITS technological and management advances can address the following: the overall mobility needs of a region, the travel requirements of transportation network users, and the development, operation, management, and maintenance needs of both public and private transportation system providers.

ITS provides agencies and their customers a means to address current urban problems, as well as anticipate and address future demand through a coordinated intermodal approach to transportation. The application of ITS allows agencies to use modern technologies to better monitor their systems, providing the agencies with more accurate information to make more informed decisions on safely operating their systems. ITS also allows agencies to distribute this information to other agencies and to the public, so each can make more informed transportation decisions.

2.2 U.S. National ITS Architecture

The United States (U.S.) National ITS Architecture (**Figure 1**) provides a common framework for planning, defining, and integrating intelligent transportation systems. It defines:

- The functions (e.g., gather traffic information or request a route) that are required for ITS

- The physical entities or subsystems where these functions reside (e.g., the roadside or the vehicle)
- The information flows and data flows that connect these physical subsystems together into an integrated system.

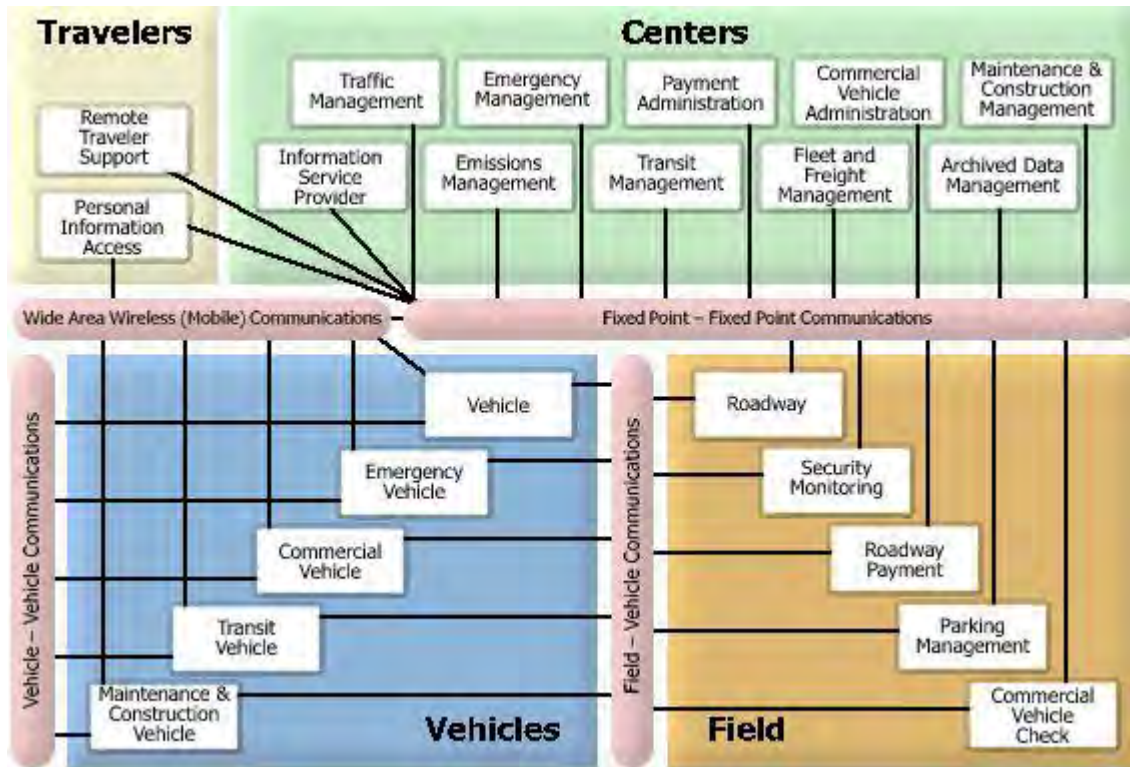


Figure 1. U.S. National ITS Architecture Version 7.0

The National ITS Architecture also introduces the concept of Service Packages. Service Packages define potential ITS deployments in both narrative and diagrammatic form. Service Package diagrams show which ITS systems are required to work together across different operators, whether public or private to deliver a given transportation service. Service Packages are designed to address specific transportation problems and needs and relate back to the ITS services and their more detailed requirements.

2.3 FHWA Final Rule and FTA Final Policy on ITS Architecture and Standards

In 1997, Congress passed the Transportation Equity Act for the 21st Century (TEA-21) to address the need to begin working toward regionally integrated transportation systems. To implement Section 5206(e) of TEA-21, which requires ITS projects to conform to the National ITS Architecture (NITSA) and Standards, the Federal Highway Administration (FHWA) issued 23 Code of Federal Regulations Parts (CFR) 655 and 940, entitled “Intelligent Transportation

Systems (ITS) Architecture and Standards” on April 1, 2001. Concurrently, the Federal Transit Administration (FTA) issued a Final Policy entitled “National ITS Architecture Policy on Transit Projects”. The intent of the FHWA Final Rule (commonly referred to as Rule 940) and FTA Final Policy is to provide policies and procedures by which to implement ITS projects in an efficient manner and to conform to the National ITS Architecture.

The purpose of the Final Rule/Final Policy is to accelerate the deployment of integrated ITS by requiring development of a Regional ITS Architecture. This Regional ITS Architecture, which is based on the National ITS Architecture but customized to meet a region’s particular needs, provides a plan by which a region can efficiently deploy ITS systems in a manner allowing for integration of these systems.

Section 940.9 of the Final Rule/Final Policy defines the nine required components that make up a Regional ITS Architecture. These components are:

- Description of the region
- Identification of participating agencies and other stakeholders
- Operational concept
- Agreements required for implementation
- System functional requirements
- Interface requirements
- Identification of ITS standards
- Sequence of projects required for implementation
- Process for maintaining a Regional ITS Architecture

2.4 Regional ITS Architecture Development Process

The process used to develop the FAMPO Regional ITS Architecture is based upon the process described in the FHWA document, *Regional ITS Architecture Guidance Version 2.0, 2006*.

Figure 2 shows six general steps in the lifecycle of a Regional ITS Architecture. In the first four steps, the Regional ITS Architecture products are developed and then used and maintained in steps five and six. The development process begins with basic scope definition and team building and moves through increasingly detailed steps culminating in specific products that will guide the implementation of the Regional ITS Architecture.

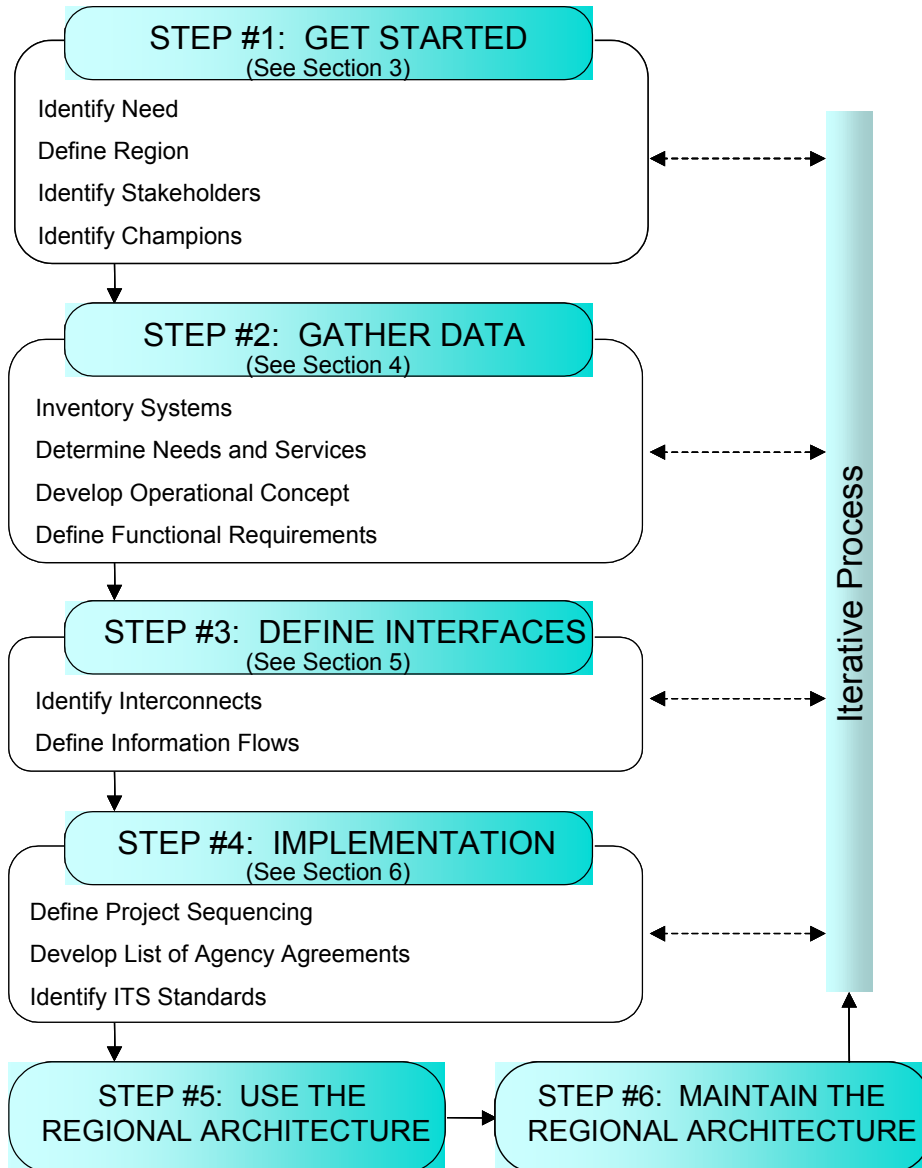


Figure 2. Regional ITS Architecture, Use and Maintenance

The steps described below can be used to develop or perform a major update to a Regional ITS Architecture. There are many possible ways of performing the steps in order to get to the desired result. The following is a suggested order in which to perform the steps.

- 1 Assign a champion to the development effort. Identify a core group that represent key stakeholders in the region and that will be heavily involved in the development effort (See Section 3.1).
- 2 Define the development team. These will be the people who will perform the “heavy lifting” on all the steps below.

- 3 Define an initial set of stakeholders (See Section 3.4).
- 4 Interview key stakeholders to identify their needs, the services they currently provide or plan on providing, their current or planned ITS elements, and the ITS projects that they have planned (See Section 4).
- 5 The information from the interviews is used to initially populate the Turbo file with the following information:
 - Inventory (See Section 4.1)
 - Services (See Section 4.2)
 - Operational Concepts (See Section 4.3)
 - Interfaces (See Section 5)
 - Projects (See Section 6)
- 6 Review the draft architecture information with the stakeholders. This review can be done as a large group workshop, in smaller groups focusing on a single area of ITS (e.g. emergency services), or individually. The customized Service Package diagrams described under Section 5 are a good vehicle for performing this review. At this review, it is also important to define the scope of the architecture (geographic, timeframe, and scope of services).
- 7 Following stakeholder review, update the Turbo Architecture file, create a draft document to pull the information together, and circulate for review. The draft document should contain the maintenance plan for the architecture and a discussion of how the architecture will be used in the region to support planning and project development.
- 8 Following one additional update cycle the architecture is completed and goes under configuration control per the maintenance plan.

3 Getting Started

The Regional ITS Architecture effort begins with a focus on the institutions and people involved. Based on the scope of the region, the relevant stakeholders are identified, one or more champions are identified, the team that will be involved in architecture development is organized, and the overall development effort is planned.

With this step:

- The scope for the regional ITS architecture will be identified, satisfying the first component of the Final Rule/FTA Policy, *Description of the Region*.

- The stakeholders for the Regional ITS Architecture will be identified, satisfying the first component of the Final Rule/FTA Policy, *Identification of Participating Agencies and Other Stakeholders*.

3.1 Identify Champion

The first step in developing an architecture is to identify a champion who will lead the development effort. This is usually a single individual from the public sector agency responsible for the architecture development, but in certain cases the champion could be a small group of individuals.

3.2 Define Scope

As part of the initial development of the architecture the scope of the architecture must be determined. The scope defines the boundaries of the region. Scope covers three distinct factors:

- **Geographic Scope** – The geographic area selected should consider the institutional boundaries of ITS in the region. Is it the boundaries of the Metropolitan Planning Organization (MPO) or some larger region, such as a transportation plan study area?.
- **Timeframe** – The architecture is a vision for the future development of ITS in the region. How far into the future will be considered? One consideration is the timeframe used by the region when developing its transportation plans. Typically 10-20 years is standard.
- **Services** – Will the architecture consider all aspects of ITS or will it leave some (such as Commercial Vehicles Operations) to be described at a statewide level?

In Turbo Architecture, scope information for a Regional ITS Architecture and project architectures are entered in the **Start** tab (See **Figure 3**).

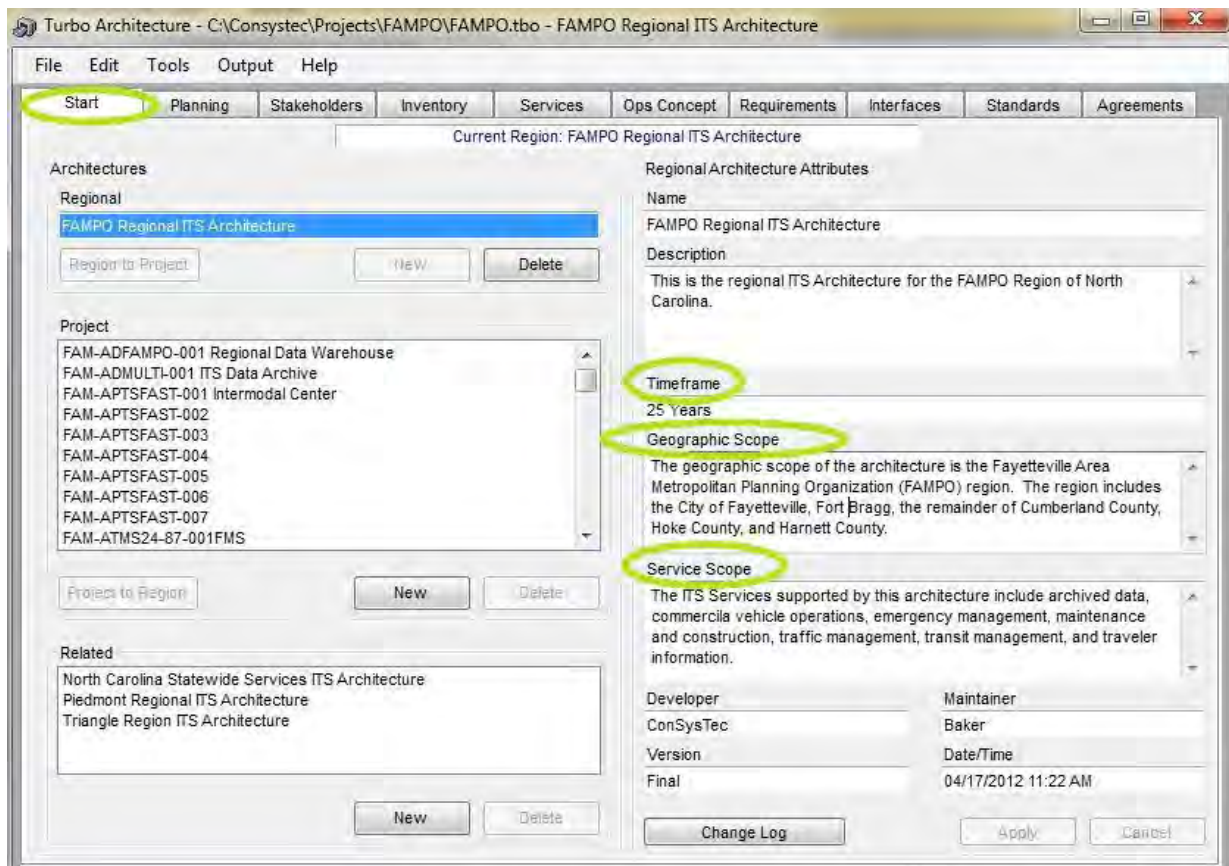


Figure 3. Start Tab

3.2.1 Enter Scope for a New Regional ITS Architecture

Turbo Architecture provides a page to enter the scope for a Regional ITS Architecture. This page can be accessed within Turbo Architecture by clicking the **Start** tab.

- **Step 1.** For a new Regional ITS Architecture, click the **Start** tab, to access the scope information for the architecture.
- **Step 2.** Click the **New** button in the **Architectures: Regional** section.
- **Step 3.** In the **Name** field, type in the name of the architecture (e.g., FAMPO Regional ITS Architecture).
- **Step 4.** In the **Description** field, enter information about the Regional ITS Architecture. This may include a description about the agencies involved, the process used to develop this Regional ITS Architecture, and how the stakeholders envision how the Regional ITS Architecture will be used to plan their ITS investments and projects.
- **Step 5.** In the **Timeframe** field, enter how far into the future is being considered for this Regional ITS Architecture.

- **Step 6.** In the **Geographic Scope** field, enter the geographic scope for this Regional ITS Architecture. This may be the boundaries of one or more MPO areas, specific counties, or specific DOT districts.
- **Step 7.** In the **Service Scope** field, provide a summary of the ITS services to be supported by the architecture. ITS Services supported by the U.S. National ITS Architecture include archived data, commercial vehicle operations, emergency management, maintenance and construction, traffic management, transit management, traveler information and vehicle safety.
- **Step 8.** In the **Developer** field, enter the name or organization developing the architecture (e.g., FAMPO). This also may be the name of the champion(s).
- **Step 9.** In the **Maintainer** field, if known, enter the name or organization that will be maintaining the architecture after the initial version is complete.
- **Step 10.** Enter the **Version** number of this architecture (e.g., draft version 0.01). The version number will be determined by maintenance procedures to be established.
- The **Date/Time** field is automatically filled in by Turbo Architecture for new architectures.
- **Step 11.** Click the **Apply** button to accept the edits on this page.
- **Step 12.** Save the architecture information by selecting **File -> Save As**. A new window will open (See **Figure 4**). Select a directory to save the Turbo Architecture file in, and type in the filename. Click the **Save** button.

3.2.2 Enter Scope for a New Project Architecture

Turbo Architecture allows the user to enter scope information for each project architecture created as part of a Regional ITS Architecture or created as a standalone file. The scope information for a project architecture is entered in Turbo Architecture in the **Start** tab.

- **Step 1.** Open the Turbo Architecture database for the Regional ITS Architecture that you wish to create a new project architecture for by selecting **File -> Open**. A new window will open (See **Figure 5**). Navigate to the directory containing the Turbo Architecture file. Select the file, and then click the **Open** button.

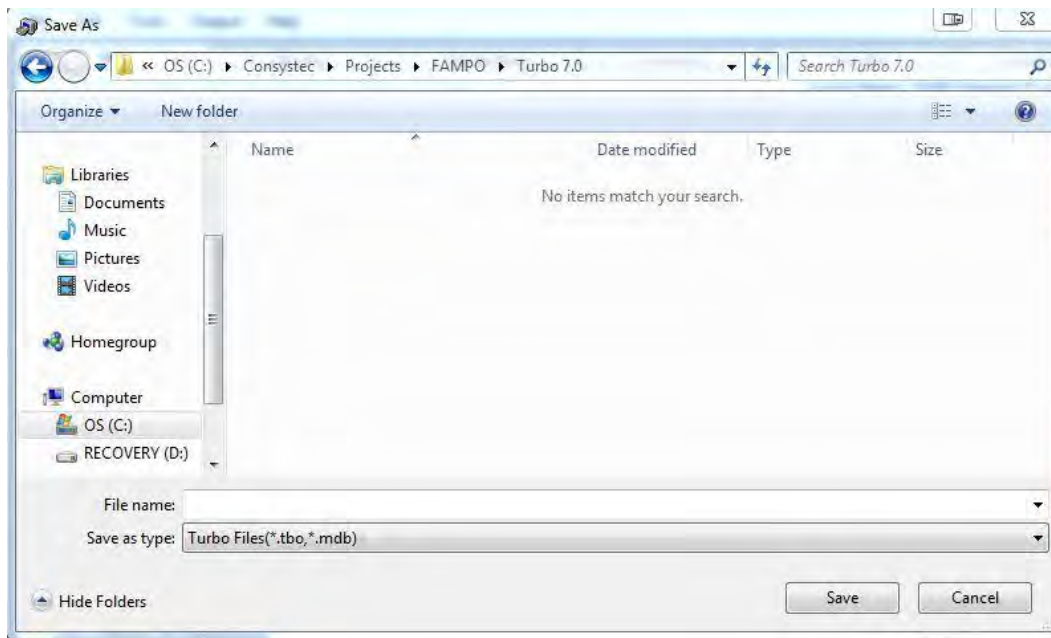


Figure 4. Save As Window

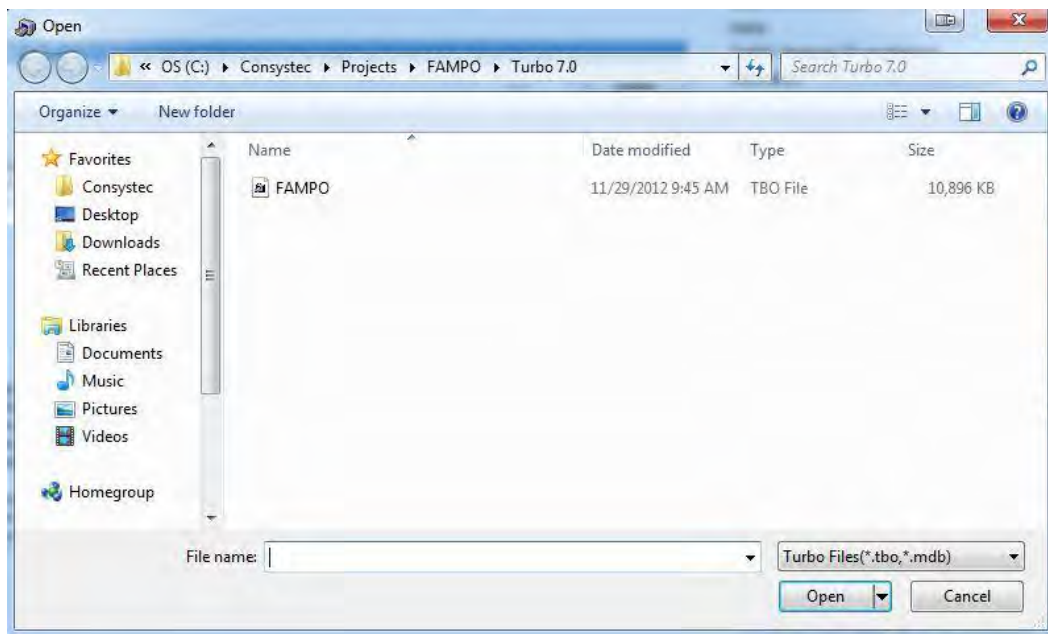


Figure 5. File Open Window

3.2.2 Enter Scope for a New Project Architecture

Turbo Architecture allows the user to enter scope information for each project architecture created as part of a Regional ITS Architecture or created as a standalone file. The scope information for a project architecture is entered in Turbo Architecture in the **Start** tab.

- **Step 1.** Open the Turbo Architecture database for the Regional ITS Architecture that you wish to create a new project architecture for by selecting **File -> Open**. A new window will open (See **Figure 5**). Navigate to the directory containing the Turbo Architecture file. Select the file, and then click the **Open** button.
- **Step 2.** To create a new project ITS architecture (See **Figure 6**), click the **Start** tab, and then click the **New** button in the **Architectures: Project** section.
- **Step 3.** In the **Name** field, type in the name of the project architecture (e.g., TRI-ATMSChapelHill-023 Chapel Hill Signal System Upgrade).
- **Step 4.** In the **Description** field, enter information about the project architecture. This may include a description about the purpose of the ITS project, the stakeholders involved, and cost information.
- **Step 5.** In the **Timeframe** field, enter when the ITS project will be designed, built, or programmed. For consistency, it is recommended that the actual year(s) be entered in this field for each phase (design, construction) if the project has been programmed.
- **Step 6.** In the **Geographic Scope** field, enter the geographic scope for this ITS project. This may be the boundaries of a city, a district, between mile markers along a route, between exits on a highway, or between intersections on a surface street.
- **Step 7.** In the **Service Scope** field, provide a summary of the ITS services to be supported by the project. If the ITS project has already been designed, the summary might include the ITS technologies to be deployed during construction.
- **Step 8.** Optionally, in the **Developer** field, enter the name or organization developing the project architecture. This also may be the name of a representative from the organization leading the ITS project. It is recommended that this field and the other remaining log information (Steps 9 to 11) be completed for configuration management purposes, allowing changes to the project architectures to be tracked.
- **Step 9.** Optionally, in the **Maintainer** field, enter the name or organization that will be maintaining the project architecture.
- **Step 10.** Enter the **Version** number of this project architecture (e.g., draft version 0.01). The version number will be determined by maintenance procedures to be established.
- The **Date/Time** field is automatically filled in by Turbo Architecture for new architectures.
- **Step 11.** Click the **Apply** button to accept the edits on this page.

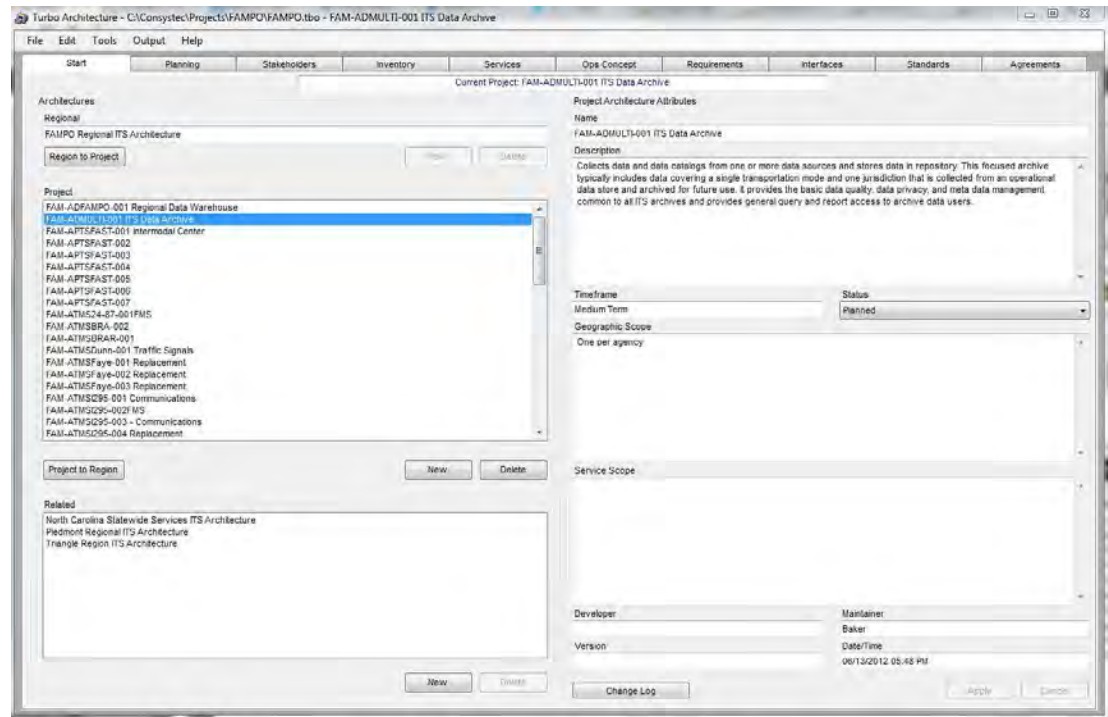


Figure 6. Project Architecture Attributes

- **Step 12.** Save the project architecture information by selecting **File -> Save**. To use a new name for the turbo architecture database, select **File -> Save As** instead. A new window will open. Select a directory to save the Turbo Architecture file and type in the new filename. Click the **Save** button.

3.2.3 Edit Scope for a Regional ITS Architecture

Turbo Architecture allows a user to edit the scope for a Regional ITS Architecture.

- **Step 1.** Open the Turbo Architecture database for the Regional ITS Architecture that you wish to edit by selecting **File -> Open**. A new window will open. Navigate to the directory containing the Turbo Architecture file. Select the file, and then click the **Open** button.
- **Step 2.** Click the **Start** tab. Click the name of the Regional ITS Architecture in the **Architectures: Regional** section.
- **Step 3.** Edit the appropriate fields as necessary: **Name**, **Description**, **Timeframe**, **Geographic Scope**, or **Service Scope**.
- **Step 4.** If necessary, edit the **Developer**, **Maintainer**, **Version**, and **Date/Time** fields.
- **Step 5.** Click the **Apply** button to accept the edits on this page.

- **Step 6.** To keep a log and record the changes made to the Regional ITS Architecture, click the **Change Log** button. A new window will appear (See **Figure 7**). Either update the current Maintenance Record Information or click the **New** button to insert a new log entry. Complete the **Date/Time**, **Log Updated By**, **Version**, and **Description** fields. To use the entry in the **Date/Time** field or the entry in the **Version** field and replace the respective entries in the **Start** tab, check the appropriate box labeled **Apply to Start Tab**. Click the **Apply** button, and then the **Close** button.
- **Step 7.** Save the Regional ITS Architecture information by selecting **File -> Save**. To use a new name for the Turbo Architecture database, select **File -> Save As** instead. A new window will open. Select a directory to save the Turbo Architecture file in, and type in the new filename. Click the **Save** button.

The screenshot shows a software window titled "FAMPO Regional ITS Architecture Change Log". The window is divided into two main panes. The left pane, titled "Maintenance Records", contains a table with two columns: "Date/Time" and "Log Updated By". The right pane, titled "Maintenance Record Information", contains several input fields and checkboxes. The "Date/Time" field is populated with "10/10/2012 03:46 PM" and has a checked "Apply to Start Tab" checkbox. The "Log Updated By" field is populated with "Baker". The "Version" field is populated with "Final" and has an unchecked "Apply to Start Tab" checkbox. The "Description" field contains the text: "The version includes comments received in June 2012. This represents the final draft version of the architecture and is currently under review." At the bottom of the window, there are four buttons: "New", "Delete", "Apply", and "Cancel". The "Apply" button is highlighted with a green border.

Figure 7. Change Log Window

3.2.4 Edit Scope for a Project Architecture

Turbo Architecture allows a user to edit the scope for a project architecture.

- **Step 1.** Open the Turbo Architecture database for the regional ITS architecture containing the project architecture that you wish to edit by selecting **File -> Open**. A new window will open. Navigate to the directory containing the Turbo Architecture file. Select the file, and then click the **Open** button.

- **Step 2.** Click the **Start** tab. Find the project architecture to be edited in the **Architectures: Project** section and click to select the project architecture.
- **Step 3.** Edit the appropriate fields as necessary: **Name**, **Description**, **Timeframe**, **Geographic Scope**, or **Service Scope**.
- **Step 4.** If necessary, edit the **Developer**, **Maintainer**, **Version**, and **Date/Time** fields.
- **Step 5.** Click the **Apply** button to accept the edits on this page.
- **Step 6.** To keep a log and record the changes made to the project architecture, click the **Change Log** button. A new window will appear (See **Figure 7**). Either update the current Maintenance Record Information or click the **New** button to insert a new log entry. Complete the **Date/Time**, **Log Updated By**, **Version**, and **Description** fields. To use the entry in the **Date/Time** field or the entry in the **Version** field and replace the respective entries in the **Start** tab, check the appropriate box labeled **Apply to Start Tab**. Click the **Apply** button, and then the **Close** button.
- **Step 7.** Save the project architecture information by selecting **File -> Save**. To use a new name for the turbo architecture database, select **File -> Save As** instead. A new window will open. Select a directory to save the Turbo Architecture file in, and type in the new filename. Click the **Save** button.

3.3 Planning

Turbo Architecture 7.0 includes a “Planning” tab as a new feature. This tab can be used to link objectives and strategies of the transportation planning process with components of regional architectures and project architectures. However, the FAMPO Architecture does not utilize this tab at this time. For more information on the functionality of the planning tab, please consult the Turbo Architecture manual, which can be accessed through the “Help” feature.

3.4 Define Stakeholders

A stakeholder is any organization or group that has an interest in, owns, operates, or maintains an ITS system in the region. Stakeholders may include public or private sector agencies, various counties, cities, and townships, and other state government agencies and private entities that have a role in transportation within the region. Stakeholders may also include agencies that operate non-ITS systems that will share information with ITS systems (e.g., the media).

3.4.1 Identify Stakeholders

The objective of this step is to build an initial list of stakeholders that will be used to perform stakeholder outreach and to populate the regional Turbo file.

- Begin with an initial list of stakeholders. This list may be the members of the MPO region or the list of stakeholders from the Turbo Architecture database for the North Carolina Statewide Services ITS Architecture – the latter represents a combination of

specific statewide stakeholders (such as NCDOT) and generic stakeholders (such as local traffic management departments).

- Review the list of stakeholders from adjacent Regional ITS Architectures, such as the FAMPO Regional ITS Architecture. Adjacent Regional ITS Architectures may have stakeholders whose jurisdiction or participation in ITS cross the geographic boundaries of the Regional ITS Architectures. Good architectures have a wide mix of stakeholders involved in all the key areas that will show up in every architecture (e.g., traffic management, transit management, public safety, maintenance, etc).
- For each stakeholder added, identify one or more representatives of the organization that can be approached to participate in the architecture development.

In Turbo Architecture, stakeholder information for a regional ITS architecture and project architectures are entered in the Stakeholder tab (See **Figure 8**).

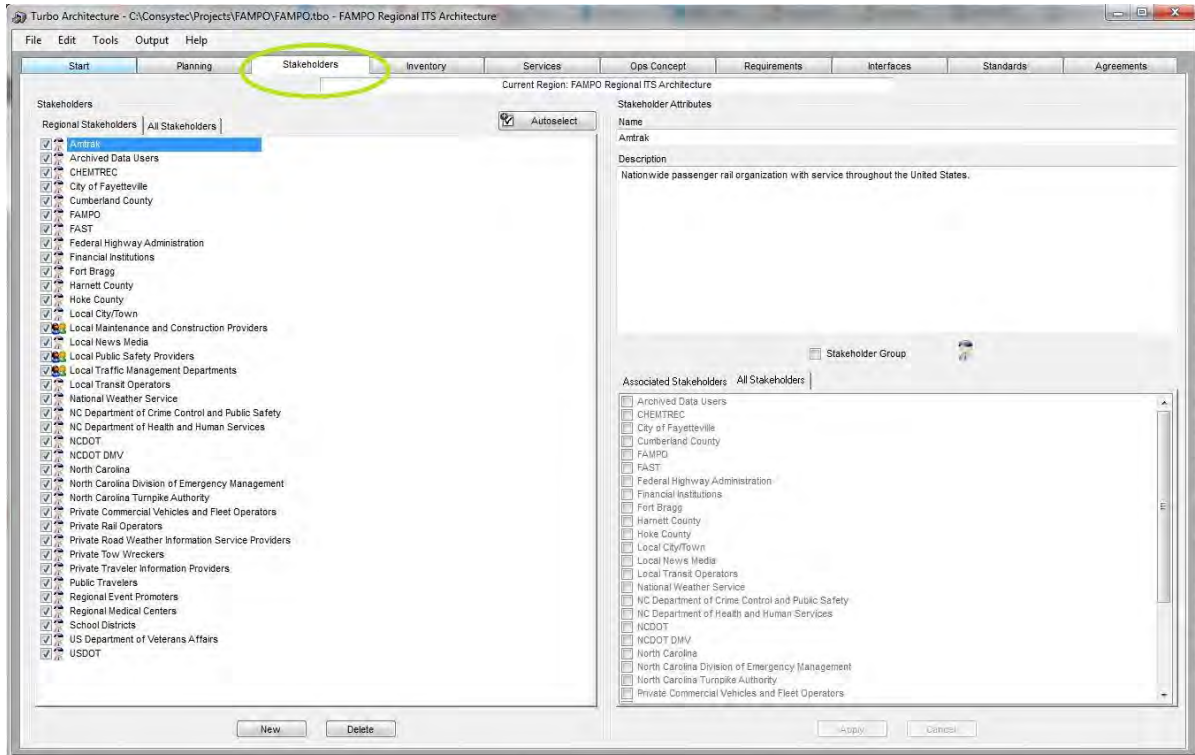


Figure 8. Stakeholder Tab

3.4.2 Stakeholders Nomenclature

The objective of this step is to build an initial list of stakeholders that will be used to perform stakeholder outreach and to populate the regional Turbo file. In general, stakeholders can be categorized into four categories.

3.4.2.1 Single Municipalities and Counties

Create a single stakeholder that represents all departments for that municipality or county. For example, instead of having a single City A Police Department, City A Fire Department, and City A Public Works Department, there would be a single City A stakeholder that represents all the departments for City A. This approach eliminates the need to update the Turbo Architecture database as departments are renamed or if functions are moved to different departments, while also decreasing the size of the stakeholder inventory.

While listing each department and agency may be more complete, there is little additional benefit to a Regional ITS Architecture being so thorough, and it makes the maintenance of the stakeholder inventory difficult.

3.4.2.2 State Agencies or Departments

For state level agencies that play a major role in providing transportation services, clarity in which government department is responsible for that function has utility in the Regional ITS Architecture so these could be listed separately, (e.g., NCDOT Division of Motor Vehicles, NCDOT Rail Division).

3.4.2.3 Specific Agencies or Organizations

Specific agencies or organizations that provide specific surface transportation services in a region should be included in the inventory. These agencies and organizations may include transit agencies or traveler information services.

3.4.2.4 Generic Stakeholders

Add generic stakeholders to the stakeholder inventory. A region may have a stakeholder that does participate in the transportation services provided in a region but has a smaller role. Or, as a region grows, either in population or development, new stakeholders may appear that may not have existed at the time the regional ITS architecture was created or updated.

The addition of several generic stakeholders is recommended. Generic stakeholders might include local traffic management departments, local public safety providers, local maintenance and construction providers, and local transit operators. These generic stakeholders, which may be public or private entities, represent other

stakeholders not specifically called out in the ITS architecture and other future stakeholders.

3.4.3 Enter Stakeholders for a Regional ITS Architecture

Turbo Architecture provides a page to enter stakeholder information for a Regional ITS Architecture. This page can be accessed within Turbo Architecture by clicking the **Stakeholder** tab.

- **Step 1.** Open the Turbo Architecture database for the Regional ITS Architecture that you wish to edit the stakeholders for by selecting **File -> Open**. A new window will open. Navigate to the directory containing the Turbo Architecture file. Select the file, and then click the **Open** button.
- **Step 2.** Click the **Stakeholders** tab (See **Figure 9**), to access the stakeholder information page for the architecture.
- **Step 3.** Select the **All Stakeholders** tab.
- **Step 4.** Click the **New** button.
- **Step 5.** In the **Name** field, enter the name of the stakeholder.
- **Step 6.** In the **Description** field, enter information about whom this stakeholder represents and its role in providing ITS services in the region.
- **Step 7.** Sometimes a group of stakeholders may form a consortium or have a shared interest in an ITS element (e.g., a joint transit traveler information system). Turbo Architecture depicts this consortium or shared interest as a stakeholder group. If this is a stakeholder group, that is, the stakeholder represents more than one stakeholder, check the **Stakeholder Group** checkbox. Then, under the **Stakeholder Group** checkbox, click the **All Stakeholders** tab and click those stakeholders that are a part of or have an interest in this stakeholder group.
- **Step 8.** Click the **Apply** button to accept the stakeholder.
- **Step 9.** Save the regional ITS architecture information by selecting **File -> Save**. To use a new name for the Turbo Architecture database, select **File -> Save As** instead. A new window will open. Select a directory to save the Turbo Architecture file in, and type in the new filename. Click the **Save** button.

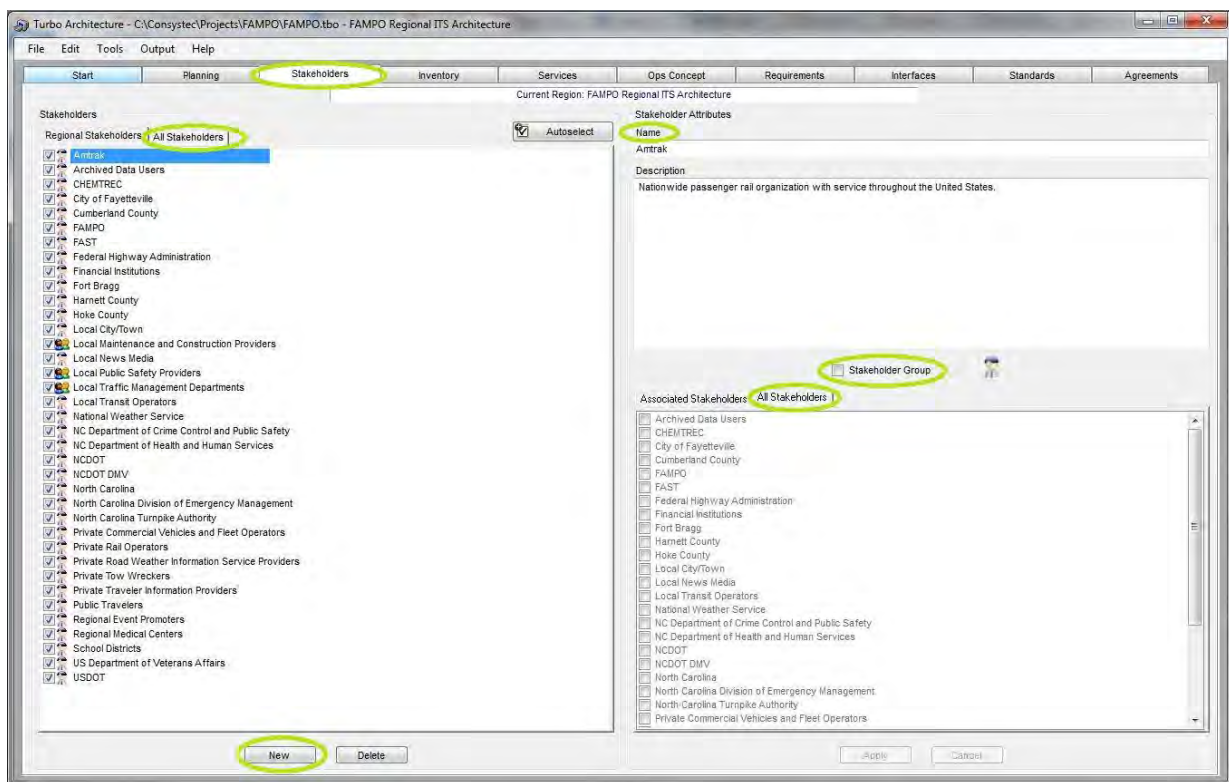


Figure 9. New Stakeholders

3.4.4 Edit Stakeholders for a Regional ITS Architecture

Turbo Architecture provides a page to edit stakeholder information for a Regional ITS Architecture. This page can be accessed within Turbo Architecture by clicking the **Stakeholder** tab.

- **Step 1.** Open the Turbo Architecture database for the Regional ITS Architecture for which you wish to edit the stakeholders by selecting **File -> Open**. A new window will open. Navigate to the directory containing the Turbo Architecture file. Select the file, and then click the **Open** button.
- **Step 2.** Click the **Stakeholders** tab, to access the stakeholder information page for the architecture.
- **Step 3.** Select the **All Stakeholders** tab.
- **Step 4.** From the list of stakeholders, click the stakeholder to be edited.

- **Step 5.** To delete the stakeholder, click the **Delete** button (See **Figure 10**). A new window will appear asking if the stakeholder should be deleted. Click the **Yes** button to confirm the deletion. Click the **No** button to cancel the deletion.
- **Step 6.** To edit the stakeholder, click the **Name** field to edit the name of the stakeholder. Click the **Description** field to edit the description of the stakeholder. Then click the **Apply** button to accept the edits on this page.
- **Step 7.** To edit the list of stakeholders that are part of a stakeholder group, click the **All Stakeholders** tab under the Stakeholder Group area, then check or uncheck the stakeholders that are a part of or have an interest in this stakeholder group. Then click the **Apply** button to accept the edits on this page.
- **Step 8.** Save the Regional ITS Architecture information by selecting **File -> Save**. To use a new name for the turbo architecture database, select **File -> Save As** instead. A new window will open. Select a directory to save the Turbo Architecture file in, and type in the new filename. Click the **Save** button.

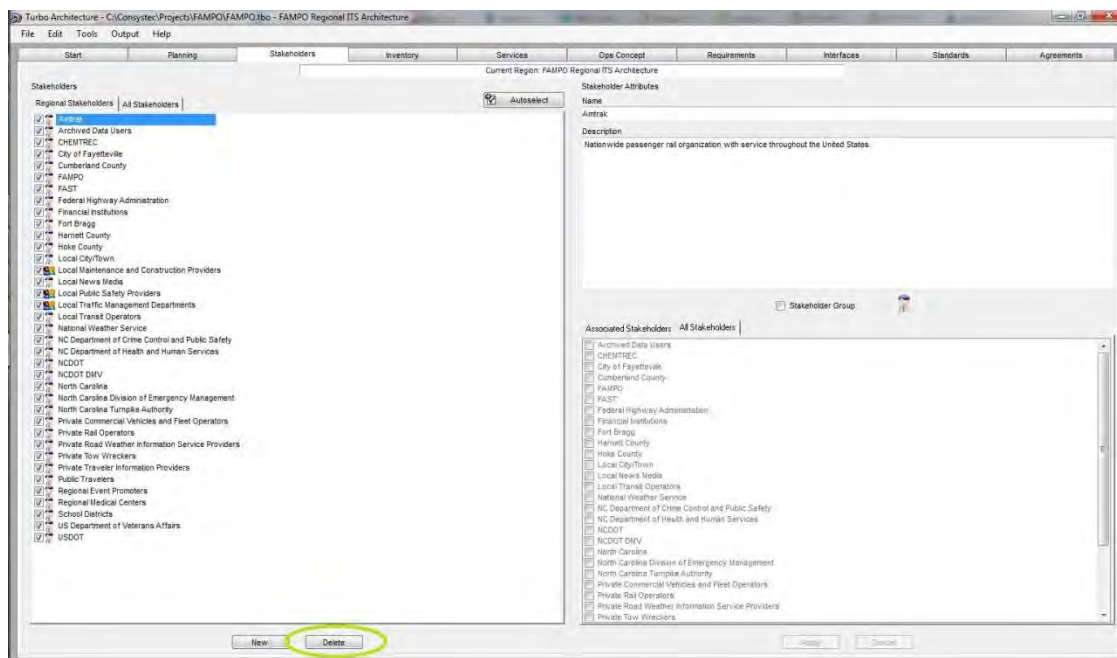


Figure 10. Editing Stakeholders - Regional

3.4.5 Edit Stakeholders for a Project Architecture

Turbo Architecture provides a page to edit stakeholder information for a project architecture. This page can be accessed within Turbo Architecture by clicking the **Stakeholder** tab.

- **Step 1.** Open the Turbo Architecture database for the regional ITS architecture that you wish to edit the stakeholders for by selecting **File -> Open**. A new window will

open. Navigate to the directory containing the Turbo Architecture file. Select the file, and then click the **Open** button.

- **Step 2.** Click the Start tab and select the appropriate project architecture in the **Architectures: Project** section.
- **Step 3.** Click the **Stakeholders** tab, to access the stakeholder information page for the project architecture.
- **Step 4.** Select the **All Stakeholders** tab.
- **Step 5.** From the list of stakeholders, check the checkbox next to the stakeholders that have a role or responsibility in this ITS project. Click the **Apply** button to accept the list of stakeholders for this ITS project (See **Figure 11**).
- **Step 6.** Although we are editing a project architecture, Turbo Architecture still allows the user to edit any stakeholder in the Regional ITS Architecture. Click the **Name** field to edit the name of the stakeholder. Click the **Description** field to edit the description of the stakeholder. Then click the **Apply** button to accept the edits on this page. Note making a change in the stakeholder name or description while in a project changes that name or description for the Regional ITS architecture and for all other project architectures in the file.
- **Step 7.** To delete a stakeholder from a project architecture un-select the button. If you wish to delete a stakeholder from the project and the regional ITS architecture, click the **Delete** button (See **Figure 10**). A new window will appear asking if the stakeholder should be deleted. Click the **Yes** button to confirm the deletion. Click the **No** button to cancel the deletion.
- **Step 8.** To edit the list of stakeholders that are part of a stakeholder group, click the **All Stakeholders** tab under the Stakeholder Group area, then check or uncheck the stakeholders that are a part of or have an interest in this stakeholder group. Then click the **Apply** button to accept the edits on this page.
- **Step 9.** Save the project architecture information by selecting **File -> Save**. To use a new name for the Turbo Architecture database, select **File -> Save As** instead. A new window will open. Select a directory to save the Turbo Architecture file in, and type in the new filename. Click the **Save** button.

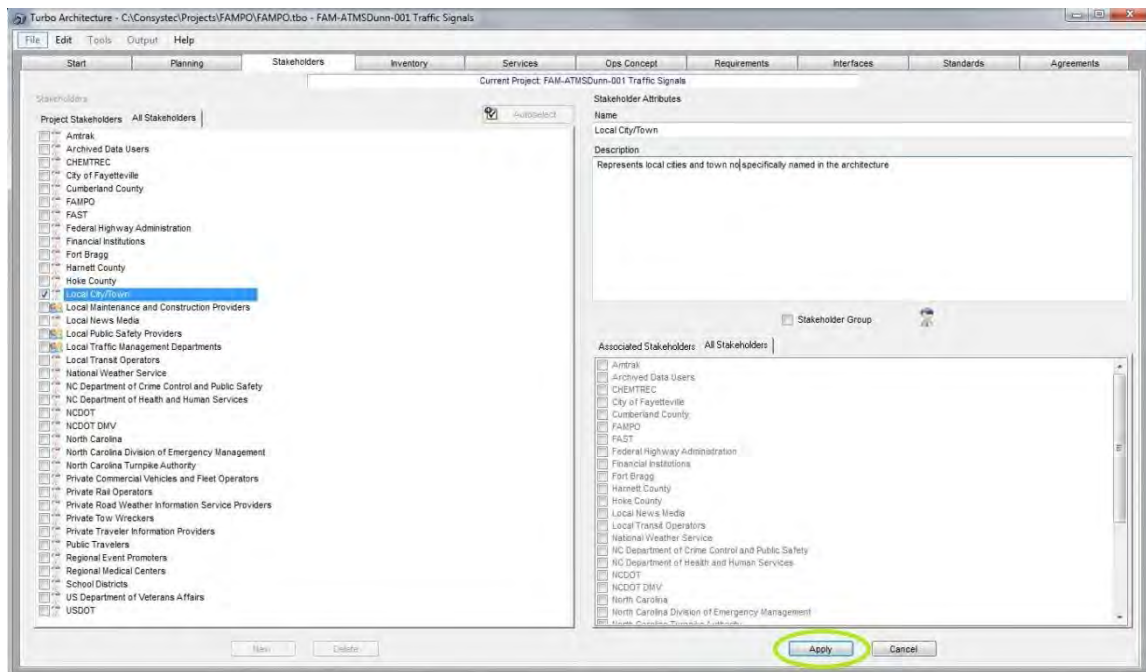


Figure 11. Editing Stakeholders - Project Architectures

4. Gathering Data

The second step of the Regional ITS Architecture development process is gathering data. In this step, the information necessary to build the Regional ITS Architecture is collected from the various sources.

With this step:

- The existing and planned ITS systems inventory for the Regional ITS Architecture will be identified.
- The existing and desired ITS services for the region will be defined, based on the transportation needs identified for the region.
- Based on the inventory and ITS services for the region, roles and responsibilities will be identified for the stakeholders in the region, satisfying the third component of the Final Rule/FTA Policy, *Operational Concepts*.
- Based on the inventory and ITS services for the region, high level functional requirements will be identified for each ITS system (inventory) region, satisfying the fifth component of the Final Rule/FTA Policy, *System Functional Requirements*.

4.1 Define Inventory

The inventory is a listing of existing and planned, public or private, ITS systems (elements) in the region. These systems are categorized by the National ITS Architecture as centers, field/devices, vehicles and personal traveler systems.

4.1.1 Identify Inventory

The objective of this step is to develop an initial set of elements to populate the Turbo Architecture database.

- Begin by adding a series of elements that represent the centers in the region. Centers generally need the most attention because they are involved with inter-agency interfaces. Review the inventory from adjacent Regional ITS Architectures, such as the FAMPO Regional ITS Architecture, or the North Carolina Statewide Services ITS Architecture for a representative list of centers (e.g. traffic management, transit management, emergency management, maintenance, etc).
- Add elements as appropriate to represent the ITS field equipment. Again, review the inventory from adjacent Regional ITS Architectures, such as the FAMPO Regional ITS Architecture, or the North Carolina Statewide Services ITS Architecture for a representative list of field devices.
- Add elements to represent various types of vehicles that contain ITS components (e.g. transit vehicles).
- Add elements representing traveler interfaces.
- For each element added develop a definition of the element that will be meaningful to the stakeholders in the region.

4.1.2 Inventory Nomenclature - Guidance

To make the architecture easier to use and understand, it is essential to use a consistent naming convention in the definition of elements. The recommended naming convention is the owner of the system followed by the name of the system or the type of system. When searching a Regional ITS Architecture, users are generally more interested in seeing what elements are owned by a stakeholder than by type of system. Thus, the owner of the system would come first, making it easier to sort architecture information. For example, all elements owned by NCDOT would begin with the word "NCDOT."

An architecture is more easily used by stakeholders in a region if the names of the elements are recognizable. For example, if a region calls message signs, dynamic message signs, the element should be named "DMS." For example, "NCDOT DMS," instead of "NCDOT variable message signs".

The creation of generic ITS elements are also recommended. These generic ITS elements represent multiple instances of a system or device. For example, consolidate smaller traffic signal systems and devices into a single generic traffic signal system called “Local Traffic Signals”. This single generic ITS element represents all the traffic signal devices in the region operated by local governments not specifically called out in the Regional ITS Architecture. “Local Traffic Signals” would not include NCDOT Traffic Signals or the traffic signals for a large municipality in the region (e.g., City of Fayetteville Traffic Signals in the FAMPO Regional ITS Architecture) because of the large roles both agencies play in a state or region).

Using generic elements also has the additional benefit of consistency. Because “Local Traffic Signals” represents multiple local governments, each local government using the Regional ITS Architecture to design or procure their traffic signals may implement their traffic signals in the same way, possibly resulting in interoperability. For example, two different local governments looking to implement a vehicle pre-emption capability may both look at the Regional ITS Architecture, realize that the whole region should implement the vehicle pre-emption in the same manner, then work together to implement the capability similarly or simultaneously.

4.1.3 Inventory Mapping – Guidance

In the inventory, each element must be mapped to at least one subsystem or terminator (Note: Terminators are entities out of the National ITS Architecture that are on the edge of the architecture meaning interfaces to them are important, but ITS does not try to define the functions within them. An example would be financial institutions). Most elements will be mapped to only one subsystem; however, some elements may be mapped to multiple subsystems and terminators if they perform multiple functions.

For example, several traffic management centers and transit management centers are also mapped to emergency management centers because they also perform emergency management functions, such as emergency evacuation support or surveillance of transportation facilities.

Additional generic elements may be added as terminators so that these elements may interface with each other. For example, although a generic element named “Local Traffic Operations Centers” may exist, an additional generic element named “Other Local Traffic Operations Center” should be added since an element cannot interface with itself. However, since these two elements really represents the same system, “Local Traffic Operations Center” would be mapped to a Traffic Management subsystem, thus having the ability to support the functions of a traffic management center while “Other Local Traffic Operations Center” would be mapped to the “Other Traffic Management Center” terminators, thus supporting no functions, instead of a Traffic Management subsystem because otherwise the functions and requirements supported would be repetitious.

4.1.4 Enter Inventory for a Regional ITS Architecture

In Turbo Architecture, inventory information for a Regional ITS Architecture is entered in the **Inventory** tab (See **Figure 12**).

- **Step 1.** Open the Turbo Architecture database for the Regional ITS Architecture that you wish to add the inventory to by selecting **File -> Open**. A new window will open. Navigate to the directory containing the Turbo Architecture file. Select the file, and then click the **Open** button.
- **Step 2.** Click the **Inventory** tab (See **Figure 12**), to access the inventory information page for the architecture.
- **Step 3.** Select the **All Elements** tab.
- **Step 4.** Click the **New** button.
- **Step 5.** In the **Name** field, enter the name of the element (ITS system).

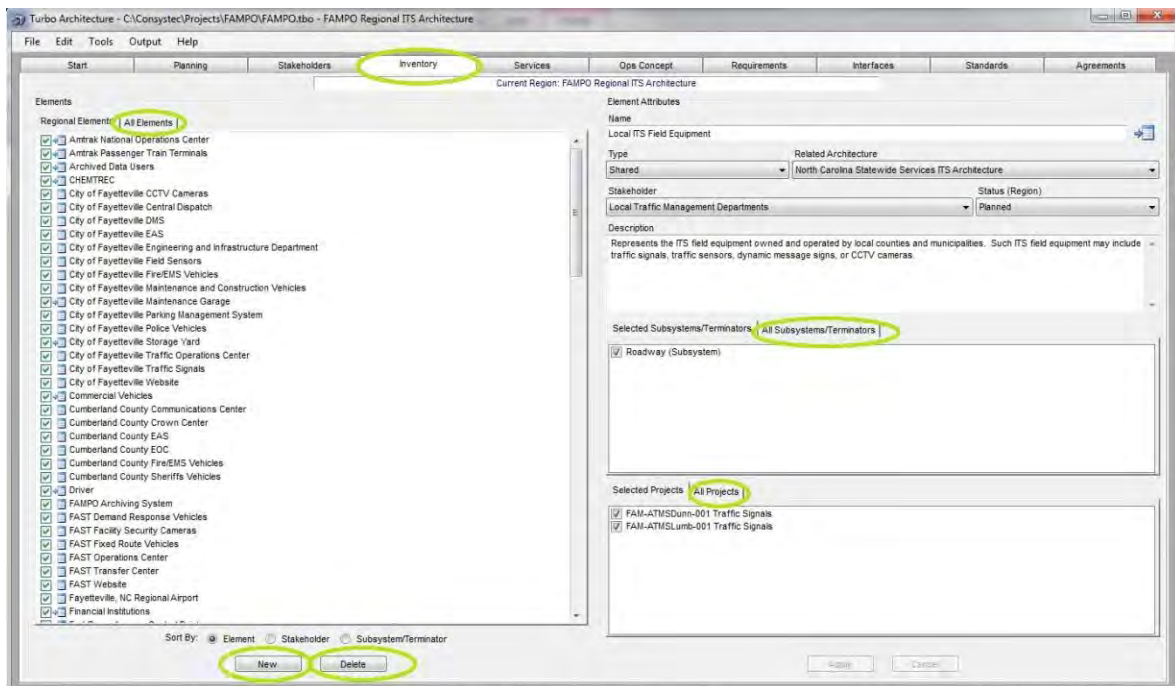


Figure 12. Inventory Tab

- **Step 6.** In the **Type** field, select the type of element, from **Normal**, **Instance**, **Shared**, or **Communications**. See the *Turbo Architecture User's Manual*, Section 3.3, for a description of each type. A majority of the elements will be Normal. Several statewide elements (e.g., NCDOT 511 System) will appear in multiple Regional ITS Architectures so those elements would be of the type **Shared**. If an element is Shared, a new field will appear called **Related Architecture** (See **Figure 13**). Select the appropriate Related Architecture from the list. Related architectures are added from the **Scope** tab.

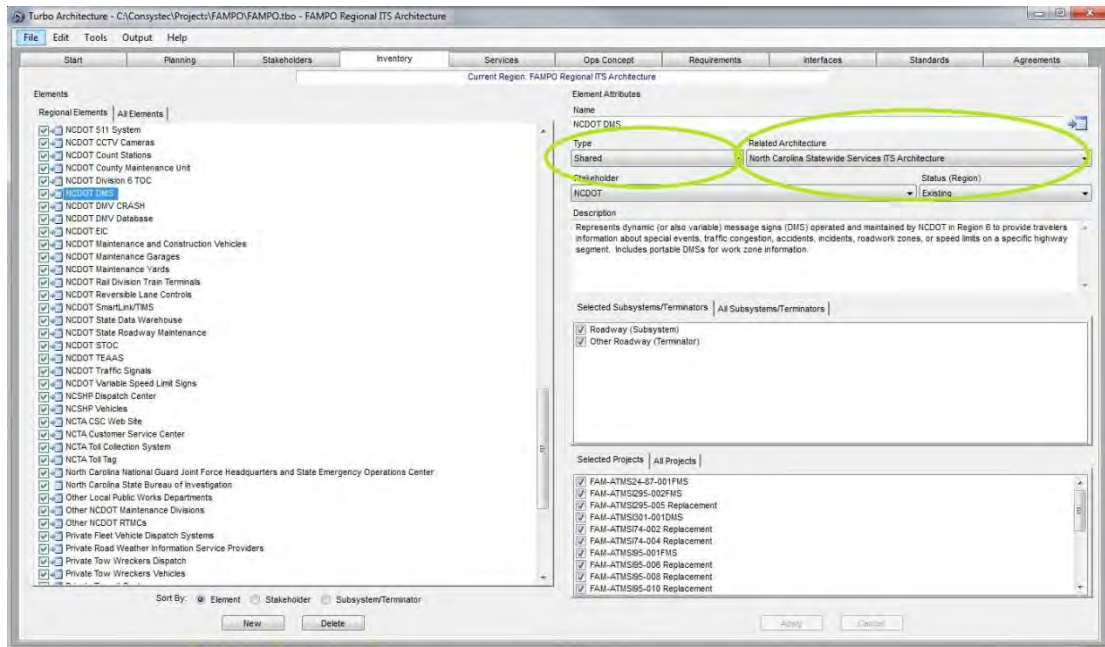


Figure 13. Shared Elements

- **Step 7.** In the **Stakeholder** field, select the stakeholder or owner of the element. If the stakeholder is not listed, select **<New Stakeholder>** at the top of the list. A new window will open (See **Figure 14**). Enter the **Name** and a **Description** for the stakeholder.

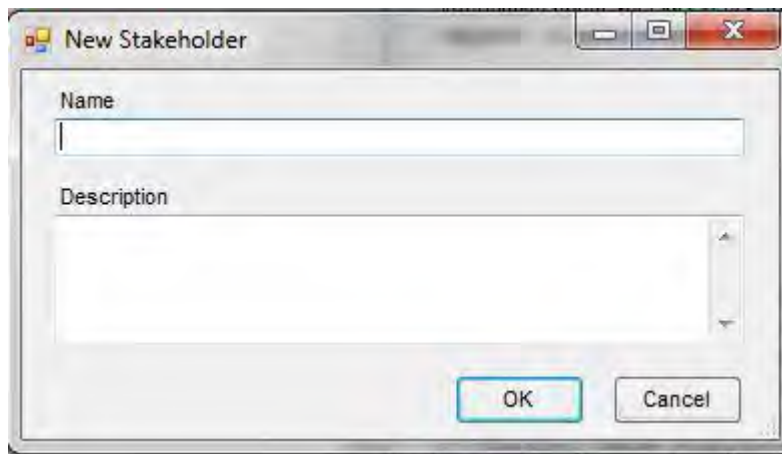


Figure 14. New Stakeholder Window

- **Step 8.** In the **Status** field, select the status of the element. The status will generally be **Existing** or **Planned**. To edit or add a status type, go to **Tools -> Update Status**. See the *Turbo Architecture User's Manual*, Section 4.3, for further information on editing status attributes.
- **Step 9.** In the **Description** field, provide a description of the element and what the element represents.

- **Step 10.** Click the **All Subsystems/Terminator** tab and select the subsystems and terminators that this element maps to. You must select at least one subsystem or terminator to map to the element.
- **Step 11.** Click the **Apply** button to accept the element.
- **Step 12.** Save the Regional ITS Architecture information by selecting **File -> Save**. To use a new name for the Turbo Architecture database, select **File -> Save As** instead. A new window will open. Select a directory to save the Turbo Architecture file in, and type in the new filename. Click the **Save** button.

4.1.5 Edit Inventory for a Regional ITS Architecture

Turbo Architecture provides a page to edit inventory information for a Regional ITS Architecture. This page can be accessed within Turbo Architecture by clicking the **Inventory** tab.

- **Step 1.** Open the Turbo Architecture database for the Regional ITS Architecture that you wish to edit the inventory for by selecting **File -> Open**. A new window will open. Navigate to the directory containing the Turbo Architecture file. Select the file, and then click the **Open** button.
- **Step 2.** Click the **Inventory** tab, to access the inventory information page for the architecture.
- **Step 3.** Select the **All Elements** tab.
- **Step 4.** From the list of elements, click the element to be edited.
- **Step 5.** To delete the element, click the **Delete** button. A new window will appear asking if the element and all its interfaces should be deleted. Click the **Yes** button to confirm the deletion. Click the **No** button to cancel the deletion.
- **Step 6.** To edit the element, click the **Name** field to edit the name of the stakeholder, **Type** to edit the type of element, **Stakeholder** to select a different stakeholder, **Status** to change the status of the element, and **Description** to edit the description of the element. Click the **All Subsystems/Terminators** tab, to check or uncheck the subsystems and terminators the element maps to.
- **Step 7.** Click the **Apply** button to accept the edits on this page.
- **Step 8.** Save the Regional ITS Architecture information by selecting **File -> Save**. To use a new name for the Turbo Architecture database, select **File -> Save As** instead. A new window will open. Select a directory to save the Turbo Architecture file in, and type in the new filename. Click the **Save** button.

4.1.6 Edit Inventory for a Project Architecture

Turbo Architecture provides a page to edit inventory information for a project architecture. This page can be accessed within Turbo Architecture by clicking the **Inventory** tab.

- **Step 1.** Open the Turbo Architecture database for the Regional ITS Architecture that you wish to edit the inventory for by selecting **File -> Open**. A new window will open. Navigate to the directory containing the Turbo Architecture file. Select the file, and then click the **Open** button.
- **Step 2.** Click the **Start** tab and select the appropriate project architecture in the **Architectures: Project** section.
- **Step 3.** Click the **Inventory** tab, to access the inventory information page for the architecture.
- **Step 4.** Select the **All Elements** tab.
- **Step 5.** From the list of elements, check the checkbox next to the elements that have a role in the ITS project.
- **Step 6.** To delete the element, click the **Delete** button. A new window will appear asking if the element and all its interfaces should be deleted. Click the **Yes** button to confirm the deletion. Click the **No** button to cancel the deletion. Performing this step will delete the element from the file and consequently, from the Regional ITS Architecture. If the desire is to not have the element as part of the project, just un-select it from the list.
- **Step 7.** Although we are editing a project architecture, Turbo Architecture still allows the user to edit any element in the Regional ITS Architecture. To edit the element, click the **Name** field to edit the name of the stakeholder, **Type** to edit the type of element, **Stakeholder** to select a different stakeholder, **Status** to change the status of the element, and **Description** to edit the description of the element. Click the **All Subsystems/Terminators** tab, to check or uncheck the subsystems and terminators the element maps to.
- **Step 8.** Click the **Apply** button to accept the edits on this page.
- **Step 9.** Save the Regional ITS Architecture information by selecting **File -> Save**. To use a new name for the turbo architecture database, select **File -> Save As** instead. A new window will open. Select a directory to save the Turbo Architecture file in, and type in the new filename. Click the **Save** button.

4.2 Define Needs and Service

This step is the selection of ITS services to address the transportation needs of the region. This is the first step in determining what the region's ITS systems should do tomorrow that they do not do today.

4.2.1 Identify Needs and Services

The objective of this step is to develop a set of needs and services.

- Although needs are not required as part of Rule 940, creating a set of transportation needs that ITS will address is important to making the architecture useful for the planning process. The suggested procedure is to begin with the region's long range transportation plan (LRTP) goals, objectives, or strategies. Develop a set of ITS related transportation needs that clearly map to the LRTP.
- Develop an initial list of ITS services for the region. Start with the list of ITS services, also known as Service Packages, supported in the U.S. National ITS Architecture and refine the list by reviewing the ITS services supported in the North Carolina Statewide Services ITS Architecture and adjacent regional ITS architectures. In the Turbo Architecture database, add each ITS service and assign elements to the services that are expected to be involved.
- Develop a prioritized list of services with a fairly broad set of stakeholders. This list of services will augment those initially entered into Turbo Architecture and assist with the definition of project sequencing later.

4.2.2 ITS Services - Instances

Once the ITS services are selected for a region, it is recommended that creating multiple instances of an ITS service be considered. Some ITS services will be performed by multiple stakeholders and systems to satisfy the regional need. For example, there will be multiple agencies and municipalities that will perform the Traffic Signal Control ITS service, usually via traffic signal control systems, or the Transit Fixed-Route Operations ITS service. Rather than trying to map all the agencies and systems at once, instances of the ITS Service can be created, with each instance focusing on how one stakeholder or system would perform the ITS service. For example, there may be an instance on how NCDOT performs Surface Street Control, then another instance for City A, another instance for City B, etc.

The advantage of this approach is that users and stakeholders can focus on how a single stakeholder or system would perform that service. This approach also helps with the development and definition of ITS projects, which can be mapped to a single instance of an ITS service.

Turbo Architecture allows users to name instances of an ITS service. It recommended that the instances be named in the format of xxxxxx-yy, where xxxxxx is the ITS service and yy is the instance number. For example, if the ITS service is ATMS01, Network Surveillance and NCDOT is the second instance, the instance would be named ATMS01-02.

4.2.3 Enter Services for a Regional ITS Architecture

In Turbo Architecture, services information for a Regional ITS Architecture are entered in the **Services** tab (See **Figure 15**). As previously mentioned, in Turbo Architecture, ITS services are also known as service packages.

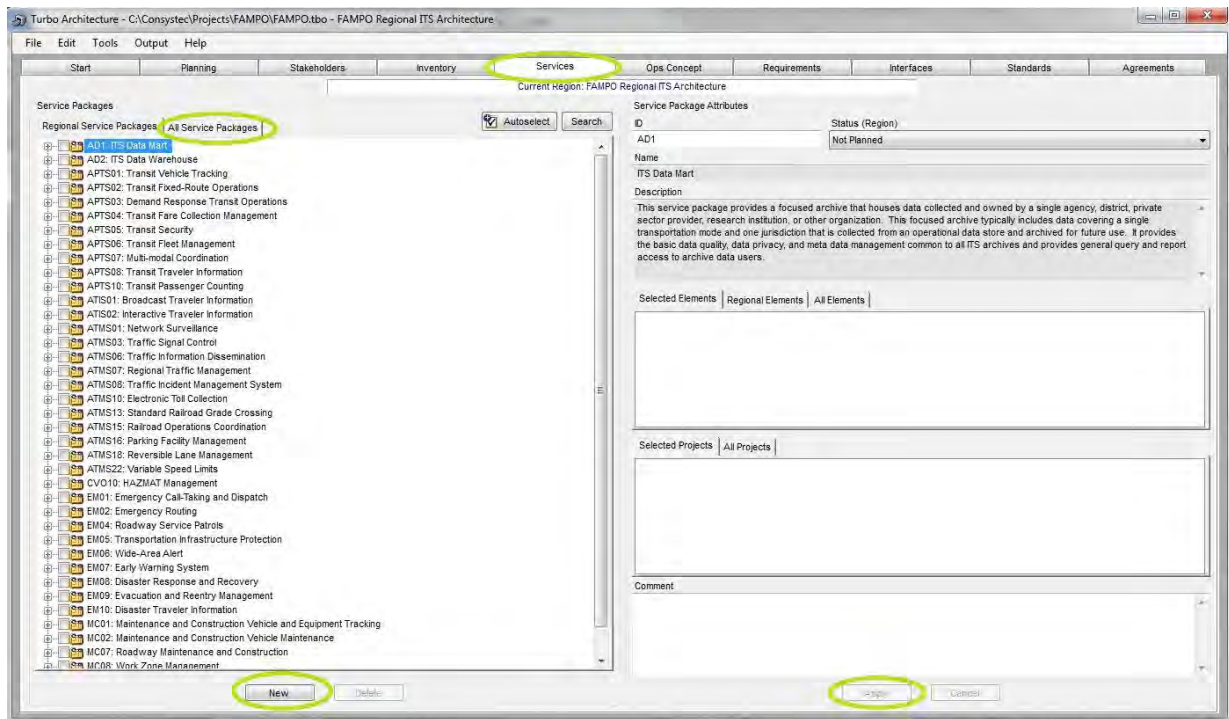


Figure 15. Services Tab

- **Step 1.** Open the Turbo Architecture database for the Regional ITS Architecture that you wish to add ITS Services for by selecting **File -> Open**. A new window will open. Navigate to the directory containing the Turbo Architecture file. Select the file, and then click the **Open** button.
- **Step 2.** Click the **Services** tab, to access the inventory information page for the architecture.
- **Step 3.** Click the **All Service Packages** tab.
- **Step 4.** Check the checkbox next to the ITS Services that are applicable to or are planned for the region.
- **Step 5.** Click the **Apply** button to accept the ITS Services selected.
- **Step 6.** For each ITS Service selected, in the **Status** field, indicate the status of the ITS service in the region (e.g., existing or planned).
- **Step 7.** For each ITS Service selected, click the **All Elements** tab and check the checkbox next to the elements that would participate in providing this ITS service for this region.

- **Step 8.** For each ITS Service selected, click the **All Projects** tab and check the checkbox next to the project architectures that support or implement this ITS Service.
- **Step 9.** Click the **Apply** button to accept the edits for each ITS Service.
- **Step 10.** Save the Regional ITS Architecture information by selecting **File -> Save**. To use a new name for the Turbo Architecture database, select **File -> Save As** instead. A new window will open. Select a directory to save the Turbo Architecture file in, and type in the new filename. Click the **Save** button.

4.2.4 Add New Service Instances for a Regional ITS Architecture

In Turbo Architecture, service instances information for a Regional ITS Architecture are entered in the **Services** tab. In Turbo Architecture, ITS services instances are also known as Service Packages instances.

- **Step 1.** Open the Turbo Architecture database for the Regional ITS Architecture where you wish to add ITS service instances by selecting **File -> Open**. A new window will open. Navigate to the directory containing the Turbo Architecture file. Select the file, and then click the **Open** button.
- **Step 2.** Click the **Services** tab, to access the inventory information page for the architecture.
- **Step 3.** Click the **All Service Packages** tab.
- **Step 4.** Select the ITS Service that you wish to create an instance for (by left clicking on the service in the All Service Packages list).
- **Step 5.** Click the **New** button.
- **Step 6.** In the **Status** field, indicate the status of the ITS service in the region (e.g., existing or planned).
- **Step 7.** In the **Name** field, enter a name for the ITS Service Instance (e.g., ATMS01-1).
- **Step 8.** In the **Description** field, type in information describing what this ITS service instance represents (e.g., the stakeholder or element that this instance focuses on).
- **Step 9.** Click the **All Elements** tab and check the checkbox next to the elements that would participate in providing this ITS service for this region.
- **Step 10.** Click the **All Projects** tab and check the checkbox next to the project architectures that support or implements this ITS Service.
- **Step 11.** In the **Comments** field, type in any additional information about this ITS Service instance.

- **Step 12.** Click the **Apply** button to accept the edits for each ITS Service.
- **Step 13.** Save the Regional ITS Architecture information by selecting **File -> Save**. To use a new name for the Turbo Architecture database, select **File -> Save As** instead. A new window will open. Select a directory to save the Turbo Architecture file in, and type in the new filename. Click the **Save** button.

4.2.5 Edit Services for a Regional ITS Architecture

In Turbo Architecture, services information for a Regional ITS Architecture can be edited in the **Services** tab. In Turbo Architecture, ITS services are also known as Service Packages.

- **Step 1.** Open the Turbo Architecture database for the Regional ITS Architecture that you wish to edit the ITS Services for by selecting **File -> Open**. A new window will open. Navigate to the directory containing the Turbo Architecture file. Select the file, and then click the **Open** button.
- **Step 2.** Click the **Services** tab, to access the inventory information page for the architecture.
- **Step 3.** Click the **All Service Packages** tab.
- **Step 4.** Select the ITS service or ITS service instance to be edited.
- **Step 5.** To add an ITS service or instance to the region, check the checkbox next to the ITS service or instance. Click the **Apply** button to accept the edits.
- **Step 6.** To remove the ITS service or instance from the region, uncheck the checkbox next to the ITS service or instance. Click the **Apply** button to accept the edits.
- **Step 7.** To delete an ITS Service instance from the region, click the **Delete** button. A new window will appear asking if the ITS service instance should be deleted. Click the **Yes** button to confirm the deletion. Click the **No** button to cancel the deletion. Deleting an ITS service instance deletes it from all project architectures in the file as well.
- **Step 8.** To edit the ITS service or ITS service instance, click the **Status (Region)** field to edit the status of the ITS service instance, click the **Name** field to edit the name of the ITS service instance, click the **All Elements** tab to edit which elements participate in this ITS service instance, click the **All Projects** tab to edit which ITS projects will support or implement this ITS service instance; and click the **Comments** field to edit the comments. Click the **Apply** button to accept the edits for this ITS service instance.
- **Step 9.** Save the Regional ITS Architecture information by selecting **File -> Save**. To use a new name for the Turbo Architecture database, select **File -> Save As** instead. A new window will open. Select a directory to save the Turbo Architecture file in, and type in the new filename. Click the **Save** button.

4.2.6 Edit Services for a Project Architecture

Turbo Architecture provides a page to select the ITS services (or instances of ITS services) applicable to a project architecture. This page can be accessed within Turbo Architecture by clicking the **Services** tab. In Turbo Architecture, ITS services are also known as Service Packages.

- **Step 1.** Open the Turbo Architecture database for the Regional ITS Architecture that you wish to edit the ITS services for by selecting **File -> Open**. A new window will open. Navigate to the directory containing the Turbo Architecture file. Select the file, and then click the **Open** button.
- **Step 2.** Click the **Start** tab and select the appropriate project architecture in the **Architectures: Project** section.
- **Step 3.** Click the **Services** tab, to access the inventory information page for the architecture.
- **Step 4.** Click the **All Service Packages** tab.
- **Step 5.** Check the checkbox next to those ITS services or instances that are supported or to be implemented by the project.
- **Step 6.** Click the **Apply** button to accept the selection of ITS services and instances for this project.
- **Step 7.** Save the Regional ITS Architecture information by selecting **File -> Save**. To use a new name for the Turbo Architecture database, select **File -> Save As** instead. A new window will open. Select a directory to save the Turbo Architecture file in, and type in the new filename. Click the **Save** button.

4.3 Develop Operational Concept

The operational concept defines the roles and responsibilities of the stakeholders in providing ITS services and operating and maintaining ITS systems in the region.

4.3.1 Identify Operational Concepts

The objective of this step is to develop a set of high-level roles and responsibilities for each stakeholder.

- To create a list of roles and responsibilities, review each stakeholder's roles and responsibilities for every ITS service that each stakeholder participates in. The North Carolina Statewide Services ITS Architecture will have a draft set of roles and responsibilities for statewide elements and generic elements that can serve as a starting point. Also, look at adjacent Regional ITS Architectures to view the roles and responsibilities for a stakeholder in other regions. It is unlikely that a stakeholder's roles and responsibilities significantly changes from region to region.
- For each key stakeholder, define a set of roles and responsibilities.

4.3.2 Enter Operational Concepts for a Regional ITS Architecture

In Turbo Architecture, operational concepts information for a Regional ITS Architecture are entered in the **Ops Concept** tab (See **Figure 16**).

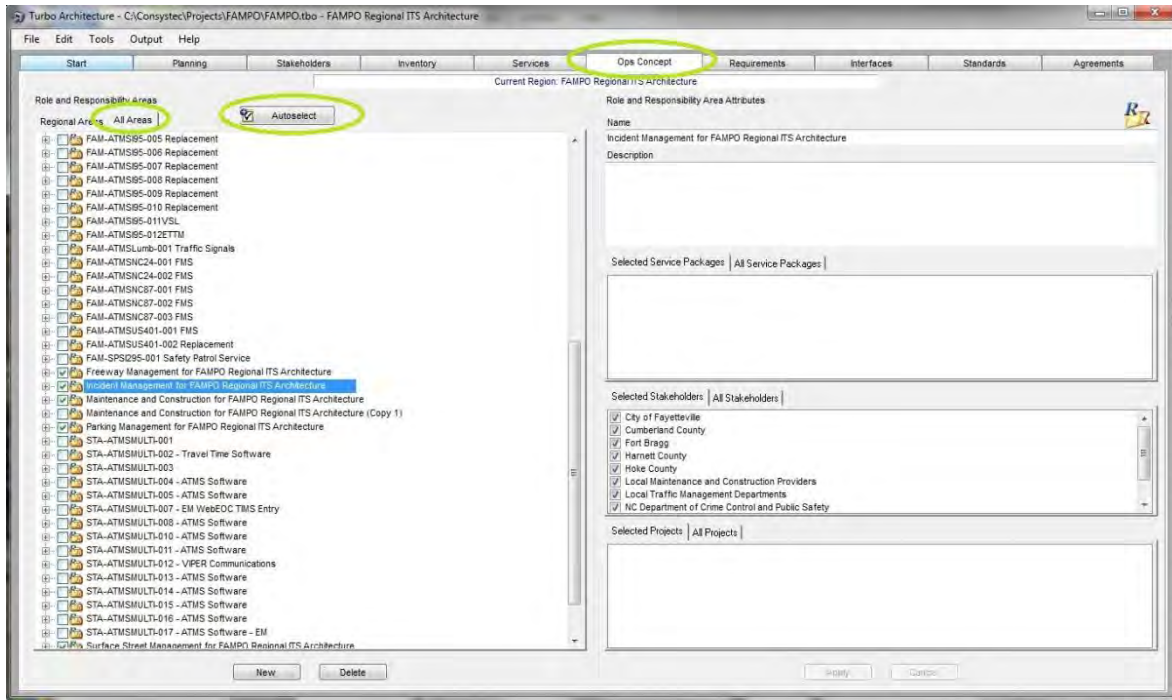


Figure 16. Ops Concept Tab

- **Step 1.** Open the Turbo Architecture database for the Regional ITS Architecture that you wish to add operational concepts for by selecting **File -> Open**. A new window will open. Navigate to the directory containing the Turbo Architecture file. Select the file, and then click the **Open** button.
- **Step 2.** Click the **Ops Concept** tab (See **Figure 16**), to access the operational concepts information page for the architecture.
- **Step 3.** Click the **All Areas** tab.
- **Step 4.** Click the **Autoselect** button. A new window will appear (See **Figure 17**). Several options will be available, including allowing Turbo Architecture to select **Role and responsibility areas**, **Stakeholders for new areas**, **Roles and responsibilities for selected stakeholders**, and **Create multiple areas if needed**. See the *Turbo Architecture User's Manual*, Section 3.5, for a description of each option. When creating operational concepts for the first time, it is recommended that all the options be selected.



Figure 17. Autoselect Roles and Responsibilities Window

- **Step 5.** Click the **Continue** button. Based on the ITS Services previously selected, Turbo Architecture creates a list of roles and responsibility areas that may be applicable to the region.
- **Step 6.** Click the **Close** button.
- **Step 7.** In the **Description** field, enter a description of each role and responsibility, if desired.
- **Step 8.** For each role and responsibility area, click the **All Service Packages** tab and review the list of the Service Packages and Service Package instances that the role and responsibility area applies to. Check or uncheck the checkbox next to each Service Package and Service Package instance.
- **Step 9.** For each role and responsibility area, click the **All Stakeholders** tab and review the list of stakeholders that have a role and responsibility in providing ITS services for this area. Check or uncheck the checkbox next to each stakeholder.
- **Step 10.** For each role and responsibility area, click the **All Projects** tab and select any project architectures where this role and responsibility area may apply. Check or uncheck the checkbox next to each project architecture.
- **Step 11.** Click the **Apply** button to accept the edits for each role and responsibility area.
- **Step 12.** Click the "+" box next to each role and responsibility area to expand the list and view the stakeholders that have been mapped to that area (See **Figure 18**).

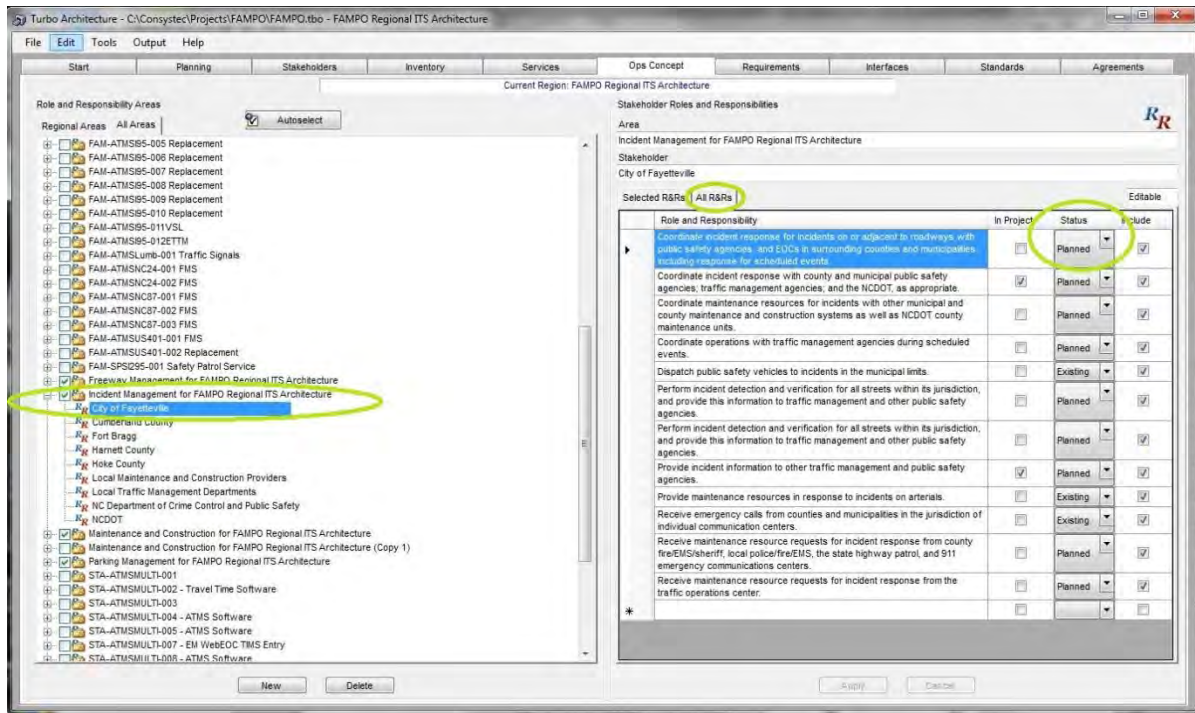


Figure 18. Roles and Responsibilities

- **Step 13.** Select a stakeholder.
- **Step 14.** Click the **All R&Rs** tab.
- **Step 15.** Enter each role and responsibility for that stakeholder for that specific role and responsibility area.
- **Step 16.** For each stakeholder role and responsibility, indicate the status (e.g., existing, planned) in the **Status** field.
- **Step 17.** Click the **Apply** button to accept the stakeholder role and responsibility.
- **Step 18.** Save the Regional ITS Architecture information by selecting **File -> Save**. To use a new name for the Turbo Architecture database, select **File -> Save As** instead. A new window will open. Select a directory to save the Turbo Architecture file in, and type in the new filename. Click the **Save** button.

4.3.3 Edit Operational Concepts for a Regional ITS Architecture

In Turbo Architecture, operational concepts information for a Regional ITS Architecture can be edited in the **Ops Concept** tab.

- **Step 1.** Open the Turbo Architecture database for the Regional ITS Architecture that you wish to edit the operational concepts for by selecting **File -> Open**. A new window will open.

Navigate to the directory containing the Turbo Architecture file. Select the file, and then click the **Open** button.

- **Step 2.** Click the **Ops Concept** tab, to access the operational concepts information page for the architecture.
- **Step 3.** Click the **All Areas** tab.
- **Step 4.** From the list of roles and responsibility areas, click the role and responsibility area to be edited.
- **Step 5.** To remove a role and responsibility area from the region, click the **Delete** button. A new window will appear asking if the role and responsibility should be deleted. Click the **Yes** button to confirm the deletion. Click the **No** button to cancel the deletion.
- **Step 6.** To edit a role and responsibility area, click the **Name** field to edit the name of the role and responsibility area, click the **Description** field to edit the description of role and responsibility area, click the **All Service Packages** tab to edit the Service Packages that the role and responsibility area applies to, click the **All Stakeholders** tab to edit the stakeholders have a role and responsibility in the role and responsibility area, and click the **All Projects** tab to edit the projects that the role and responsibility area pertains to. Click the **Apply** button to accept the edits for this role and responsibility area.
- **Step 7.** To edit the roles and responsibilities of a stakeholder for a role and responsibility area, select the stakeholder under the appropriate role and responsibility area.
- **Step 8.** Click the **All R&Rs** tab to view all the roles and responsibilities for the stakeholders in the Regional ITS Architecture. Check the checkbox to the left of the role and responsibility to assign it to the selected role and responsibility area, or uncheck the checkbox to remove the role and responsibility from the area. Click the **Status** field to edit the status of that role or responsibility. Click the **Apply** button to accept the changes.
- **Step 9.** New roles and responsibilities for the Regional ITS Architecture or the project architecture can be added under the **All R&Rs** tab or the **Selected R&Rs** tab. Only roles and responsibilities for this specific role and responsibility area will appear under the **Selected R&Rs** tab. **Important:** Changing a role and responsibility is a change for the entire Regional ITS Architecture, not just a specific role and responsibility area or a project architecture. If necessary, create a new role and responsibility.
- **Step 10.** Save the Regional ITS Architecture information by selecting **File -> Save**. To use a new name for the Turbo Architecture database, select **File -> Save As** instead. A new window will open. Select a directory to save the Turbo Architecture file in, and type in the new filename. Click the **Save** button.

4.3.4 Edit Operational Concepts for a Project Architecture

In Turbo Architecture, operational concepts information for a project architecture can be edited in the **Ops Concept** tab. One or more of the roles and responsibility areas that were created for the Regional ITS Architecture can also be assigned to a project architecture. However, any changes to the list of stakeholders or a stakeholder's role and responsibility will result in Turbo Architecture assigning an instance of the role and responsibility area. Therefore, it is recommended that a new role and responsibility area be created specifically for that project architecture, and the area be renamed to reflect the project architecture (e.g., a role and responsibility area called Fam-ATMSi95-001 FMS – Deploy ITS on I-95).

- **Step 1.** Open the Turbo Architecture database for the Regional ITS Architecture that you wish to edit the operational concepts for by selecting **File -> Open**. A new window will open. Navigate to the directory containing the Turbo Architecture file. Select the file, and then click the **Open** button.
- **Step 2.** Click the **Start** tab and select the appropriate project architecture in the **Architectures: Project** section.
- **Step 3.** Click the **Ops Concept** tab, to access the operational concepts information page for the project architecture.
- **Step 4.** Click the **All Areas** tab.
- **Step 5.** From the list of roles and responsibility areas, check the checkbox next to each role and responsibility area that apply to the project architecture.
- **Step 6.** Click the **Apply** button to accept the assignments.
- **Step 7.** For each stakeholder, click the **All R&Rs** tab, and review each role and responsibility. Check the checkbox in the left column for those roles and responsibilities that apply for this project architecture and click the **Status** field to edit the status. Click the **Apply** button.
- **Step 8.** If the roles or responsibilities for a project architecture is different from the Regional ITS Architecture, a new window will appear (See **Figure 19**). Click the **OK** button to create a new area. Click the **Cancel** button to cancel creating a new area. If no changes to the roles and responsibilities are necessary from the Regional ITS Architecture, skip to the last step.

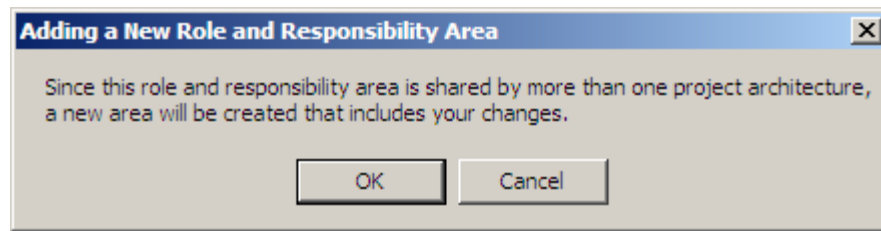


Figure 19. New Role and Responsibility Area

- **Step 9.** If a new area has been created, click the **Name** field and update the name. A recommendation is to update the name to include the identifier for and the name of the ITS project. Click the **Description** field to add a description of the project, the stakeholders involved, and perhaps a summary of the roles and responsibilities. Click the **All Service Packages** tab to edit the Service Packages that the new area applies to and click the **All Stakeholders** tab to edit the stakeholders have a role and responsibility in this project. Click the **Apply** button to accept the changes.
- **Step 10.** Once a new area has been created specifically for the ITS project, it is no longer necessary to assign multiple role and responsibility areas for the project. It is recommended that all other role and responsibility areas be unselected for the project and all the roles and responsibilities be documented in the new area.
- **Step 11.** To select the roles and responsibilities of a stakeholder for the project architecture, click the stakeholder under the appropriate role and responsibility area. Click the **All R&Rs** tab. To include a role or responsibility in the role and responsibility area, check the checkbox to the left of the role or responsibility, or uncheck the checkbox to remove the role and responsibility from the area. Click the **Status** field to edit the status of that role or responsibility. Click the **Apply** button to accept the changes.
- **Step 12.** New roles and responsibilities for the Regional ITS Architecture or the project architecture can be added under the **All R&Rs** tab or the **Selected R&Rs** tab. Note that only roles and responsibilities for this specific role and responsibility area will appear under the **Selected R&Rs** tab. **Important:** Be aware that editing a role and responsibility is a change that will occur for the entire Regional ITS Architecture, not just a specific role and responsibility area or a project architecture. If necessary, create a new role and responsibility.
- **Step 13.** Save the Regional ITS Architecture information by selecting **File -> Save**. To use a new name for the Turbo Architecture database, select **File -> Save As** instead. A new window will open. Select a directory to save the Turbo Architecture file in, and type in the new filename. Click the **Save** button.

4.4 Define Functional Requirements

The functional requirements define the tasks or activities that are performed by each ITS element in the region. The functional requirements document the work that each ITS element will do to provide the ITS services defined for the regional ITS architecture and the project architecture.

4.4.1 Identify Functional Requirements

The objective of this step is to define a set of high level functional requirements for each of the major elements of the architecture. This step is usually done later in the development process once a set of interfaces have been defined.

- Once there are a well-defined set of Service Packages and elements, use Turbo to AutoSelect a set of functional areas.
- Element by element, select requirements, review the individual requirements, and identify those that apply. In some cases you will need to edit the requirements.

4.4.2 Enter Functional Requirements for a Regional ITS Architecture

In Turbo Architecture, high level functional requirements information for a Regional ITS Architecture are entered in the **Requirements** tab (See **Figure 20**).

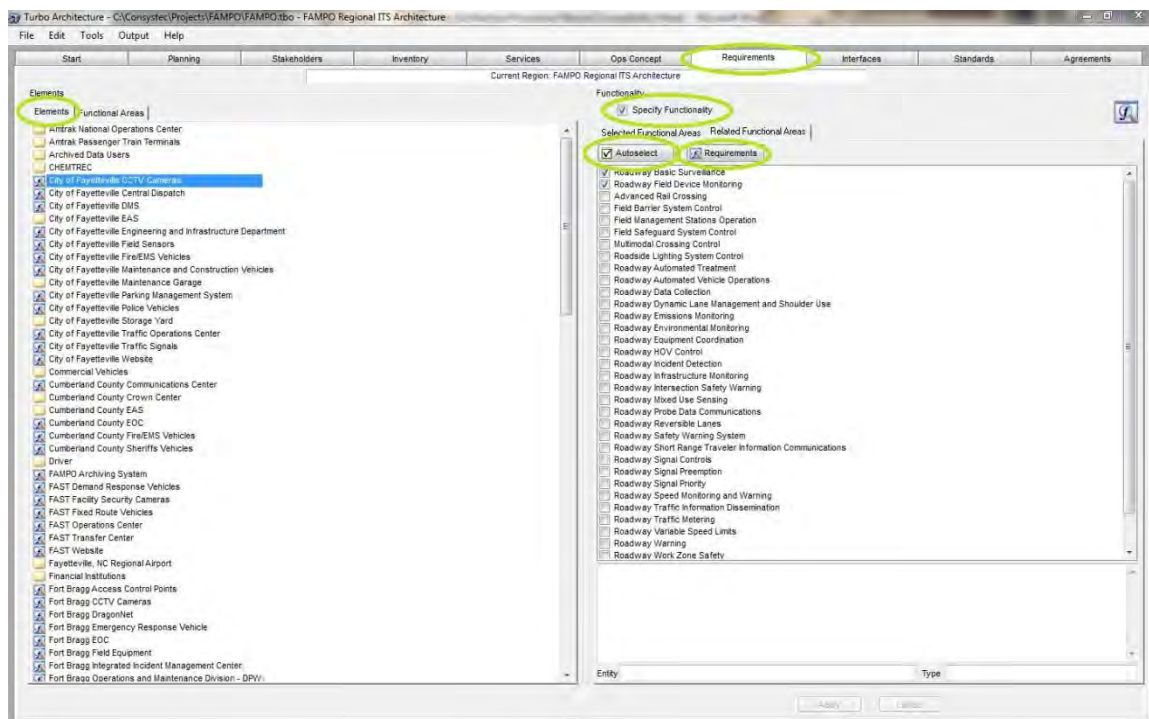


Figure 20. Requirements Tab

- **Step 1.** Open the Turbo Architecture database for the Regional ITS Architecture that you wish to add functional requirements for by selecting **File -> Open**. A new window will open. Navigate to the directory containing the Turbo Architecture file. Select the file, and then click the **Open** button.
- **Step 2.** Click the **Requirements** tab, to access the functional requirements information page for the architecture.
- **Step 3.** Click the **Elements** tab.
- **Step 4.** Click the **Autoselect** button. A new window will appear (See **Figure 21**). Autoselect allows Turbo Architecture to select functional areas for each element in the Regional ITS Architecture based on what elements have been assigned to what ITS services and what

subsystem an ITS element is mapped to. Each functional area is a high level functional definition, consisting of more detailed functional requirements. At this time, focus on the functional area.

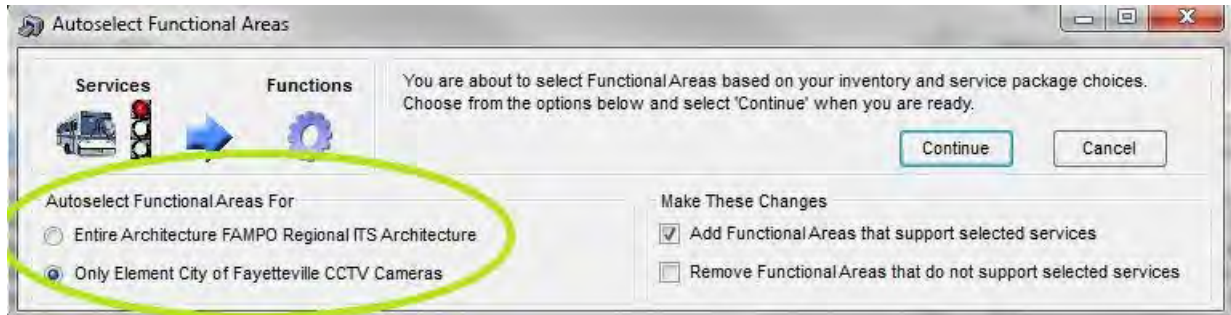


Figure 21. Autoselect Functional Areas Window

- **Step 5.** On the left of the **Autoselect Functional Areas** window, select whether the functional areas should be selected for the entire architecture or for only the selected specific ITS element. On the right, select whether Turbo Architecture is allowed to make suggestions that “Add Functional Areas” or “Remove Functional Areas” from ITS elements.
- **Step 6.** Click the **Continue** button.
- **Step 7.** Turbo Architecture will review each selected element and make suggestions on functional areas. Upon reviewing the suggested changes, click the **Yes** button to accept the suggestions or click the **No** button to ignore the suggestions. Click the **Continue** or **Close** button.
- **Step 8.** Click the **Elements** tab.
- **Step 9.** Select an element in the **Elements** tab.
- **Step 10.** Click the **Related Functional Areas** tab and review the functional areas selected. Check or uncheck the checkbox next to each functional area as appropriate.
- **Step 11.** Click the **Requirements** button to review the potential detailed functional requirements for that specific element. A new window will appear (See **Figure 22**).

Functional Requirements

City of Fayetteville CCTV Cameras

All

Limit Sort Present

City of Fayetteville CCTV Cameras - All Requirements (10 Entries)

Functional Area	Number	Requirement	Status	Include	Tailored
Roadway Basic Surveillance	1	The field element shall collect, process, digitize, and send traffic sensor data (speed, volume, and occupancy) to the center for further analysis and storage, under center control.	Planned	☒	☐
	2	The field element shall collect, process, and send traffic images to the center for further analysis and distribution.	Planned	☒	☐
	3	The field element shall collect, digitize, and send multimodal crossing and high occupancy vehicle (HOV) lane sensor data to the center for further analysis and storage.	Not Planned	☒	☐
	4	The field element shall return sensor and CCTV system operational status to the controlling center.	Planned	☒	☐
	5	The field element shall return sensor and CCTV system fault data to the controlling center for repair.	Planned	☒	☐
Roadway Field Device Monitoring	1	The field element shall monitor the operational status (state of the device, configuration, and fault data) of connected sensors (such as traffic, infrastructure, environmental, security, speed) and devices (such as highway advisory radio, dynamic message signs, automated roadway treatment systems, barrier and safeguard systems, cameras, traffic signals, ramp meters, short range communications equipment, security surveillance equipment).	Planned	☒	☐

New Tailor Delete Apply Close

Figure 22. Functional Requirements Window - Regional

- **Step 12.** Edit each requirement listed for the ITS element. If a requirement is applicable for that element for the region, check the checkbox in the **Include** column. Update the **Status** field if necessary. Click the **Apply** button to accept the changes.
- **Step 13.** To add a new requirement for an element, click the **New** button. A new window will appear (See **Figure 23**). Click the **Functional Area** field to select the functional area that this requirement applies to, and then click the **Requirement** field to enter the requirements text. Select if the requirement applies to only that one element or may apply to other elements. Click the **Apply** button.
- **Step 14.** Optionally, to tailor a requirement for an element, select the requirements and click the **Tailor** button. A new window will appear similar to the New Functional Requirement window (See **Figure 23**). Click the **Functional Area** field to select the functional area that this requirement applies to (normally this isn't changed since you are tailoring a requirement in a specific functional area), then click the **Requirement** field to tailor the requirements text. Select if the requirement applies to only that one element or may apply to other elements. Click the **Apply** button.



Figure 23. New Functional Requirement Window

- **Step 14.** Optionally, to tailor a requirement for an element, select the requirements and click the **Tailor** button. A new window will appear similar to the New Functional Requirement window (See **Figure 23**). Click the **Functional Area** field to select the functional area that this requirement applies to (normally this isn't changed since you are tailoring a requirement in a specific functional area), then click the **Requirement** field to tailor the requirements text. Select if the requirement applies to only that one element or may apply to other elements. Click the **Apply** button.
- **Step 15.** Click the **Close** button to accept the detailed functional requirements for this ITS element.
- **Step 16.** Save the Regional ITS Architecture information by selecting **File -> Save**. To use a new name for the Turbo Architecture database, select **File -> Save As** instead. A new window will open. Select a directory to save the Turbo Architecture file in, and type in the new filename. Click the **Save** button.

4.4.3 Edit Functional Requirements for a Regional ITS Architecture

In Turbo Architecture, high level functional requirements information for a Regional ITS Architecture are entered in the **Requirements** tab (See **Figure 20**).

- **Step 1.** Open the Turbo Architecture database for the Regional ITS Architecture that you wish to edit the requirements for by selecting **File -> Open**. A new window will open. Navigate to the directory containing the Turbo Architecture file. Select the file, and then click the **Open** button.

- **Step 2.** Click the **Requirements** tab, to access the functional requirements information page for the architecture.
- **Step 3.** Click the **Elements** tab.
- **Step 4.** If changes were made to the mapping of ITS Elements, or to the ITS Services, it may be necessary to update the selection of functional areas for the Regional ITS Architecture. To update the functional areas, click the **Autoselect** button. A new window will appear (See **Figure 21**).
- **Step 5.** On the left of the new window, select whether the functional areas should be selected for the entire architecture or for only the selected specific ITS element. On the right, select whether Turbo Architecture is allowed to make suggestions that “Add Functional Areas” or “Remove Functional Areas” from ITS elements.
- **Step 6.** Click the **Continue** button.
- **Step 7.** Turbo Architecture will review each selected element and make suggestions on functional areas. Upon reviewing the suggested changes, click the **Yes** button to accept the suggestions or click the **No** button to ignore the suggestions. Click the **Continue** or **Close** button.
- **Step 8.** Click the **Elements** tab.
- **Step 9.** Select an element in the **Elements** tab.
- **Step 10.** Click the **Related Functional Areas** tab and review the functional areas selected. Check or uncheck the checkbox next to each functional area as appropriate.
- **Step 11.** Click the **Requirements** button to review the potential detailed functional requirements for that specific element. A new window will appear (See **Figure 22**).
- **Step 12.** Edit each requirement listed for the ITS element. If a requirement is applicable for that element for the region, check the checkbox in the **Include** column. Update the **Status** field if necessary. Click the **Apply** button to accept the changes.
- **Step 13.** To add a new requirement for an element, click the **New** button. A new window will appear (See **Figure 23**). Click the **Functional Area** field to select the functional area that this requirement applies to, and then click the **Requirement** field to enter the requirements text. Select if the requirement applies to only that one element or may apply to other elements. Click the **Apply** button.
- **Step 14.** Optionally, to tailor a requirement for an element, click the **Tailor** button. A new window will appear similar to the New Functional Requirement window (See **Figure 23**). Click the **Functional Area** field to select the functional area that this requirement applies to, and

then click the **Requirement** field to enter the requirements text. Select if the requirement applies to only that one element or may apply to other elements. Click the **Apply** button.

- **Step 15.** Click the **Close** button to accept the detailed functional requirements for this ITS element.
- **Step 16.** Save the Regional ITS Architecture information by selecting **File -> Save**. To use a new name for the Turbo Architecture database, select **File -> Save As** instead. A new window will open. Select a directory to save the Turbo Architecture file in, and type in the new filename. Click the **Save** button.

4.4.4 Edit Functional Requirements for a Project Architecture

In Turbo Architecture, high level functional requirements information for a project architecture are entered in the **Requirements** tab (See **Figure 20**).

- **Step 1.** Open the Turbo Architecture database for the Regional ITS Architecture that you wish to edit the requirements for by selecting **File -> Open**. A new window will open. Navigate to the directory containing the Turbo Architecture file. Select the file, and then click the **Open** button.
- **Step 2.** Click the **Start** tab and select the appropriate project architecture in the **Architectures: Project** section.
- **Step 3.** Click the **Requirements** tab, to access the functional requirements information page for the architecture.
- **Step 4.** Click the **Elements** tab.
- **Step 5.** For a new project architecture, or if changes were made to the mapping of ITS elements or ITS services, it may be necessary to update the selection of functional areas for the project architecture. To update the functional areas, click the **Autoselect** button. A new window will appear (See **Figure 21**).
- **Step 6.** On the left of the new window, select whether the functional areas should be selected for the entire architecture or for only the selected specific ITS element. On the right, select whether Turbo Architecture is allowed to make suggestions that “Add Functional Areas” or “Remove Functional Areas” from ITS elements.
- **Step 7.** Click the **Continue** button.
- **Step 8.** Turbo Architecture will review each selected element and make suggestions on functional areas. Upon reviewing the suggested changes, click the **Yes** button to accept the suggestions or click the **No** button to ignore the suggestions. Click the **Continue** or **Close** button.

- **Step 9.** Click the **Elements** tab.
- **Step 10.** Select an element in the **Elements** tab.
- **Step 11.** Click the **Related Functional Areas** tab and review the functional areas selected. Check or uncheck the checkbox next to each functional area as appropriate.
- **Step 12.** Click the **Requirements** button to review the potential detailed functional requirements for that specific element. A new window will appear (See **Figure 24**).

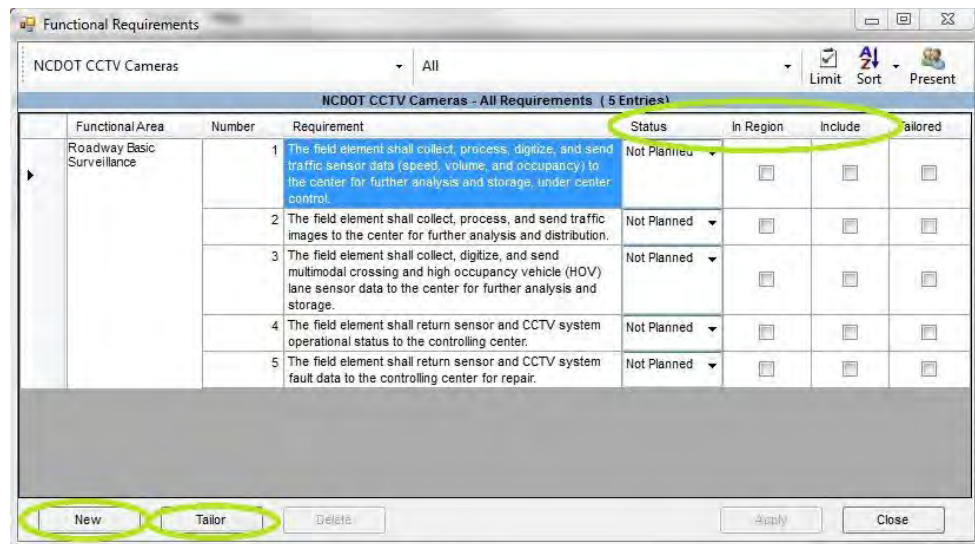


Figure 24. Functional Requirements Window - Project

- **Step 13.** Edit each requirement listed for the ITS element. If a requirement is applicable for that element for the project, check the checkbox in the **Include** column. Update the **Status** field if necessary. Click the **Apply** button to accept the changes.
- **Step 14.** To add a new requirement for an element, click the **New** button. A new window will appear (See **Figure 23**). Click the **Functional Area** field to select the functional area that this requirement applies to, and then click the **Requirement** field to enter the requirements text. Select if the requirement applies to only that one element or may apply to other elements. Click the **Apply** button.
- **Step 15.** Optionally, to tailor a requirement for an element, click the **Tailor** button. A new window will appear similar to the New Functional Requirement window (See **Figure 23**). Click the **Functional Area** field to select the functional area that this requirement applies to, and then click the **Requirement** field to enter the requirements text. Select if the requirement applies to only that one element or may apply to other elements. Click the **Apply** button.
- **Step 16.** Click the **Close** button to accept the detailed functional requirements for this ITS element.

- **Step 17.** Save the Regional ITS Architecture information by selecting **File -> Save**. To use a new name for the Turbo Architecture database, select **File -> Save As** instead. A new window will open. Select a directory to save the Turbo Architecture file in, and type in the new filename. Click the **Save** button.

5 Defining Interfaces

The third step of the Regional ITS Architecture development process is defining the interfaces. At this point, the ITS services desired for the region and the ITS elements necessary to provide those ITS services have been identified. This step determines what ITS elements have to be interconnected and what information must be shared between those ITS elements to provide those ITS services. The interface definitions should build on the operational concepts defined in the previous step.

With this step:

- The interconnects and information flows between ITS elements necessary to provide the desired ITS services and support the operational concepts will be defined, satisfying the sixth component of the Final Rule/FTA Policy, *Interface Requirements*.

5.1 Define Interconnects and Flows

The objective of this step is to define the interconnects and interfaces for the architecture. The interfaces represent the most detailed view of what information elements share with each other.

- Following the entry of services (and the elements involved in the services), go to the Interfaces tab and perform a Build on the architecture. Use a Moderate setting on the Flow Selection portion of the Settings. This build will create an initial set of interconnects and information flows for the architecture. The Moderate setting will only add the interface if both elements are mapped to a particular Service Package that contains the information flow.
- Review the interfaces for each element by selecting a single element on the top left of the interfaces tab. Remove any obvious incorrect interfaces and add any ones that are clearly missing. This creates a pretty good first cut at interfaces.
- One of the key challenges of architecture review is to give stakeholders something they can understand and comment on. One of the best ways to do this is to create a set of customized Service Package diagrams out of Turbo. To do this follow the following steps:
 - **Step 1.** Select **Outputs -> Diagram -> Flow->**
 - **Step 2.** Select **Filters-> Service Packages (SP) -> Show only this Service Package** and select a single MP.
 - **Step 3.** Preview the MP. If it involves more than six to eight elements, the diagram will be very hard to review, so you need to break it into multiple diagrams. Do this by

identifying two or more elements that are key to a service (e.g. the North Carolina State Data Warehouse for the AD1 SP). Open Elements tab and select just that element. Also check the Show all Interfaces box. This will give you all interfaces to the selected element that are a part of the selected Service Package.

- **Step 4.** Save the file and repeat for all the MPs and key elements as needed.
- The result of these steps will be to create a large set of MP diagrams. The suggestion is to sort them by stakeholder or by MP depending on how you plan on reviewing them with the stakeholders. If the review will be one-on-one with each key stakeholder, then creating a package that will be just their diagrams is useful. If the review will be a group meeting with multiple stakeholders, then reviewing the interfaces by MP is probably the best choice.
- Following the review with the stakeholders, update the interfaces Tab in Turbo.

5.2 Add Interconnects and Flows to a New Regional ITS Architecture

In Turbo Architecture, both the interconnects and architecture flow information for a Regional TS Architecture are entered in the Interfaces tab (See **Figure 25**).

- **Step 1.** Open the Turbo Architecture database for the Regional ITS Architecture that you wish to edit the interfaces for by selecting **File -> Open**. A new window will open. Navigate to the directory containing the Turbo Architecture file. Select the file, and then click the **Open** button.
- **Step 2.** Click the **Interfaces** tab (See **Figure 25**), to access the interconnects and architecture flow information page for the architecture.
- **Step 3.** Click the **Build** button. A new window will appear (See **Figure 26**).

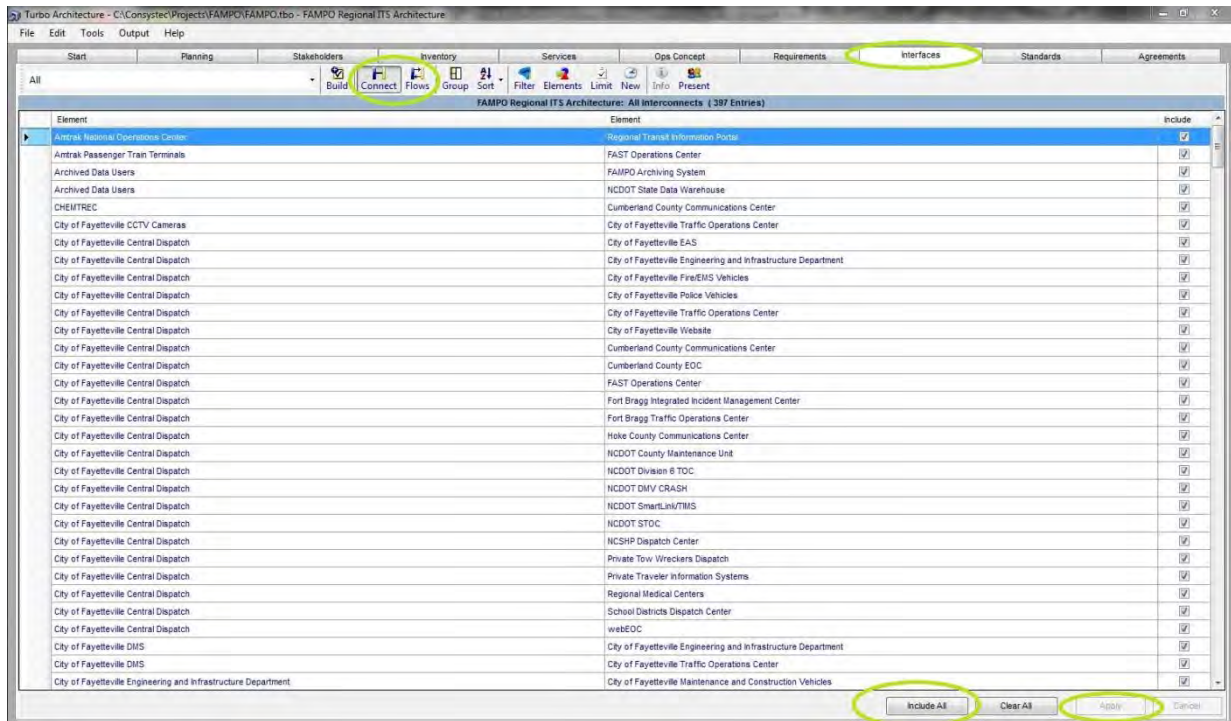


Figure 25. Interface Tab

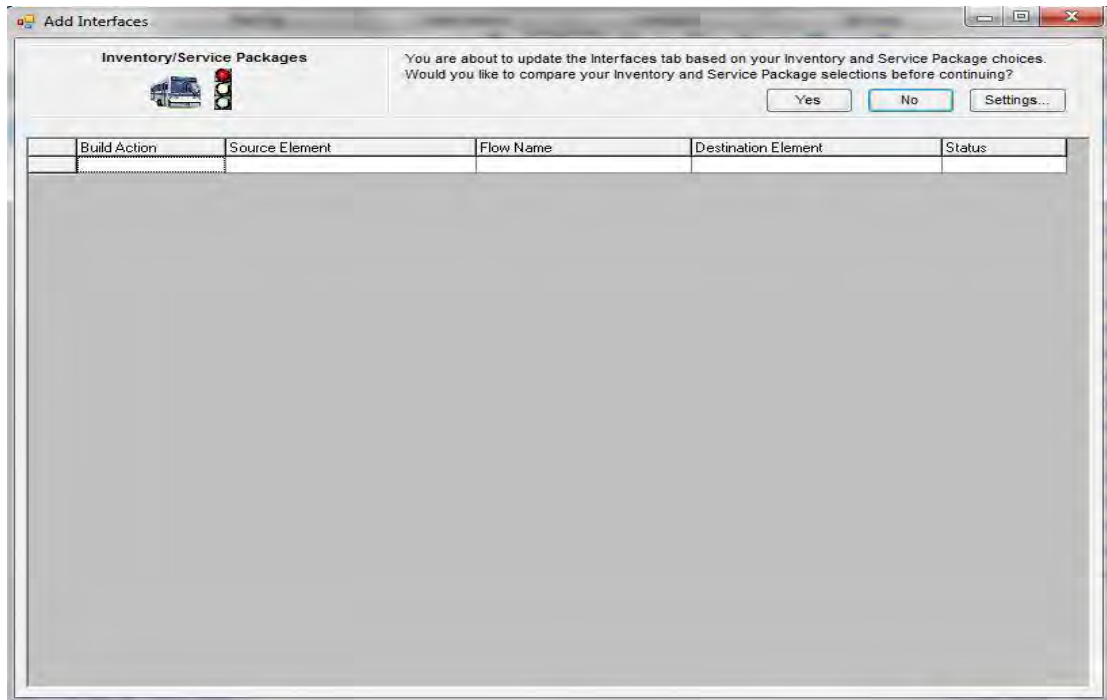


Figure 26. Add Interfaces Window

- **Step 4.** Click the **Settings** button. A new window will appear (See **Figure 27**).

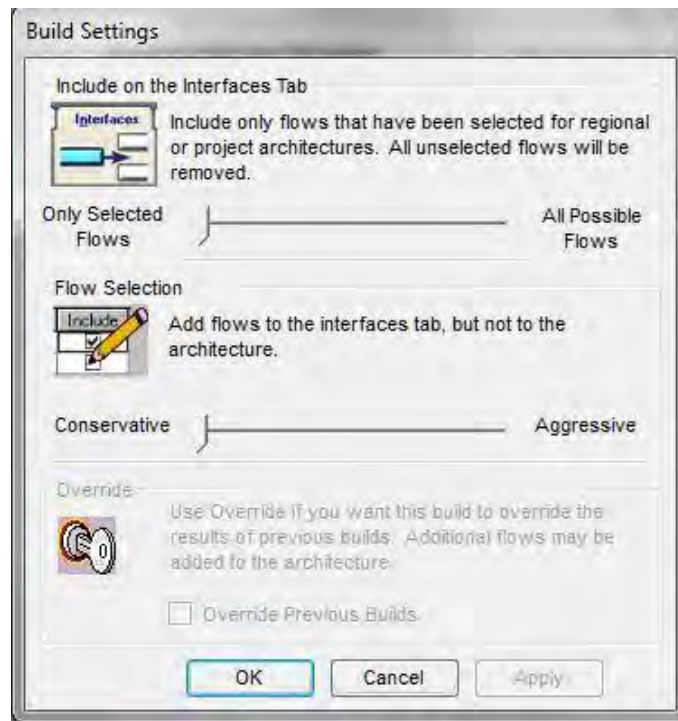


Figure 27. Build Settings Window

- **Step 5.** Select the settings for **Include on the Interfaces Tab** and **Flow Selection**. See the *Turbo Architecture User's Manual*, Section 3.7.1, for a description of the settings. When adding interfaces and architecture flows for the first time, a setting in the middle for both **Include on the Interfaces Tab** and **Flow Selection** is recommended. Other settings may be considered for comparison or informational purposes. A setting of the slider bar to the left will show the interfaces and flows to be added, but those interfaces and flows will **NOT** be added to the architecture. A setting of the slider bar to the right will add **ALL** possible interfaces and flows to the architecture.
- **Step 6.** Click the **Apply** button if changes have been made.
- **Step 7.** Click the **OK** button.
- **Step 8.** Turbo Architecture now returns to the **Add Interfaces** window. Click the **Yes** button to review a report that identifies any elements defined for the regional architecture, but which do not assigned to any Service Packages. . Or click the **No** button to skip the report.
- **Step 9.** The report, if selected, will open in a new window (See **Figure 28**). Click the **Print** button to print the report. Click the **Exit** button to exit the report preview window.

Entity Name	Type	Element Name
The following Element(s) are in the inventory, but do not participate in any of the selected Service Packages		
Map Update Provider	Terminator	NC OneMap
Emergency Management	Subsystem	NCDOT EIC
Equipment Repair Facility	Terminator	NCDOT Maintenance Garages
Surface Transportation Weather Service	Terminator	Private Road Weather Information Service Providers
Wayside Equipment	Terminator	Rail Wayside Equipment
Payment Administration	Subsystem	Regional Smart / Electronic Payment Card Clearinghouse
Other Payment Administration	Terminator	Regional Smart / Electronic Payment Card Clearinghouse
Service Package: (AD1) AD1-1 [Instance]		
Archived Data User Systems	Terminator	Archived Data Users
Roadway	Subsystem	NCDOT Count Stations
Emergency Management	Subsystem	NCDOT Division 6 TOC
Maintenance and Construction Management	Subsystem	NCDOT Division 6 TOC
Traffic Management	Subsystem	NCDOT Division 6 TOC
Archived Data Management	Subsystem	NCDOT State Data Warehouse
Information Service Provider	Subsystem	Private Traveler Information Systems

Figure 28. Recommended Interfaces Update Report

- **Step 10.** Click the **Yes** button to continue with the update to the Interfaces tab, click the **No** button to cancel the Build, or click the **Settings** button to change the Build settings.
- **Step 11.** If the **Yes** button was clicked in the previous step, Turbo Architecture will provide a list of the proposed changes to the architecture. Click the **Yes** button to make the changes to the architecture and the Interfaces tab, or click the **No** button to ignore the proposed changes.
- **Step 12.** If the **Yes** button was clicked in the previous step, Turbo Architecture will accept the proposed changes to the architecture. Click the **OK** button to exit the window.
- **Step 13.** Click the **Connect** button to review the interconnects defined for this architecture (See **Figure 29**). Check the checkbox under the **Include** column if the interconnect should be included in the architecture. Click the pulldown list, **Group**, **Sort**, **Filter**, **Elements**, or the **Limit** buttons to organize and arrange the list of interconnects. See the *Turbo Architecture User's Manual*, Section 3.7.2, for a description of the settings.

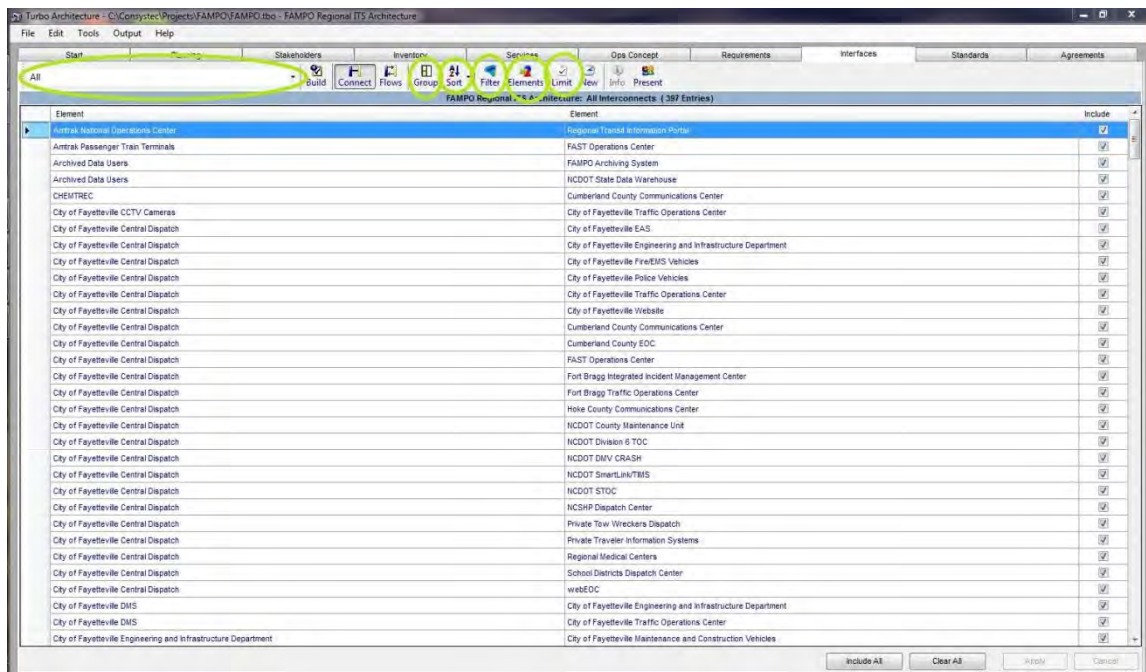


Figure 29. Interconnects - Regional

- **Step 14.** Click the **Apply** button to accept the changes to the interconnects.
- **Step 15.** Click the **Flow** button to review the architecture flows (See **Figure 30**). Check the checkbox under the **Include** column if the architecture flow should be included in the architecture. Under the **Status** column, select the status of the architecture flow. The status will generally be **Existing** or **Planned**. Click the pull-down list, **Group**, **Sort**, **Filter**, **Elements**, or the **Limit** buttons to organize and arrange the list of interconnects.
- **Step 16.** Click the **Apply** button to accept the changes to the architecture flows.
- **Step 17.** Save the Regional ITS Architecture information by selecting **File -> Save**. To use a new name for the Turbo Architecture database, select **File -> Save As** instead. A new window will open. Select a directory to save the Turbo Architecture file in, and type in the new filename. Click the **Save** button.

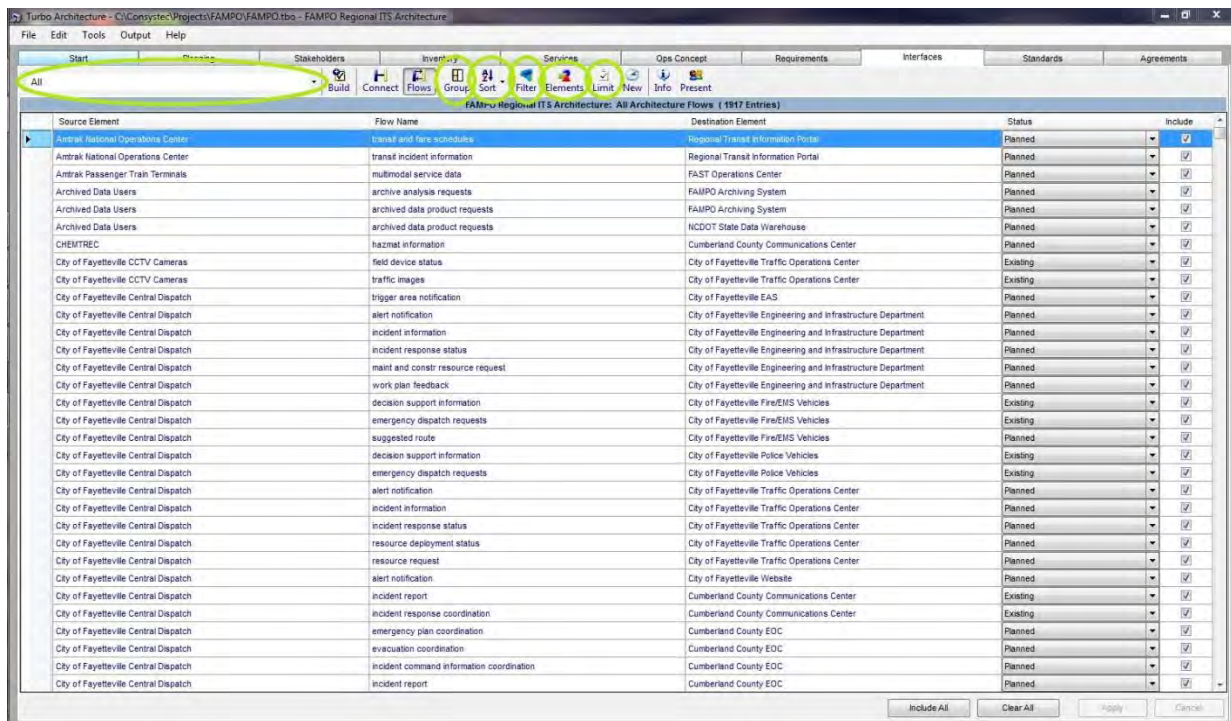


Figure 30. Architecture Flows - Regional

5.3 Edit Interconnects and Flows in a Regional ITS Architecture

In Turbo Architecture, both the interconnects and architecture flow information for a Regional ITS Architecture are edited in the Interfaces tab.

- **Step 1.** Open the Turbo Architecture database for the Regional ITS Architecture that you wish to edit the interfaces for by selecting **File -> Open**. A new window will open. Navigate to the directory containing the Turbo Architecture file. Select the file, and then click the **Open** button.
- **Step 2.** Click the **Interfaces** tab, to access the interconnects and architecture flow information page for the architecture.
- **Step 3.** Click the **Connect** button to review the interconnects defined for this architecture. Check the checkbox under the **Include** column if the interconnect should be included in the architecture. Click the pulldown list, **Group**, **Sort**, **Filter**, **Elements**, or the **Limit** buttons to organize and arrange the list of architecture flows. See the *Turbo Architecture User's Manual*, Section 3.7.2, for a description of the settings.
- **Step 4.** Click the **Apply** button to accept the changes to the interconnects.
- **Step 5.** Click the **Flow** button to review the architecture flows. Check the checkbox under the **Include** column if the architecture flow should be included in the architecture. Under the **Status** column, select the status of the architecture flow. The status will generally be **Existing** or **Planned**. Click the pulldown list, **Group**, **Sort**, **Filter**, **Elements**, or the **Limit** buttons to

organize and arrange the list of interconnects. See the *Turbo Architecture User's Manual*, Section 3.7.2, for a description of the settings.

- **Step 6.** Click the **Apply** button to accept the changes to the architecture flows.
- **Step 7.** Save the Regional ITS Architecture information by selecting **File -> Save**. To use a new name for the Turbo Architecture database, select **File -> Save As** instead. A new window will open. Select a directory to save the Turbo Architecture file in, and type in the new filename. Click the **Save** button.

5.4 Edit Interconnects and Flows in a Project Architecture

In Turbo Architecture, both the interconnects and architecture flow information for a project architecture are edited in the Interfaces tab.

- **Step 1.** Open the Turbo Architecture database for the Regional ITS Architecture that you wish to edit the interfaces for by selecting **File -> Open**. A new window will open. Navigate to the directory containing the Turbo Architecture file. Select the file, and then click the **Open** button.
- **Step 2.** Click the **Start** tab and select the appropriate project architecture in the **Architectures: Project** section.
- **Step 3.** Click the **Interfaces** tab, to access the interconnects and architecture flow information page for the project architecture.
- **Step 4.** Click the **Connect** button to review the interconnects defined for this project architecture (See **Figure 31**). Check the checkbox under the **Include** column if the interconnect should be included in the architecture. Click the pulldown list, **Group**, **Sort**, **Filter**, **Elements**, or the **Limit** buttons to organize and arrange the list of architecture flows. See the *Turbo Architecture User's Manual*, Section 3.7.3, for a description of the settings.



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6 Implementation Definition

The fourth step of the Regional ITS Architecture development process is the implementation. The purpose of the implementation step is to define several additional products that will bridge the gap between the Regional ITS Architecture and the deployment of ITS systems.

With this step:

- Existing ITS standards that may be applicable to the region during its implementation of ITS services will be identified, satisfying the fourth component of the Final Rule/FTA Policy, *Identification of ITS Standards*.
- The necessary agreements to implement the ITS services desired for the region will be identified, satisfying the fourth component of the Final Rule/FTA Policy, *Agreements Required for Implementation*.
- ITS projects will be created and staged to support and implement the ITS services identified for the region, satisfying the eighth component of the Final Rule/FTA Policy, *Sequence of Projects Required for Implementation*.

6.1 Identify ITS Standards

The definition of ITS standards is largely handled automatically by Turbo Architecture as part of the development process.

In Turbo Architecture, ITS standards information for a Regional ITS Architecture and project architectures are presented in the **Standards** tab (See **Figure 33**).

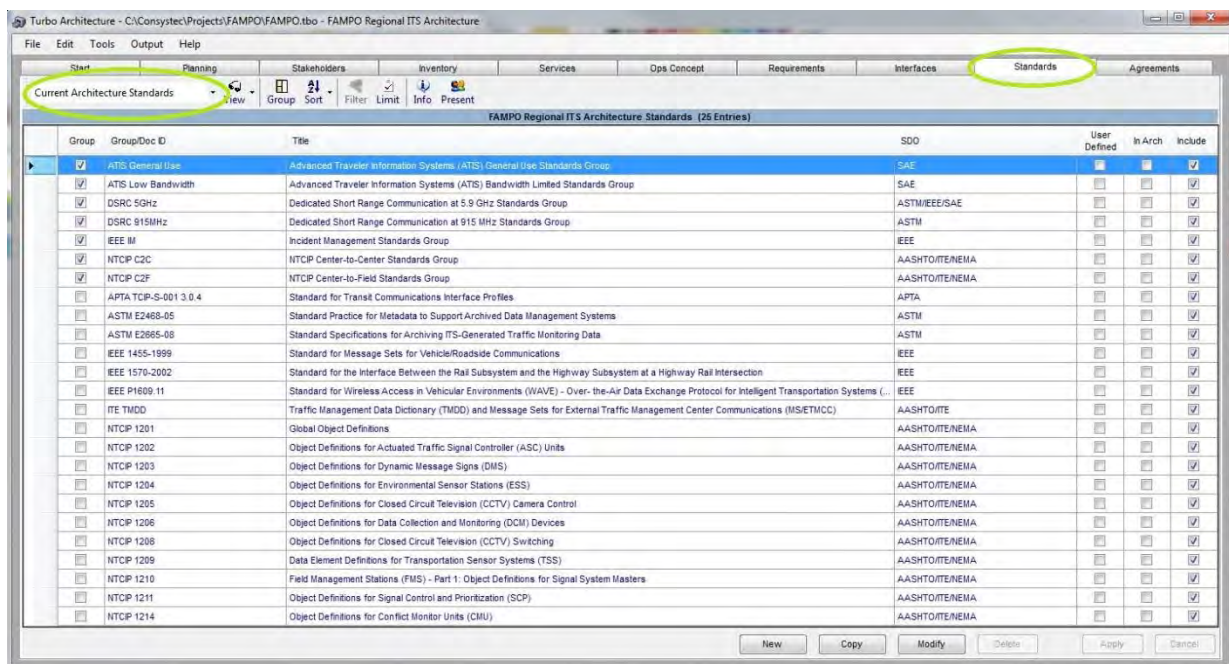


Figure 33. Standards Tab

6.1.1 Enter ITS Standards for a New Regional ITS Architecture

Turbo Architecture provides a page to add ITS Standards for a Regional ITS Architecture. This page can be accessed within Turbo Architecture by clicking the **Standards** tab. An ITS standard selected for a Regional ITS Architecture does not mean that the ITS Standard has to be implemented for the region, rather it means that the stakeholders in the region have agreed that deploying the ITS standard is desired, and should be considered when designing and deploying ITS projects. Whether the ITS standard will actually be deployed will depend on factors outside the Regional ITS Architecture, such as whether the ITS standard fulfills the project requirements or the costs associated with implementing the ITS standard.

- **Step 1.** Open the Turbo Architecture database for the Regional ITS Architecture that you wish to edit the ITS Standards for by selecting **File -> Open**. A new window will open. Navigate to the directory containing the Turbo Architecture file. Select the file, and then click the **Open** button.
- **Step 2.** Click the **Standards** tab to access the ITS Standards information page for the architecture.
- **Step 3.** Turbo Architecture initially selects those ITS Standards that may be applicable to the region, based on the architecture flows that have been selected in the previous step.
- **Step 4.** To view the ITS standards currently selected for the architecture, click the list field in the upper left hand corner of the page (See **Figure 33**), and select **Current Architecture Standards**. To remove an ITS Standard from the Regional ITS Architecture, uncheck the checkbox next to the ITS Standard under the **Include** column.
- **Step 5.** To view all the potential ITS standards available for the architecture, click the list field in the upper left hand corner of the page (See **Figure 33**), and select **All Standards**. To add an ITS standard to the Regional ITS Architecture, check the checkbox next to the ITS standard under the **InArch** column.
- **Step 6.** Turbo Architecture allows users to indicate which version of an ITS Standard to adopt and to add comments about an ITS standard. To edit the ITS standard, click the ITS standard and click the **Modify** button. A new window will appear (See **Figure 34**). In the **Version** field, enter what version of the ITS standard the region adopted. In the **Comment** field, enter any additional information about adopting the ITS standard.

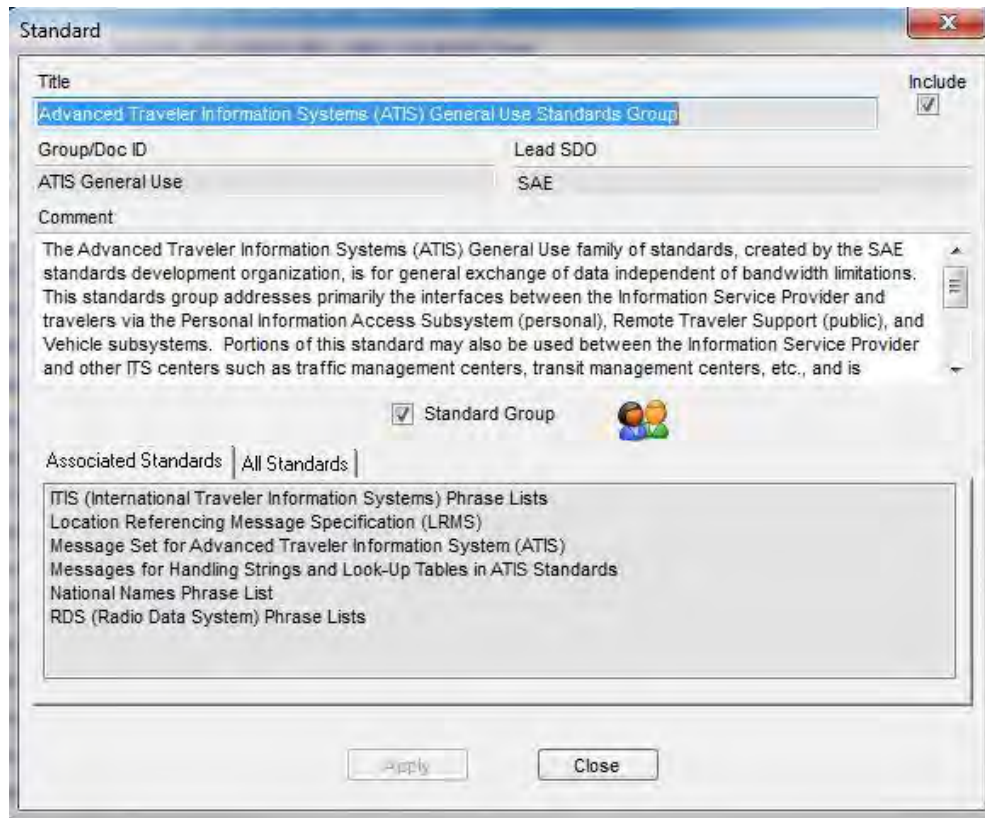


Figure 34. Edit ITS Standards Window

- **Step 7.** Directions to enter a new ITS standard for the Regional ITS Architecture can be found in Section 0.
- **Step 8.** Save the Regional ITS Architecture information by selecting **File -> Save**. To use a new name for the Turbo Architecture database, select **File -> Save As** instead. A new window will open. Select a directory to save the Turbo Architecture file in, and type in the new filename. Click the **Save** button.

6.1.2 Edit ITS Standards for a Regional ITS Architecture

Turbo Architecture provides a page to edit ITS Standards in a Regional ITS Architecture.

- **Step 1.** Open the Turbo Architecture database for the Regional ITS Architecture that you wish to edit the ITS standards for by selecting **File -> Open**. A new window will open. Navigate to the directory containing the Turbo Architecture file. Select the file, and then click the **Open** button.
- **Step 2.** Click the **Standards** tab to access the ITS standards information page for the architecture.

- **Step 3.** To view the ITS standards currently selected for the architecture, click the list field in the upper left hand corner of the page (See **Figure 33**), and select **Current Architecture Standards**. To remove an ITS standard from the Regional ITS Architecture, uncheck the checkbox next to the ITS Standard under the **Include** column.
- **Step 4.** To view all the potential ITS standards available for the architecture, click the list field in the upper left hand corner of the page (See **Figure 33**), and select **All Standards**. To add an ITS standard to the Regional ITS Architecture, check the checkbox next to the ITS standard under the **InArch** column.
- **Step 5.** Click the **Apply** button to accept the edits on this page.
- **Step 6.** Turbo Architecture allows users to indicate which version of an ITS standard to adopt and to add comments about an ITS standard. To edit the ITS standard, click the ITS standard and click the **Modify** button. A new window will appear (See **Figure 34**). In the **Version** field, enter what version of the ITS standard the region adopted. In the **Comment** field, enter any additional information about adopting the ITS standard.
- **Step 7.** To enter a new ITS standard for the Regional ITS Architecture, see Section 0.
- **Step 8.** To delete a user-defined ITS standard, select the ITS standard and click the **Delete** button.
- **Step 9.** Save the Regional ITS Architecture information by selecting **File -> Save**. To use a new name for the Turbo Architecture database, select **File -> Save As** instead. A new window will open. Select a directory to save the Turbo Architecture file in, and type in the new filename. Click the **Save** button.

6.1.3 Edit ITS Standards for a Project Architecture

Turbo Architecture provides a page to indicate the ITS standards that may applicable for a project architecture.

- **Step 1.** Open the Turbo Architecture database for the Regional ITS Architecture that you wish to edit the ITS Standards for by selecting **File -> Open**. A new window will open. Navigate to the directory containing the Turbo Architecture file. Select the file, and then click the **Open** button.
- **Step 2.** Click the **Start** tab and select the appropriate project architecture in the **Architectures: Project** section.
- **Step 3.** Click the **Standards** tab to access the ITS standards information page for the project architecture.

- **Step 4.** To view the ITS standards currently selected for the project architecture, click the list field in the upper left hand corner of the page (See **Figure 33**), and select **Current Architecture Standards**. To remove an ITS standard from the project architecture, uncheck the checkbox next to the ITS standard under the **Include** column.
- **Step 5.** To view all the potential ITS standards available for the project architecture, click the list field in the upper left hand corner of the page (See **Figure 33**), and select **All Standards**. To add an ITS standard to the project architecture, check the checkbox next to the ITS standard under the **In Arch** column.
- **Step 6.** Click the **Apply** button to accept the edits on this page.
- **Step 7.** Turbo Architecture allows users to indicate which version of an ITS standard to adopt and to add comments about an ITS standard. To edit the ITS standard, click the ITS standard and click the **Modify** button. A new window will appear (See **Figure 34**). In the **Version** field, enter what version of the ITS standard the region adopted. In the **Comment** field, enter any additional information about adopting the ITS standard.
- **Step 8.** To enter a new ITS standard for the project architecture, see Section 0.
- **Step 9.** To delete a user-defined ITS standard from the Regional ITS Architecture, select the ITS Standard and click the **Delete** button.
- **Step 10.** Save the Regional ITS Architecture information by selecting **File -> Save**. To use a new name for the Turbo Architecture database, select **File -> Save As** instead. A new window will open. Select a directory to save the Turbo Architecture file in, and type in the new filename. Click the **Save** button.

6.1.4 Add New ITS Standard to a Regional ITS Architecture

Turbo Architecture allows users to enter user defined ITS standards into the architecture. These ITS standards may be regional standards that have been agreed upon by the region (e.g., E-ZPass is a regional standard by the InterAgency Group). See the *Turbo Architecture User's Manual*, Section 3.8.1, for further information on adding a new ITS standard.

- **Step 1.** Open the Turbo Architecture database for the Regional ITS Architecture that you wish to edit the scope for by selecting **File -> Open**. A new window will open. Navigate to the directory containing the Turbo Architecture file. Select the file, and then click the **Open** button.
- **Step 2.** Click the **Standards** tab to access the ITS standards information page for the architecture.
- **Step 3.** To add a new ITS standard to the architecture, click the **New** button. Optionally, if the new ITS standard is similar to an existing ITS standard, select the existing ITS standard, click the **Copy** button to make a copy, then edit the copy of the ITS standard. A window will appear

asking, “**Have you considered other applicable ITS standards?**” Click the **Yes** button to continue and click the **No** button to exit. If the **Yes** button was clicked, a new window will appear (See **Figure 35**).

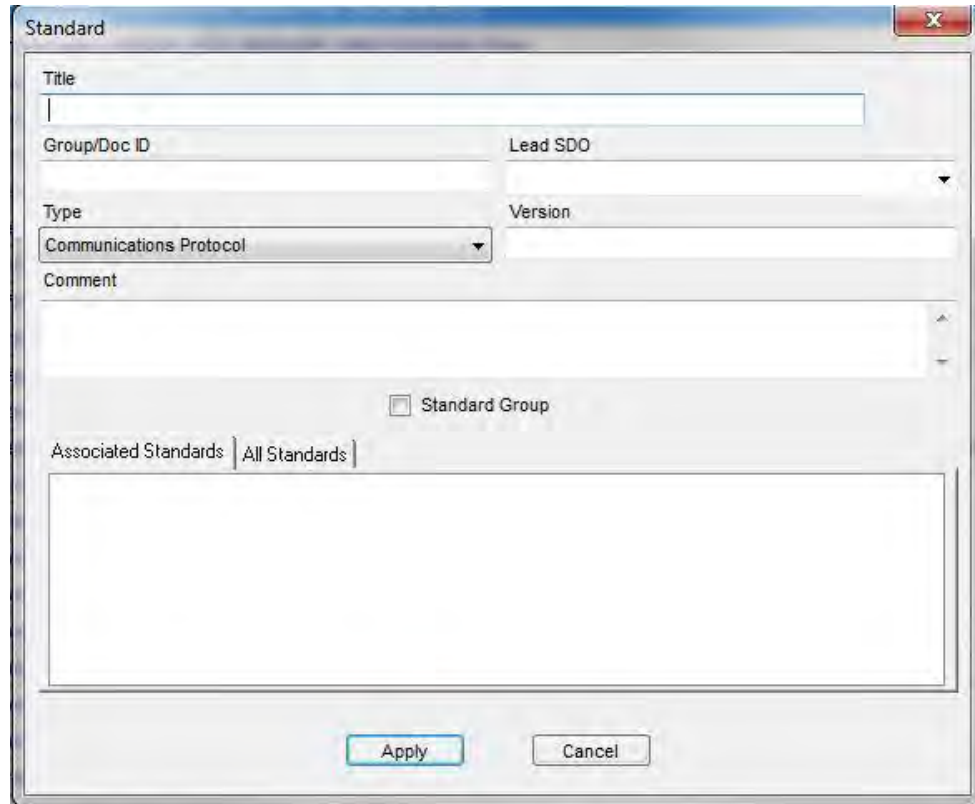


Figure 35. New ITS Standard Window

- **Step 4.** In the **Title** field, enter the name of the standard.
- **Step 5.** In the **Group/Doc ID** field, enter the standard document number or the name of the group if it is a group of standards (e.g., NTCIP is a group/family of standards).
- **Step 6.** In the **Lead SDO** field, enter the organization that oversees or is leading the standards effort (e.g., InterAgency Group is the lead group for E-ZPass). Click the field to see a list of organizations or enter a new organization.
- **Step 7.** In the **Type** field, select if the standard is a **Communications Protocol**, **Message/Data** or **Other**.
- **Step 8.** Click the **Apply** button to accept the edits on this page.
- **Step 9.** Save the Regional ITS Architecture information by selecting **File -> Save**. To use a new name for the Turbo Architecture database, select **File -> Save As** instead. A new window will open. Select a directory to save the Turbo Architecture file in, and type in the new filename. Click the **Save** button.

6.2 Develop List of Agency Agreements

The objective of this step is to identify current or planned agreements that will be used to facilitate the exchange of ITS information defined by the architecture. The identification of institutional agreements required is crucial to the development of a consensus architecture. Data exchanges between systems require agreements on the transmission protocol and data formats to ensure compatibility. Coordinating field device operations owned by different agencies require defined procedures for submitting message requests and rules governing when such requests can be honored. Such coordination can be done with informal arrangements such as a Memorandum of Understanding (MOU).

Sharing control of field devices operated by different agencies involves more liability issues, which require more formal agreements. Coordinated incident response may also require formal agreements and also requires group training of personnel from various agencies. While all interfaces involve agreements for data compatibility, agreements for procedure and operation as well as training can also be critical elements to optimizing the benefits of the architecture.

Turbo Architecture provides a page to document agreements for a Regional ITS Architecture and a project architecture. This page can be accessed within Turbo Architecture by clicking the **Agreements** tab (See Figure 36).

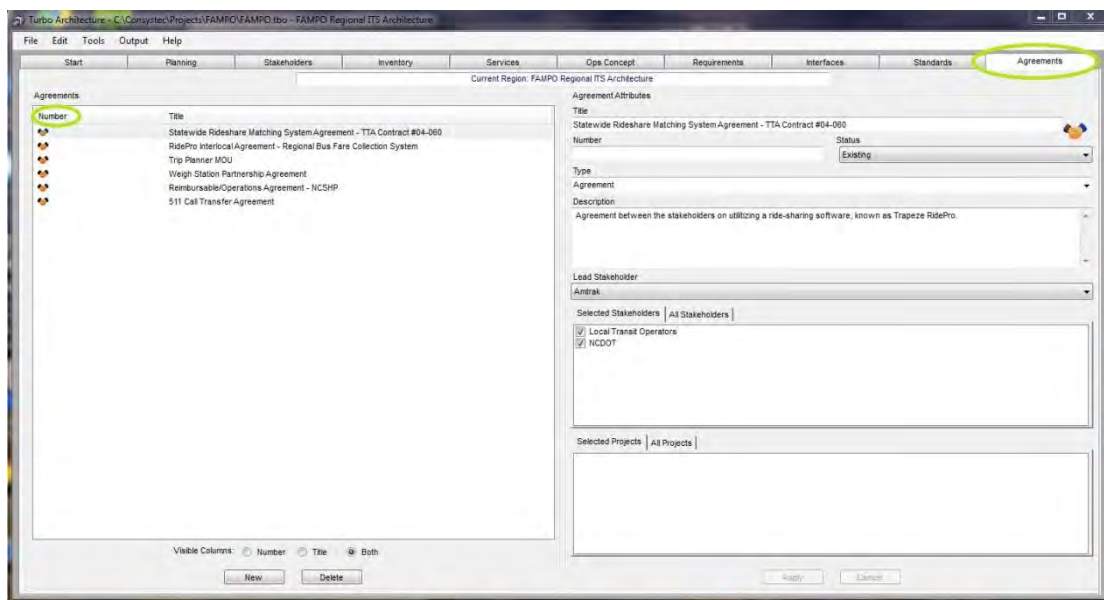


Figure 36. Agreements Tab

6.2.1 Enter Agreements for a Regional ITS Architecture

Turbo Architecture provides a page to document agreements for a Regional ITS Architecture. This page can be accessed within Turbo Architecture by clicking the **Agreements** tab.

- **Step 1.** Open the Turbo Architecture database for the Regional ITS Architecture that you wish to enter agreements for by selecting **File -> Open**. A new window will open. Navigate to the directory containing the Turbo Architecture file. Select the file, and then click the **Open** button.
- **Step 2.** Click the **Agreements** tab to access the agreements information page for the architecture.
- **Step 3.** Click the **New** button.
- **Step 4.** In the **Title** field, enter the name of the agreement.
- **Step 5.** In the **Number** field, type in the agreement number or any identifying information about the agreement.
- **Step 6.** In the **Status** field, select the status of the agreement. The status will generally be **Existing** or **Planned**. To edit or add a status type, (after clicking the Apply button) go to **Tools > Update Status**. See the *Turbo Architecture User's Manual*, Section 4.3, for further information on editing status attributes.
- **Step 7.** In the **Type** field, enter the type of agreement. Examples of types of agreements include Memorandum of Understanding (MOU), Master Agreements, Cooperative Agreements, and Operational Agreements. Click the field to see a list of agreements or enter a new agreement type.
- **Step 8.** In the **Description** field, enter a description about the agreement, including a summary of what the agreement covers.
- **Step 9.** In the **Lead Stakeholder** field, select the lead stakeholder for the agreement. The lead stakeholder may be executor
- **Step 10.** Click the **All Stakeholders** tab and check the checkbox next to each stakeholder that is part of the agreement.
- **Step 11.** Click the **All Projects** tab and check the checkbox next to each project architecture that is affected by that agreement.
- **Step 12.** Click the **Apply** button to accept all the edits on this page.
- **Step 13.** Save the Regional ITS Architecture information by selecting **File -> Save**. To use a new name for the Turbo Architecture database, select **File -> Save As** instead. A new window will open. Select a directory to save the Turbo Architecture file in, and type in the new filename. Click the **Save** button.

6.2.2 Edit Agreements for a Regional ITS Architecture

Turbo Architecture provides a page to document agreements for a Regional ITS Architecture. This page can be accessed within Turbo Architecture by clicking the **Agreements** tab.

- **Step 1.** Open the Turbo Architecture database for the Regional ITS Architecture that you wish to edit the agreements for by selecting **File -> Open**. A new window will open. Navigate to the directory containing the Turbo Architecture file. Select the file, and then click the **Open** button.
- **Step 2.** Click the **Agreements** tab to access the agreements information page for the architecture.
- **Step 3.** To add a new agreement, click the **New** button.
- **Step 4.** To delete an agreement, select the agreement in the **Agreements** field on the left side of the page, and then click the **Delete** button.
- **Step 5.** To edit an agreement, select the agreement in the **Agreements** field on the left side of the page. Click the **Title** field to edit the name of the agreement, click the **Number** field to edit the agreement number, click the **Status** field to edit the status of the agreement, click the **Type** field to edit the type of agreement, click the **Description** field to edit a description about the agreement, and click the **Lead Stakeholder** field to edit the lead stakeholder for the agreement. Click the **All Stakeholders** tab to edit which stakeholders are party to the agreement and click the **All Projects** tab to edit the ITS projects that are affected by the agreement.
- **Step 6.** Click the **Apply** button to accept all the edits on this page.
- **Step 7.** Save the Regional ITS Architecture information by selecting **File -> Save**. To use a new name for the Turbo Architecture database, select **File -> Save As** instead. A new window will open. Select a directory to save the Turbo Architecture file in, and type in the new filename. Click the **Save** button.

6.2.3 Edit Agreements for a Project Architecture

Turbo Architecture provides a page to document agreements for a project architecture. This page can be accessed within Turbo Architecture by clicking the **Agreements** tab.

- **Step 1.** Open the Turbo Architecture database for the Regional ITS Architecture that you wish to edit the agreements for by selecting **File -> Open**. A new window will open. Navigate to the directory containing the Turbo Architecture file. Select the file, and then click the **Open** button.
- **Step 2.** Click the **Start** tab and select the appropriate project architecture in the **Architectures: Project** section.
- **Step 3.** Click the **Agreements** tab to access the agreements information page for the architecture.

- **Step 4.** Click the **All Agreements** tab. Check the checkbox next to each agreement that affects the project. Uncheck the checkbox next any agreement that is not affected by the project.
- **Step 5.** To edit an agreement, select the agreement in the **Agreements** field on the left side of the page. Click the **Title** field to edit the name of the agreement, click the **Number** field to edit the agreement number, click the **Status** field to edit the status of the agreement, click the **Type** field to edit the type of agreement, click the **Description** field to edit a description about the agreement, and click the **Lead Stakeholder** field to edit the lead stakeholder for the agreement. Click the **All Stakeholders** tab to edit which stakeholders are party to the agreement and click the **All Projects** tab to edit the ITS projects that are affected by the agreement.
- **Step 6.** Click the **Apply** button to accept all the edits on this page.
- **Step 7.** Save the Regional ITS Architecture information by selecting **File -> Save**. To use a new name for the Turbo Architecture database, select **File -> Save As** instead. A new window will open. Select a directory to save the Turbo Architecture file in, and type in the new filename. Click the **Save** button.

6.3 Architecture Maintenance

The ITS Architecture developed for the FAMPO Region addresses the Region's vision for ITS implementation at the time the plan was developed. As the Region grows, needs will change, and, as technology progresses, new ITS opportunities will arise. Shifts in regional needs and focus as well as changes in the National ITS Architecture will necessitate that the FAMPO Regional ITS Architecture be updated to remain a useful resource for the Region.

6.3.1 Procedure for Submitting ITS Architecture Changes Between Scheduled Updates

Documentation for needed updates of the Regional ITS Architecture will need to be submitted to the maintainer of the regional ITS architectures, which is the NCDOT ITS Project Development Group. Between interim and full plan updates, administrative updates will be required to accommodate ITS projects deployed in the Region. For situations where a change to the Regional ITS Architecture is required, an ITS Architecture Maintenance Documentation Form has been developed and is included in *The SDP Maintenance Plan (2010)*, Appendix D. This form should be completed and submitted to NCDOT whenever a change is proposed.

The Maintenance Change Request Form identifies three levels of modifications. They include:

- Level 1 – Basic changes that do not affect the structure of the architecture

Examples include: Changes to stakeholder or element name, element status, or data flow status.

- Level 2 – Structural changes that impact only one agency

Examples include: Addition of a new Service Package or modifications to an existing Service Package that affects only one agency.

- Level 3 – Structural changes that have the potential to impact multiple agencies

Examples include: Addition of a new Service Package or modifications to an existing Service Package that involves multiple agencies or incorporation of a new stakeholder into the architecture.

In the process of documenting the change, the stakeholder proposing the change and FAMPO should contact all agencies that will be impacted to obtain feedback. The defined architecture review committee will review and accept the proposed changes when they are submitted and incorporate the changes into the Service Package diagrams and Turbo Architecture database. Most interim changes will not impact the Regional ITS Architecture document. If an interim change does impact the document, the committee will decide whether or not the change is significant enough to require an immediate update, or if the change can simply be documented for incorporation during the next complete update.

6.3.2 Maintenance of Baseline Documents

The NCDOT will be responsible for maintaining the official baseline documents for the regional ITS architecture. The following items are the components of the architecture baseline.

- Regional ITS Architecture Document
- Set of Customized Service Packages
- Turbo Architecture Database

The official Regional ITS Architecture document, in Microsoft Word format, will be held by the NCDOT and a PDF version of the document will be available for general distribution. A version number and date will be included on the cover page.

The customized Service Packages, Turbo Architecture database and other baseline components also will be held and maintained by the NCDOT. Each document will use a versioning scheme that identifies the baseline and revision number. For example, since this architecture is an update of the initial release of the FAMPO Regional ITS Architecture, the documents at the conclusion of this effort will be version 1.00. Minor revisions will be 1.01, 1.02, etc. The next full update to the document will be version 2.00.

Table 1 summarizes the components of the Regional ITS Architecture and identifies the current version at the completion and release of this document. This table should be updated any time an interim update to the architecture document is performed.

Table 1. Summary of Baseline Architecture Components

Architecture Component	Format	Version at Completion of Update
Architecture Document	Microsoft Word (.doc)	1.0
Customized Service Package Diagrams	Microsoft Visio (.vsd)	1.0
Turbo Architecture Database	Turbo Database (.tbo)	1.0

When completing the change form, the requesting agency should identify the baseline document versions that they are intending to modify to reduce the potential for confusion.

6.4 Define Project Sequencing

One of the key outputs of a Regional ITS Architecture development is a list of regional projects with ITS.

Stakeholders should develop a prioritized list of projects for planned ITS deployments. Map each project to one or more Service Packages as an initial mapping into the architecture. This can be accomplished by one of the following methods:

- Option 1: Add each ITS project to the Turbo file as a project architecture, selecting elements, operational concept, services, interfaces, and functional requirements as appropriate from the Regional ITS Architecture. The project sequencing can be determined by looking at or editing the **Timeframe** field in the **Start** tab.
- Option 2: Include information about architecture mapping, stakeholders, etc in a table in the architecture document.

7 Developing Project Systems Engineering Analyses

Section 940.11 of the Final Rule/Final Policy requires that projects containing ITS that use federal funds must perform a Systems Engineering Analysis to qualify for funding. The systems engineering analysis must minimally include the following seven requirements:

- How project fits into regional architecture
- Roles/responsibilities of participants
- Requirements definition
- Analysis of alternative systems & technologies
- Procurement options
- ITS standards and testing procedures
- Procedures and resources for Operations and Maintenance (O&M)

This section provides a little more detail about each of the seven requirements, and if applicable, describes how Turbo Architecture can be used to extract information that satisfies three of these requirements and part of another requirement. NCDOT has developed a checklist as part of their System Engineering Process (see **Appendix A**) that can be used as a resource to identify other documents and reports that will satisfy the remaining requirements.

7.1 How the Project fits into the Regional Architecture

What portions of the Regional ITS Architecture describe the ITS project? The Turbo Architecture application and database provides this information in the form of reports and

diagrams. The procedures below assumes that a project architecture has been created for the ITS project in the Regional ITS Architecture database.

The description of how the project fits into the Regional ITS Architecture should contain three types of information, all of which can be found in the Turbo Architecture database:

- Inventory
- Services
- Interfaces

7.1.1 Print Inventory Reports

Turbo Architecture allows a user to print an inventory report for a project architecture.

- **Step 1.** Open the Turbo Architecture database for the Regional ITS Architecture that the project architecture exists in by selecting **File -> Open**. A new window will open. Navigate to the directory containing the Turbo Architecture file. Select the file, and then click the **Open** button.
- **Step 2.** Click the **Start** tab and select the appropriate project architecture in the **Architectures: Project** section.
- **Step 3.** Select **Output -> Reports**, or type **Ctrl+R**. A new window will appear (See **Figure 37**).

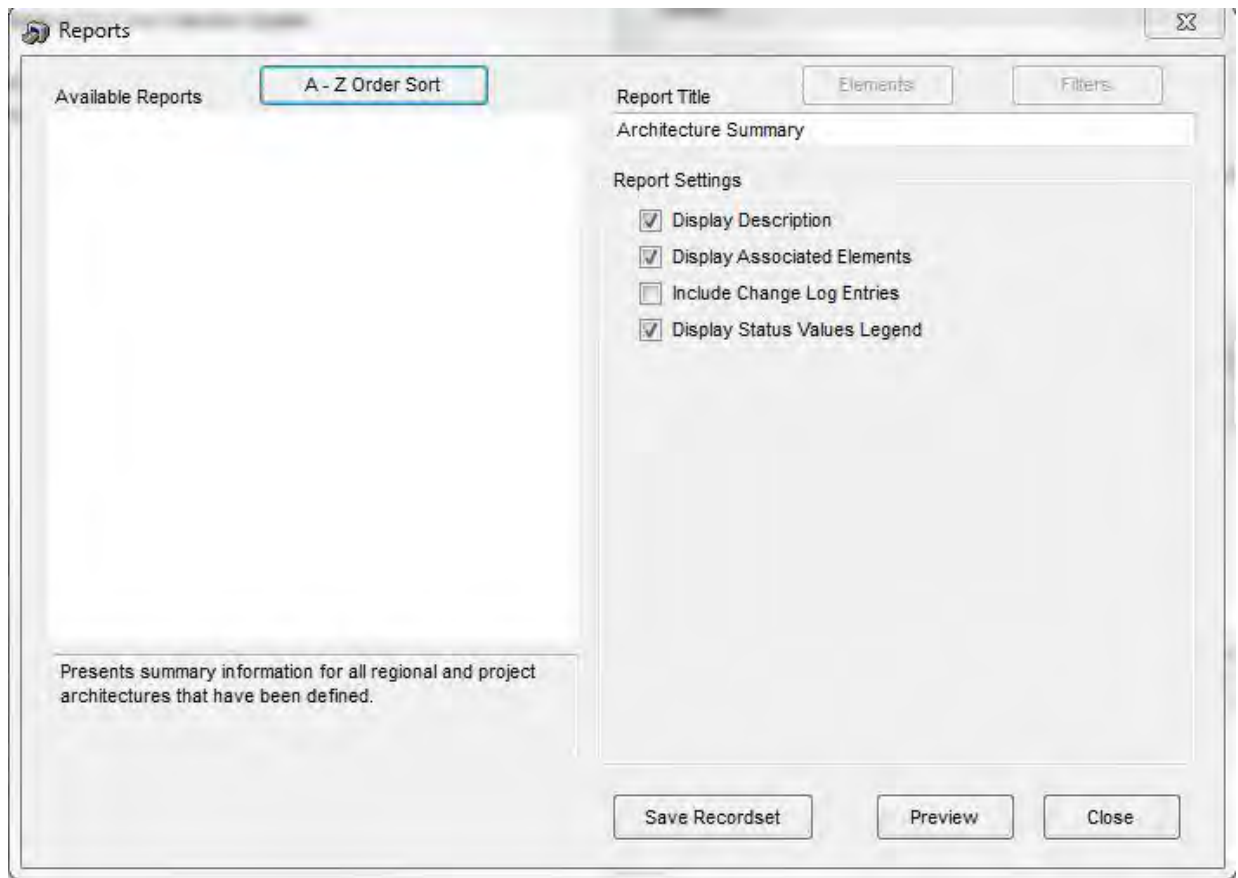


Figure 37. Reports Window

- **Step 4.** Select the **Inventory** report.
- **Step 5.** Click the **Elements** button to indicate which ITS elements should be included in the report. A new window will appear (See **Figure 38**). To select only those ITS elements that have been defined to be part of the project architecture, click the **Project Elements** button. Click the **OK** button.

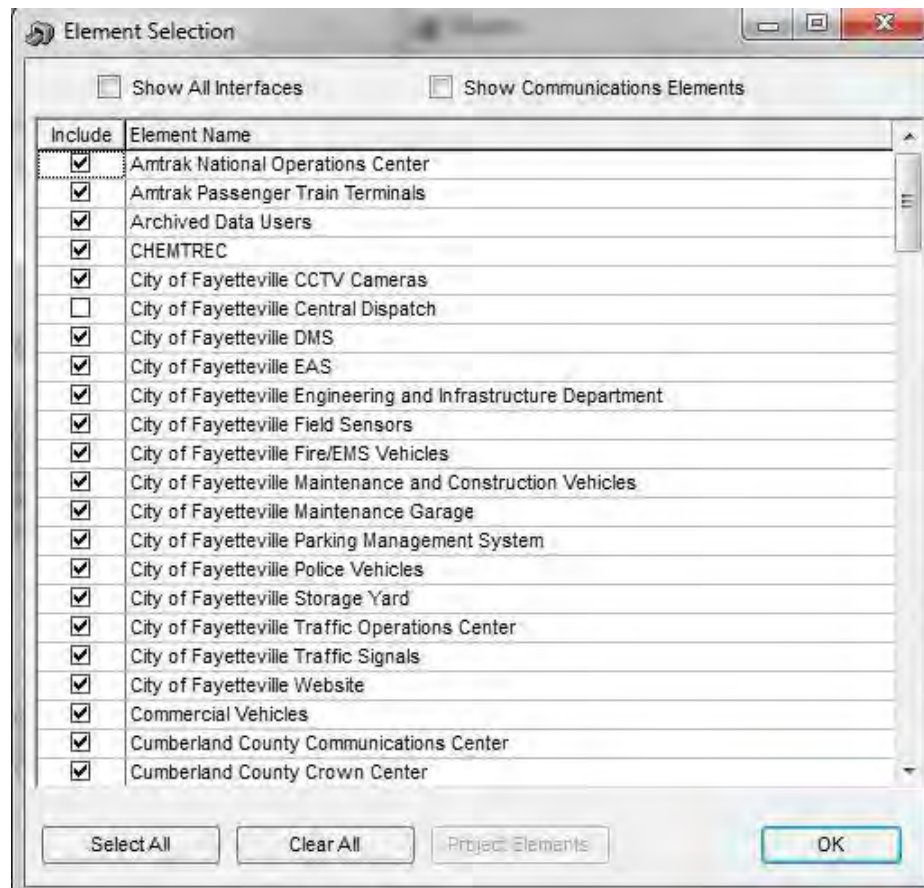


Figure 38. Turbo Architecture - Element Selection Window

- **Step 6.** Back in the **Reports** window, click the **Filters** button to limit the data or types that is included in the reports. See the *Turbo Architecture User's Manual*, Section 4.4.1, for further information on using filters. A new window will appear (See **Figure 39**). Click the **Apply** button to apply any changes to the filter. Click the **Ok** button to exit the Filters window.

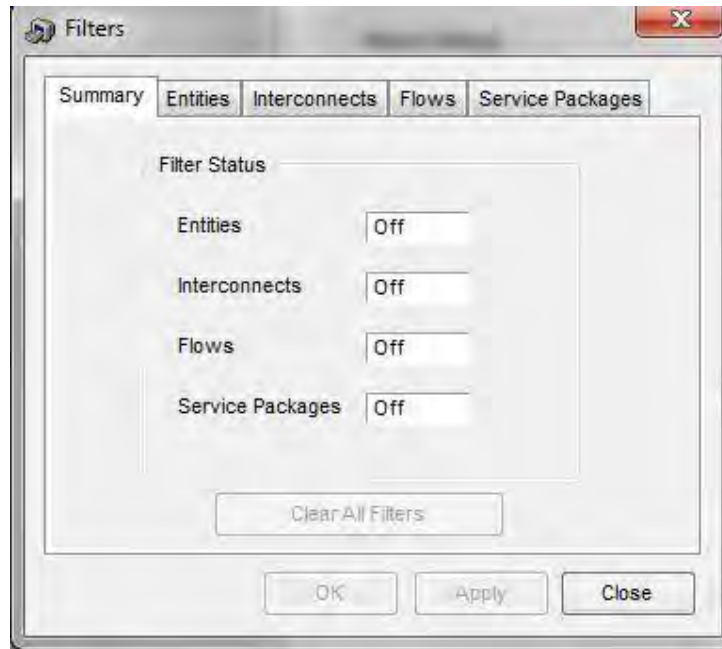


Figure 39. Filters Window

- **Step 7.** Back in the **Reports** window, select the **Report Title** field to edit the title of the report.
- **Step 8.** In the **Report Settings**, check or uncheck the checkboxes to select or unselect the options available for the Inventory report. See the *Turbo Architecture User's Manual*, Section 4.4.4.3, for further information on these report settings.
- **Step 9.** Click the **Save Recordset** button to create a comma delimited text file containing the contents of the Inventory Report.
- **Step 10.** Click the **Preview** button to create a view of the report as it will appear. The preview will open in a new window (See **Figure 40**).

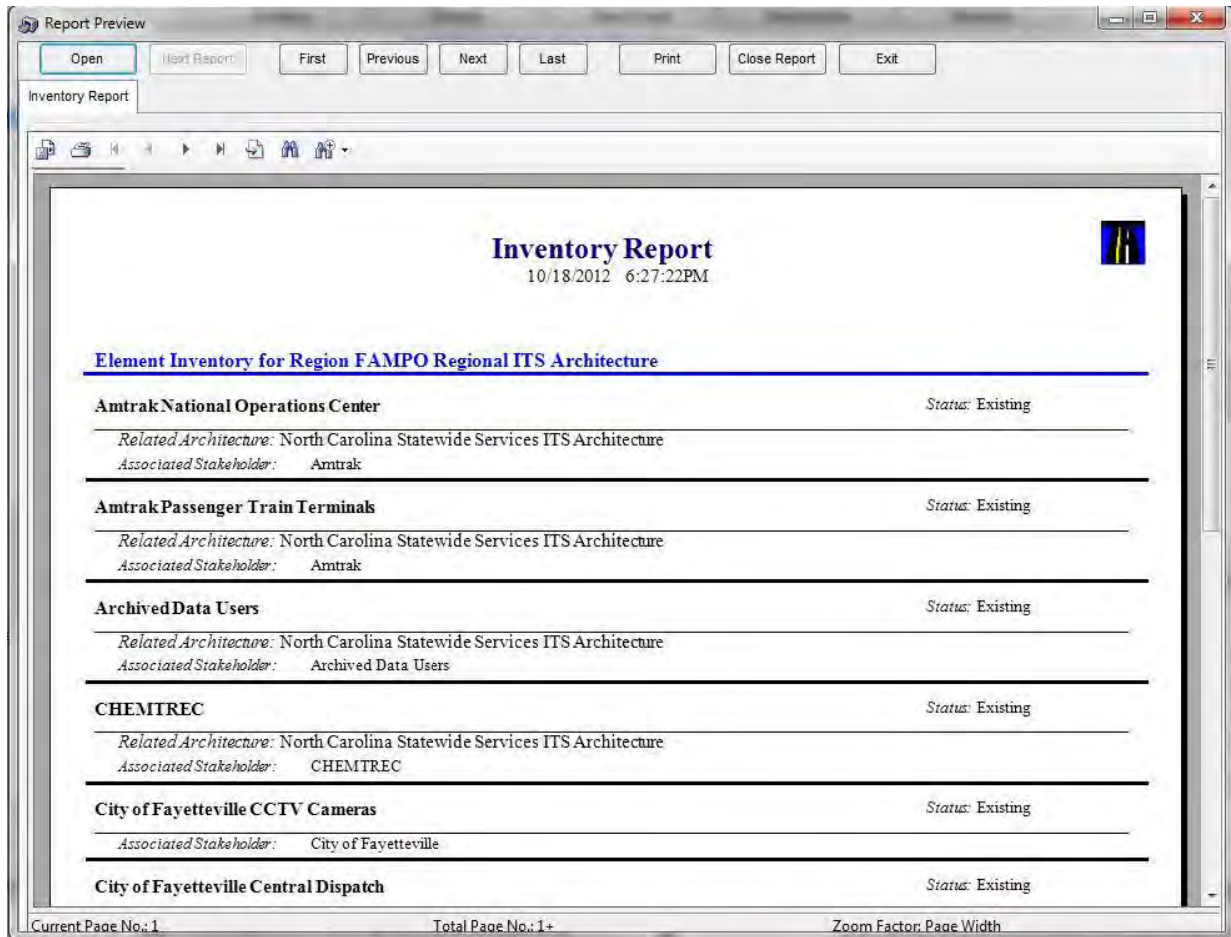


Figure 40. Inventory Report

- **Step 11.** In the **Preview** window, click the **Print** button or **Print** icon to print the report to a printer.
- **Step 12.** Optionally, click the **Export** icon to export the file. Options for exporting the file include .pdf, Microsoft Word, or Rich Text Format (RTF) format. The **Export** icon can be found between the **Print** icon and the **Zoom** field. A new window will appear (See **Figure 41**). Select the **Format** field to select which format to save the report in. Select the **Destination** field to select where the export file should be sent to.

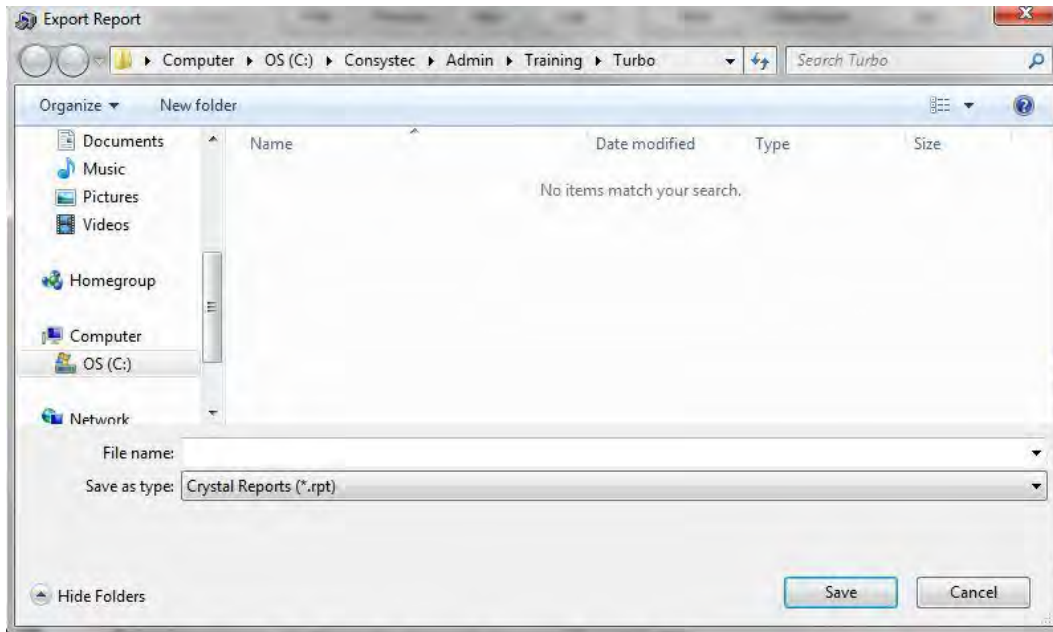


Figure 41. Export Window

- **Step 13.** Click the **Close Report** or **Exit** button to close the window and return to the **Reports** window.
- **Step 14.** From the **Reports** window, click the **Close** button to exit reports.

7.1.2 Print Service Package Reports

Turbo Architecture allows a user to print an ITS services report for a project architecture.

- **Step 1.** Open the Turbo Architecture database for the Regional ITS Architecture that the project architecture exists in by selecting **File -> Open**. A new window will open. Navigate to the directory containing the Turbo Architecture file. Select the file, and then click the **Open** button.
- **Step 2.** Click the **Start** tab and select the appropriate project architecture in the **Architectures:Project** section.
- **Step 3.** Select **Output -> Reports**, or type **Ctrl+R**. A new window will appear (See **Figure 37**).
- **Step 4.** Click the '+' box next to **Service Packages (Transportation Services)** to view the two reports related to Service Packages, one called **Service Packages** and the other called **Inventory to Service Package Comparison**.
- **Step 5.** Click the **Service Packages** report.
- **Step 6.** Select the **Report Title** field to edit the title of the report.

- **Step 7.** In the **Report Settings**, check or uncheck the checkboxes to select or unselect the options available for the ITS Services report. See the *Turbo Architecture User's Manual*, Section 4.4.4.3, for further information on these report settings. However, it is recommended that the **Show-Not-planned** option remain unchecked, so that only those Service Packages or Service Package instances involved with the project will appear in the report.
- **Step 8.** Click the **Save Recordset** button to create a comma delimited text file containing the contents of the Service Packages Report.
- **Step 9.** Click the **Preview** button to create a view of the report as it will appear. The preview will open in a new window (See **Figure 42**).

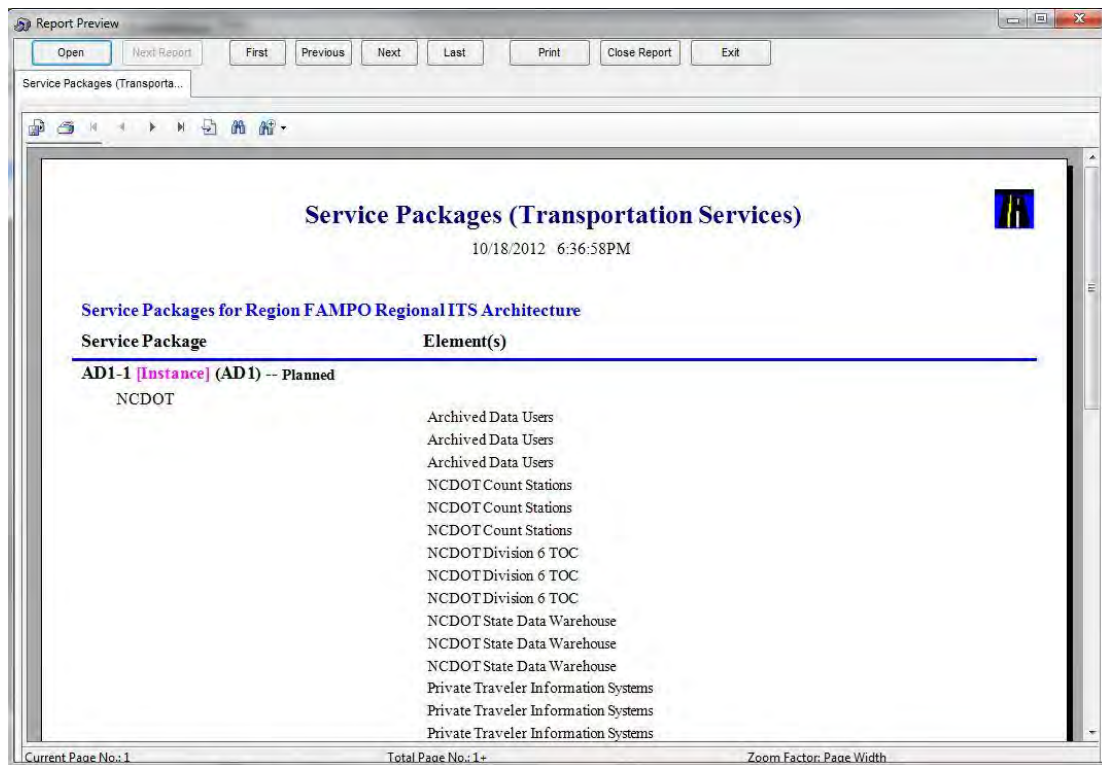


Figure 42. Service Packages Report

- **Step 10.** In the **Preview** window, click the **Print** button or **Print** icon to print the report to a printer.
- **Step 11.** Optionally, click the **Export** icon to export the file. Options for exporting the file include .pdf, Microsoft Word, or Rich Text Format (RTF) format. The **Export** icon can be found between the **Print** icon and the **Zoom** field. A new window will appear (See **Figure 41**). Select the **Format** field to select which format to save the report in. Select the **Destination** field to select where the export file should be sent to.

- **Step 12.** Click the **Close Report** or **Exit** button to close the window and return to the **Reports** window.
- **Step 13.** From the **Reports** window, click the **Close** button to exit reports.

7.1.3 Print Interface Diagrams

Turbo Architecture allows a user to print an interfaces diagram for a project architecture.

- **Step 1.** Open the Turbo Architecture database for the Regional ITS Architecture that the project architecture exists in by selecting **File -> Open**. A new window will open. Navigate to the directory containing the Turbo Architecture file. Select the file, and then click the **Open** button.
- **Step 2.** Click the **Start** tab and select the appropriate project architecture in the **Architectures: Project** section.
- **Step 3.** Select **Output -> Diagrams** or type **Ctrl+D**. A new window will appear (See **Figure 43**).

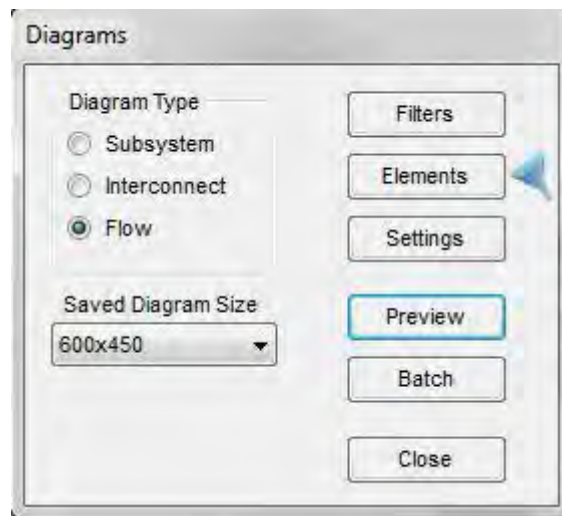


Figure 43. Diagrams Window

- **Step 4.** Under **Diagram Type**, select **Flow**.
- **Step 5.** Click the **Preview** button to preview the flow diagram for this ITS project. A new window will open (See **Figure 44**).

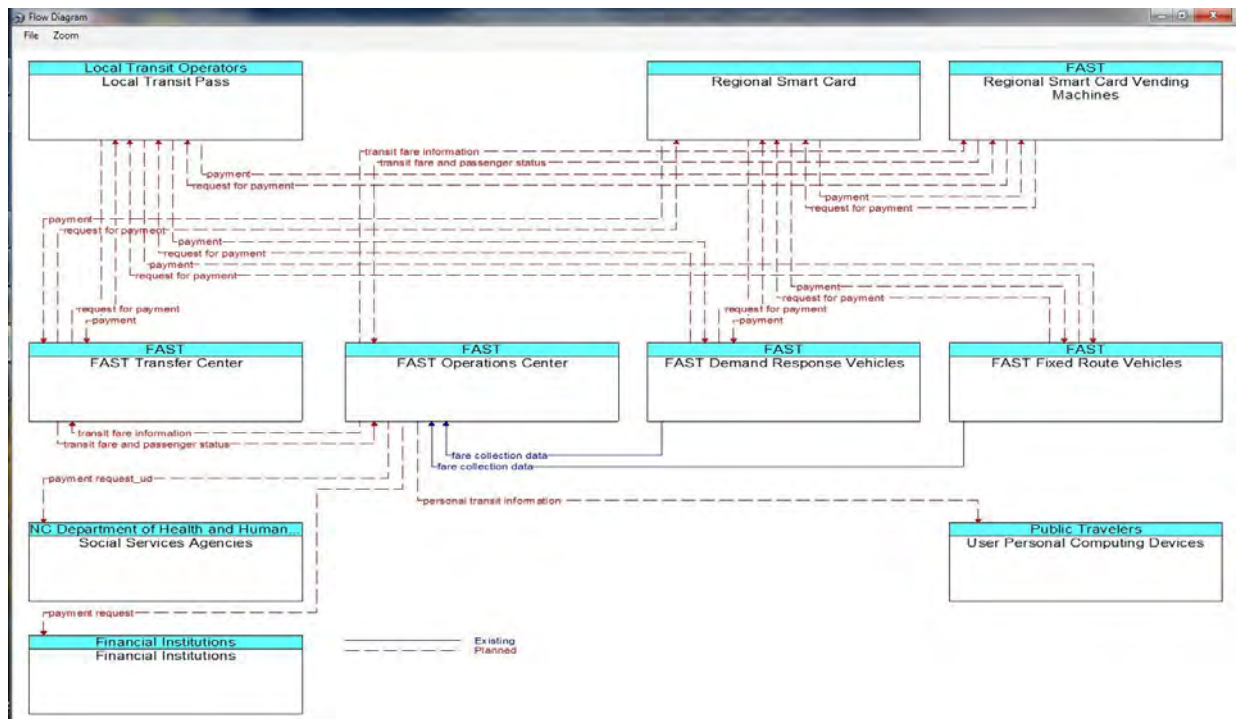


Figure 44. Flow Diagram Window

- **Step 6.** Select **File -> Print** to print the diagram.
- **Step 7.** Select **File -> Save** to save the diagram to a file. Several common graphical formats are available.
- **Step 8.** Select **File -> Close** to exit the Flow Diagram window.
- **Step 9.** Back in the **Diagrams** window, click the **Close** button to exit.

7.1.4 Edit Project Architectures

The above procedures: printing an inventory report, printing an ITS Services report, and printing an interface diagram can be used as a check that a project architecture is properly reflected in the Regional ITS Architecture.

The procedures can also be used to check that the Regional ITS Architecture is correct – if no changes in the Regional ITS Architecture are required while entering the project architecture information (e.g., no changes are needed in the inventory, ITS Services, or interfaces), then the Regional ITS Architecture does not need to be updated. If a change to the inventory, ITS services, or interfaces is required when editing a project architecture in the Turbo Architecture database, then a change is needed in the Regional ITS Architecture.

7.2 Roles and Responsibilities of Participants

This portion of the Systems Engineering Analysis relates to the roles and responsibilities of each stakeholder in the ITS project. This information is already contained in the Operational Concept portion of the Turbo Architecture database. A report can be generated in the Turbo Architecture application that contains this information. The procedures below assumes that a project architecture has been created for the ITS project in the Regional ITS Architecture database.

- **Step 1.** Open the Turbo Architecture database for the Regional ITS Architecture that the project architecture exists in by selecting **File -> Open**. A new window will open. Navigate to the directory containing the Turbo Architecture file. Select the file, and then click the **Open** button.
- **Step 2.** Click the **Start** tab and select the appropriate project architecture in the **Architectures: Project** section.
- **Step 3.** Select **Output -> Reports**, or type **Ctrl+R**. A new window will appear (See **Figure 37**).
- **Step 4.** Select the **Operational Concepts (Roles & Responsibilities)** report.
- **Step 5.** Select the **Report Title** field to edit the title of the report.
- **Step 6.** In the **Report Settings**, check or uncheck the checkboxes to select or unselect the options available for the Operational Concepts report. See the *Turbo Architecture User's Manual*, Section 4.4.4.3, for further information on these report settings.
- **Step 7.** Click the **Save Recordset** button to create a comma delimited text file containing the contents of the Inventory Report.
- **Step 8.** Click the **Preview** button to create a view of the report as it will appear. The preview will open in a new window (See **Figure 45**).

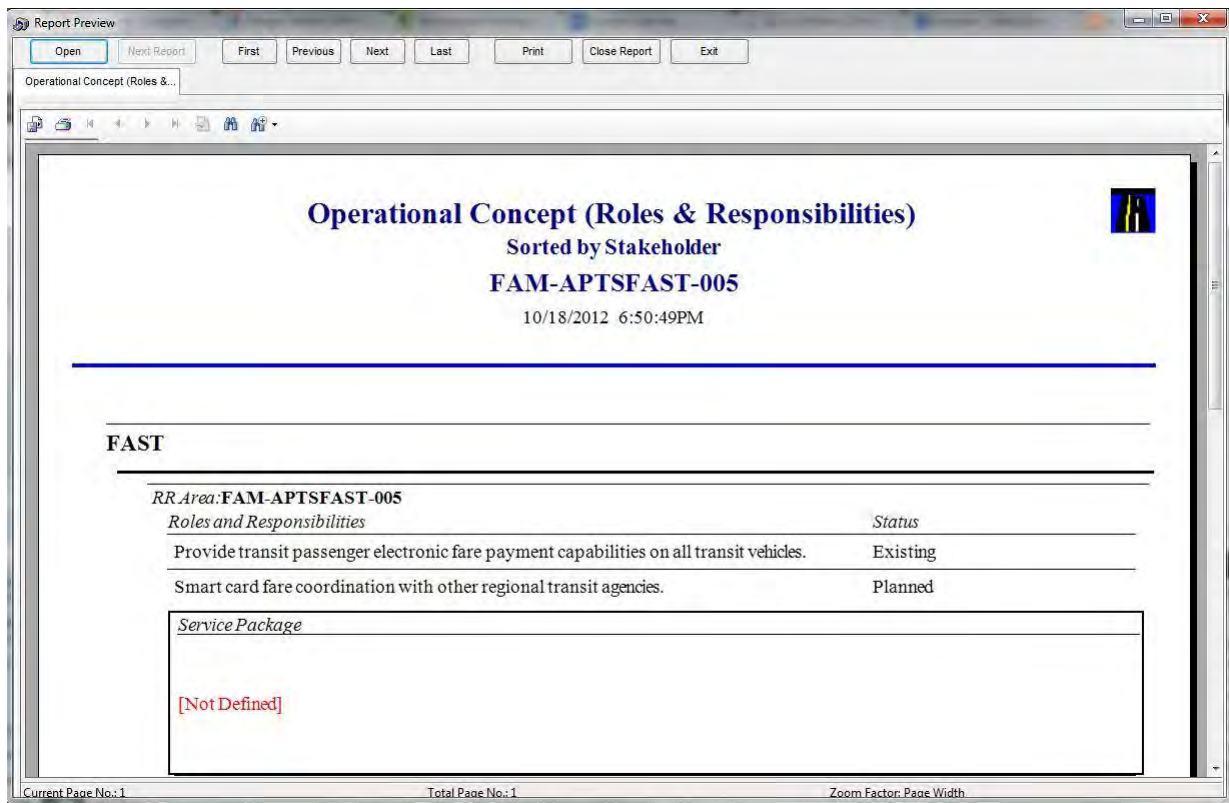


Figure 45. Operational Concepts Report

- **Step 9.** In the **Preview** window, click the **Print** button or **Print** icon to print the report.
- **Step 10.** Optionally, click the **Export** icon to export the file. Options for exporting the file include the following versions: .pdf, Microsoft Word, or Rich Text Format (RTF) format. The **Export** icon can be found between the **Print** icon and the **Zoom** field. A new window will appear (See **Figure 41**). Select the **Format** field to select which format to save the report in. Select the **Destination** field to select where the export file should be sent to.
- **Step 11.** Click the **Close Report** or **Exit** button to close the window and return to the **Reports** window.
- **Step 12.** From the **Reports** window, click the **Close** button to exit reports.

7.3 Requirements Definition

This portion of the Systems Engineering Analysis relates to the requirements for the ITS project. Functional requirements are information that is already contained in the Requirements portion of the Turbo Architecture database. A report can be generated in the Turbo Architecture application that contains this information. The procedures below assumes that a project architecture has been created for the ITS project in the Regional ITS Architecture database.

- **Step 1.** Open the Turbo Architecture database for the Regional ITS Architecture that the project architecture exists in by selecting **File -> Open**. A new window will open. Navigate to the directory containing the Turbo Architecture file. Select the file, and then click the **Open** button.
- **Step 2.** Click the **Start** tab and select the appropriate project architecture in the **Architectures:Project** section.
- **Step 3.** Select **Output -> Reports**, or type **Ctrl+R**. A new window will appear (See **Figure 37**).
- **Step 4.** Select the **Functional Requirements** report.
- **Step 5.** Select the **Report Title** field to edit the title of the report.
- **Step 6.** In the **Report Settings**, check or uncheck the checkboxes to select or unselect the options available for the Operational Concepts report. See the *Turbo Architecture User's Manual*, Section 4.4.4.3, for further information on these report settings.
- **Step 7.** Click the **Save Recordset** button to create a comma delimited text file containing the contents of the Inventory Report.
- **Step 8.** Click the **Preview** button to create a view of the report as it will appear. The preview will open in a new window (See **Figure 46**).
- **Step 9.** In the **Preview** window, click the **Print** button or **Print** icon to print the report

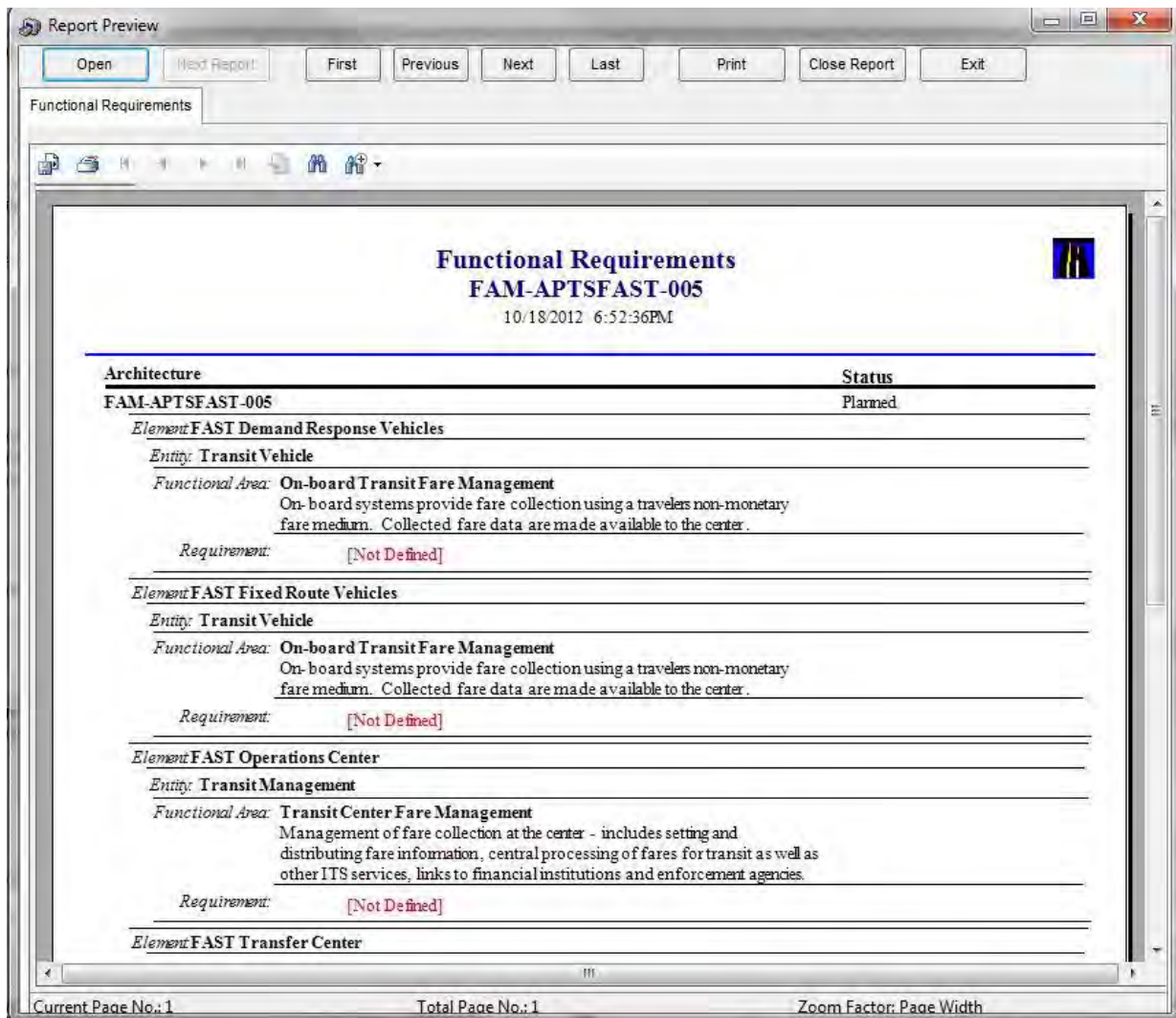


Figure 46. Functional Requirements Report.

- **Step 10.** Optionally, click the **Export** icon to export the file. Options for exporting the file include the following versions: .pdf, Microsoft Word, or Rich Text Format (RTF) format. The **Export** icon can be found between the **Print** icon and the **Zoom** field. A new window will appear (See **Figure 41**). Select the **Format** field to select which format to save the report in. Select the **Destination** field to select where the export file should be sent to.
- **Step 11.** Click the **Close Report** or **Exit** button to close the window and return to the **Reports** window.
- **Step 12.** From the **Reports** window, click the **Close** button to exit reports.

7.4 Analysis of Alternative Systems and Technologies

This portion of the Systems Engineering Analysis provides a brief description of alternative system configurations and/or technologies that will be considered in the development of the project.

The Turbo Architecture database and the Regional ITS Architecture do not contain any information that can assist in satisfying this requirement.

7.5 Procurement Options

This section of the Systems Engineering Analysis is primarily developed based on existing planning documents such as a Transportation Improvement Program (TIP) or an agency's capital plan. The key point of this section is to show traceability to the federal, state, or local sources of funds, and to indicate what portions of the project are covered by those funds (e.g., capital costs, operations, maintenance, staff, etc.). Showing the "project identifiers" used in the existing planning documents, and cost estimates as they relate to the project/system life cycle is helpful.

The Turbo Architecture database and the Regional ITS Architecture does not contain any information that can assist in satisfying this requirement.

7.6 ITS Standards and Testing Procedures

This portion of the Systems Engineering Analysis discusses the applicable ITS standards and testing procedures. This section includes a discussion about which standards were considered for implementation and which were selected for the ITS project. It also explains why, where one or more standards exist for implementation, an ITS standard will not be considered for the ITS project. For example, the justification may include an explanation that the standard is not mature, or that there are not sufficient vendors that have implemented the standard in their products, etc.

This section needs to specify what ITS standards are to be included in the ITS project and identify the data communications options/protocols to be used for the ITS project. The Turbo Architecture database and the Regional ITS Architecture contain information about what ITS standards may be applicable to the ITS project. A report can be generated in the Turbo Architecture application that contains this information. The procedures below assume that a project architecture has been created for the ITS project in the Regional ITS Architecture database.

For testing procedures, this section of the analysis should provide an outline of what needs to be tested, and an outline of what test procedures need to be specified in procuring the ITS project. However, testing procedures are not addressed by the Turbo Architecture database or the Regional ITS Architecture, and thus does not contain any information that can assist in satisfying this requirement.

To view what ITS Standards may be applicable to an ITS Project:

- **Step 1.** Open the Turbo Architecture database for the Regional ITS Architecture that the project architecture exists in by selecting **File -> Open**. A new window will open. Navigate to the directory containing the Turbo Architecture file. Select the file, and then click the **Open** button.
- **Step 2.** Click the **Start** tab and select the appropriate project architecture in the **Architectures: Project** section.
- **Step 3.** Select **Output -> Reports**, or type **Ctrl+R**. A new window will appear (See **Figure 37**).
- **Step 4.** Select the **Standards Activities** report.
- **Step 5.** Click the **Elements** button to indicate which ITS elements should be included in the report. A new window will appear (See **Figure 38**). To select only those ITS elements that have been defined to be part of the project architecture, click the **Project Elements** button. Click the **OK** button.
- **Step 6.** Back in the **Reports** window, click the **Filters** button to limit the data or types that is included in the reports. See the *Turbo Architecture User's Manual*, Section 4.4.1, for further information on using filters. A new window will appear (See **Figure 39**). Click the **Apply** button to apply any changes to the filter. Click the **Ok** button to exit the Filters window.
- **Step 7.** Back in the **Reports** window, select the **Report Title** field to edit the title of the report.
- **Step 8.** In the **Report Settings**, check or uncheck the checkboxes to select or unselect the options available for the Standards Activities report. See the *Turbo Architecture User's Manual*, Section 4.4.4.3, for further information on these report settings.
- **Step 9.** Click the **Save Recordset** button to create a comma delimited text file containing the contents of the Inventory Report.
- **Step 10.** Click the **Preview** button to create a view of the report as it will appear. The preview will open in a new window (See **Figure 47**).

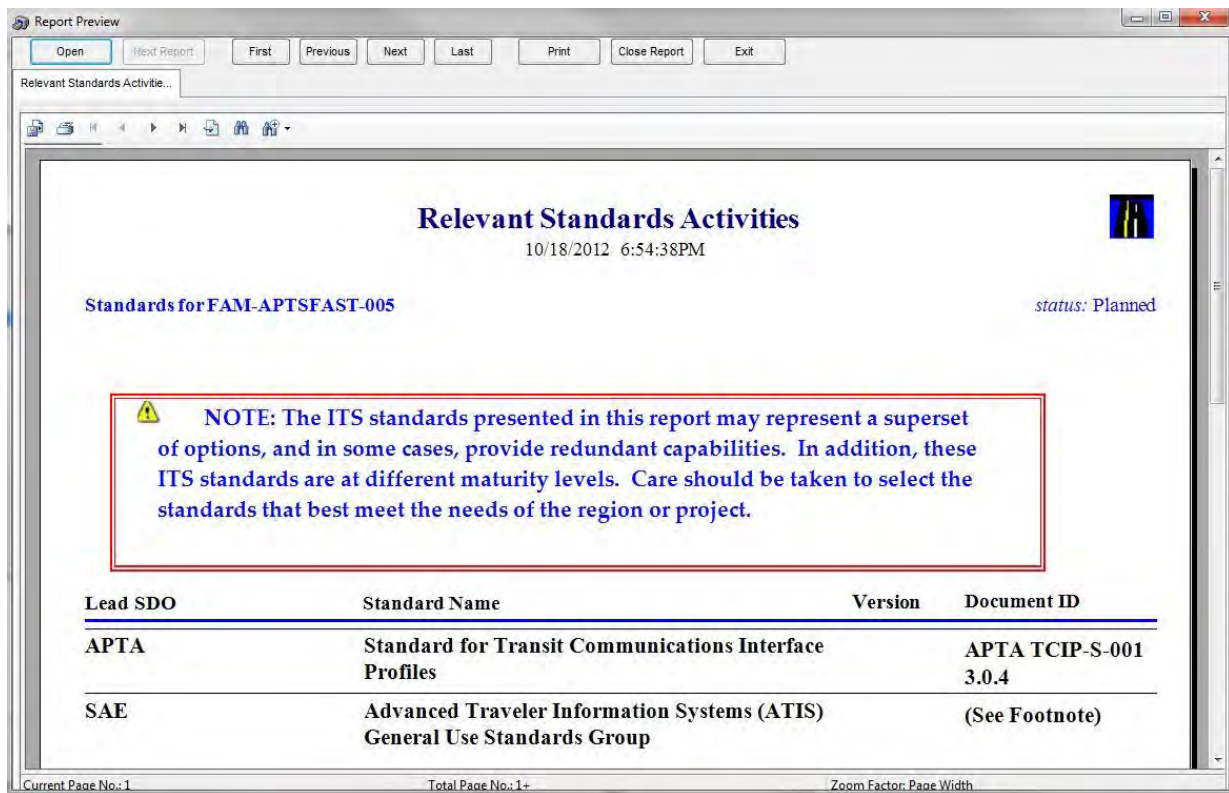


Figure 47. Standards Activities Report

- **Step 11.** In the **Preview** window, click the **Print** button or **Print** icon to print the report.
- **Step 12.** Optionally, click the **Export** icon to export the file. Options for exporting the file include the following versions: .pdf, Microsoft Word, or Rich Text Format (RTF) format. The **Export** icon can be found between the **Print** icon and the **Zoom** field. A new window will appear (See **Figure 41**). Select the **Format** field to select which format to save the report in. Select the **Destination** field to select where the export file should be sent to.
- **Step 13.** Click the **Close Report** or **Exit** button to close the window and return to the **Reports** window.
- **Step 14.** From the **Reports** window, click the **Close** button to exit reports.

7.7 Procedures and Resources for O&M

This section of the Systems Engineering Analysis includes a description of organizational procedures or practices appropriate to the system(s). It discusses how the ITS system is to be operated and maintained after the ITS project has been designed, implemented and tested, and should include staffing tables and funding costs.

The Turbo Architecture database and the Regional ITS Architecture does not contain any information that can assist in satisfying this requirement.

Glossary

Architecture	A framework within which a system can be built. Requirements dictate what functionality the architecture must satisfy. An Architecture functionally defines what pieces of the system are and the information that is exchanged between them. An Architecture is functionally oriented and not technology specific which allows the Architecture to remain effective over time. It defines “what must be done,” not “how it will be done.”
Architecture Flow	Information that is exchanged between elements in the ITS Architecture. Architecture Flows are the primary tool that is used to define the Regional ITS Architecture Interfaces. These Architecture Flows and their communication requirements define the interfaces, which form the basis for much of the ITS Standards work. The terms “architecture flow” and “information flow” are used interchangeably.
Data Flow	Data flows represent a pipeline along which information is passed.
Element	This is the basic building block of Regional ITS Architectures and Project ITS Architectures. It is the name used by the Stakeholders to describe a system or piece of a system.
Equipment Packages	Equipment Packages group like processes (e.g., requirements) of a particular Subsystem together into an “implementable” package. The grouping takes into account the need to accommodate various levels of functionality.

FHWA CFR Rule 940/FTA Policy on ITS Architectures and Standards	This Rule/Policy seeks to foster regional integration by requiring that all ITS projects funded from the Highway Trust Fund be in conformance with the National ITS Architecture and officially adopted standards. “Conformance with the National ITS Architecture” is defined in the final Rule/Policy as using the National ITS Architecture to develop a “regional ITS architecture” that would be tailored to address the local situation and ITS investment needs, and the subsequent adherence of ITS projects to the regional ITS architecture.
Functional Requirements	A description of WHAT a system must do to address the needs or provides the ITS services that have been identified for the region. In a Regional ITS Architecture, the Functional Requirements focus on the high-level requirements that support regional integration. For a project ITS architecture, these are broken down into more detailed requirements to fully understand the functionality of the system.
Information Flow	Information that is exchanged between Elements in the ITS Architecture. The terms “architecture flow” and “information flow” are used interchangeably.
Interconnect	Communication paths that carry information between elements in the ITS Architecture.
ITS Architecture	Defines an Architecture of interrelated systems that work together to deliver transportation Services. An ITS Architecture defines how systems functionally operate and the interconnection of information exchanges that must take place between these systems to accomplish transportation Services.
ITS Project	Any project that in whole or in part funds the acquisition of technologies or systems of technologies that provide or significantly contribute to the provision of one or more ITS User Services.

Interface	The connection between two systems. In the regional ITS architecture, an interface is described by the architecture interconnect – the line of communications between the two systems – and the information flows that define the types of information that will be shared over the interconnect.
Inventory	The collection of all ITS-related Elements in a Regional ITS Architecture.
Service Package	Service Packages identify the pieces of ITS Architecture that are required to implement a particular transportation Service. They provide an accessible, service oriented, perspective to the National ITS Architecture. They are tailored to fit – separately or in combination – real world transportation problems and needs. Service Packages collect together one or more Equipment Packages that must work together to deliver a given transportation Service and the Architecture Flows that connect them and other important external systems.
Operational Concept	An operational concept identifies the roles and responsibilities of participating agencies and stakeholders. It defines the institutional and technical vision for the region and describes how the system will work at a very high-level, frequently using operational scenarios as a basis.
Project Architecture	A framework that identifies the institutional agreement and technical integration necessary to define an ITS project and its interfaces with other ITS projects and systems.
Regional ITS Architecture	A specific, tailored framework for ensuring institutional agreement and technical integration for the implementation of ITS projects or groups of projects in a particular Region. It functionally defines what pieces of the system are linked to others and what information is exchanged between them.

Stakeholders	Anyone with a vested interest or “stake” in one or more transportation elements within a regional ITS architecture. This includes public agencies, private organizations, special interests, and the traveling public.
Standards	Documented technical specifications sponsored by a Standards Development Organization (SDO) to be used consistently as rules, guidelines, or definitions of characteristics for the interchange of data. A broad array of ITS Standards is currently under development that will specifically define the Interfaces identified in the National ITS Architecture.
Subsystem	Subsystems are individual pieces of the Intelligent Transportation System defined by the National ITS Architecture. Subsystems are grouped into four classes: Centers, Field, Vehicles, and Travelers. Example Subsystems are the Traffic Management Subsystem, the Vehicle Subsystem, and the Roadway Subsystem.
Systems Engineering	An interdisciplinary approach and means to enable the realization of successful systems. Systems engineering is a systematic approach that focuses on defining customer needs and required functionality early in the development cycle, documenting requirements, then proceeding with design synthesis and systems validation while considering the complete problem.
Terminator	Terminators define the boundary of an Architecture. The National ITS Architecture Terminators represent the people, systems, and general environment that interface to ITS. The Interfaces between Terminators and the Subsystems and Processes within the National ITS Architecture are defined, but no functional requirements are allocated to Terminators.
Turbo Architecture	An automated software tool used to input and manage System Inventory, Service Packages, Interconnects and Architecture Flows with regard to a Regional ITS Architecture.

System Engineering Check List

System Engineering Analysis for Project

A. Regional ITS Architecture Implemented

Document: REGIONAL ITS STRATEGIC DEPLOYMENT PLANS / ARCHITECTURE ☐

B. Participating Agencies Roles and Responsibilities

Document: REGIONAL ITS STRATEGIC DEPLOYMENT PLANS / ARCHITECTURE ☐

Document: PROJECT SPECIAL PROVISIONS ☐

Document: PROJECT MEETING MINUTES ☐

C. Requirements Definitions

Document: REGIONAL ITS STRATEGIC DEPLOYMENT PLANS / ARCHITECTURE ☐

Document: PROJECT SPECIAL PROVISIONS ☐

Document: SCOPE OF WORK ☐

D. Alternative System Configurations & Technology Options

Document: PROJECT SCOPING MEETING MINUTES ☐

Document: FEASIBILITY STUDY ☐

E. Procurement Options

Document: TRADITIONAL BID PROCESS IN COMPLIANCE WITH CHAPTER 87
OF THE GENERAL STATUTES OF NC ☐

Document: PURCHASE ORDER CONTRACT ☐

Document: DESIGN BUILD ☐

F. Applicable ITS Standards and Testing Procedures

Document: REGIONAL PROJECT ARCHITECTURE ☐

Document: PROJECT PLANS ☐

Document: PROJECT SPECIAL PROVISIONS ☐

Document: UNIT INSPECTION LIST ☐

Document: SYSTEM INSPECTION / TEST CHECKLIST ☐

Document: OPERATIONAL TEST CHECKLIST ☐

Document: MATERIAL SUBMITTALS ☐

Document: OTDR FIBER TESTING ☐

Document: AS-BUILT DOCUMENTATION ☐

G. System Operations and Management

Document: REGIONAL ITS STRATEGIC DEPLOYMENT PLANS / ARCHITECTURE ☐

Document: STATEWIDE OPERATIONS & MAINTENANCE MANUAL ☐

Document: PROJECT SPECIAL PROVISIONS ☐

Document: PROJECT MEETING MINUTES ☐

Document: MEMORANDUM OF UNDERSTANDING ☐

FAMPO Regional ITS Strategic Deployment Plan Update

Project Evaluation and Prioritization Final Report



Prepared for:
Fayetteville Area Metropolitan Planning Organization
(FAMPO)

Prepared by:



ConSysTec



May 2013

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Note: This document uses the basic outline and incorporates relevant sections of the following document developed as part of the Triangle effort: FINAL Project Evaluation and Prioritization Report, March 2010.

1. INTRODUCTION

The FAMPO is investing energy into more consistently analyzing the potential impacts and benefits of ITS deployments. For the FAMPO area study, the ITS Deployment Analysis System (IDAS) software is being used for analysis and comparison of ITS deployment options. Additionally, the stakeholders will continue to use IDAS in future years as they revise the list of prioritized projects.

All of the previous steps in the study have been important stepping stones in generating a prioritized project list that can guide the region's stakeholders in deploying the most effective ITS solutions.

This document includes four main sections.

1. **Determination of Projects:** This section highlights how the projects were derived and organized for analysis.
2. **IDAS Methodology:** This section describes how the individual projects were input to IDAS, evaluated, and how the results were packaged for comparison.
3. **Project Evaluation Measures:** This section presents the evaluation matrix that is comprised of five categories determined by the stakeholders. These categories were chosen to provide a consistent platform for ranking and prioritizing projects.
4. **Results of Analysis:** This section presents the results of the populated evaluation matrix and prioritized projects.
5. **Appendices:** The project related data is provided in appendices for ease of maintenance of the document.

The body of this document provides the approach and methodology used in project evaluation and prioritization. We provide an overview of the processes involved in its development and recommendations for reviewing and referencing the data. The use of appendices to house the results and project data allow this to be a dynamic document

2. DETERMINATION OF PROJECTS

Building on the development of the region's objectives and needs identified in the gap assessment, a preliminary listing of projects was identified. This list was cross-referenced with projects previously identified by the stakeholders and then refined through stakeholder feedback. The gap analysis identified ITS solutions and more specifically, service packages, as defined by the National ITS Architecture (www.iteris.com/itsarch/) that could be selected to achieve a desired level of operations for the region.

Through stakeholder feedback, a refined listing of projects was developed based on the gap assessment and regional objectives. The projects were segmented into six distinct categories. Three of the categories are based on associated service packages from the FAMPO Regional ITS Architecture (ATMS, APTS, and EM). A fourth category is segmented to capture system preservation projects. These projects are in a standalone category because their prioritization is addressed differently than other project types. NCDOT has made a commitment to ITS and currently has a well defined procedure for establishing the operations and maintenance funds for the statewide ITS infrastructure. The System Preservation projects should provide a prioritized listing of regional projects that easily feed into the current process. A fifth category covers a set of statewide projects relevant to the region that cannot be directly evaluated by IDAS. The final category covers projects defined for Fort Bragg. These projects also are outside the evaluation capabilities of IDAS and were separated to reflect the unique nature of the stakeholder.

- **System Preservation:** These projects represent the existing deployment of field devices and include the year of implementation. The projects are identified to assist the stakeholders in planning for extensive operations and maintenance costs associated with the replacement of devices. The projects were segmented into field devices and communications based on the life expectancy of each: 12 years for CCTV cameras and detection equipment, 15 years for DMS, and 20 years for communications.
- **Highway Projects:** These projects include freeway and arterial deployments that are typically funded by NCDOT or municipal projects. They also include technologies for controlling traffic flow on freeways and arterials, such as ramp metering and interconnected traffic signals.
 - **Advanced Traffic Management Systems (ATMS) – Freeway and Arterial Management:** These projects include deployments associated with surveillance, detection and information dissemination on the network of controlled access facilities in the region. They include expansion of closed circuit television (CCTV) cameras, dynamic message signs (DMS, and communication.
 - **Advanced Traffic Management Systems (ATMS) – Freeway and Arterial Control:** These projects represent traffic management solutions focused on controlling congestion through more direct impacts on traffic flow. The only deployment type used in the current study was centralized signal systems.
- **Transit Projects or Advanced Public Transportation Systems (APTS):** The APTS projects represent all field device deployments and central system improvements related to improving public transportation operations in the region.

There were two transit ITS projects, for which impacts analysis methodologies are identified in the FAMPO region. These are Automated Vehicle Location (AVL), and Traveler Information systems. Both of these strategies are transit *systematic* options. In particular, they do not need to use the IDAS transit analysis capabilities because transit ridership systemwide is known. When using IDAS, the transit deployments consider a specific corridor or subset of the origin destination zones from the model's transit matrix, *not* the entire system. For this reason,

analysis of these strategies was done using established techniques implemented in Excel workbooks.

- **Emergency Management Projects:** This category includes coordination of emergency management agencies and emergency response. One project, freeway service patrol services on I-95, was included in this analysis. This project is assumed to provide 2 vehicles with drivers and is expected to be implemented in the medium term (5-10 years in the future). Cumberland County identified additional projects that will provide communications links between several emergency response agencies. These communications projects are expected to provide positive benefits in response time, however, these benefits are not able to be quantified so they could not be analyzed, but they are included in the evaluation matrix for completeness.
- **Regional Non-Infrastructure Projects:** This category represents projects that have regional applications and cannot be evaluated using the IDAS software. Projects that enhance communications and coordination among agencies fall into this category as well as projects relating to data archiving and development of 511 systems.
- **Statewide Non-infrastructure Projects:** This category represents projects that have regional applications and cannot be evaluated using the IDAS software. These projects were assumed to be a part of the NCDOT statewide ITS program and they are not attributable to FAMPO, so therefore were not analyzed, but are included in the Appendix for completeness.
- **Fort Bragg Projects** – Several ITS projects were included that were identified by Fort Bragg stakeholders relating to upgrades within the base. Discussions were held with Fort Bragg officials concerning their ITS plans. They stated that their projects are internal to the base and they cannot furnish us with detailed volume and speed data needed to conduct an analysis. Therefore the projects were not analyzed, but are included in Appendix C for completeness.

Appendix A contains maps of identified project locations where feasible. The projects are identified using a unique identifier comprised of specific classifiers as shown in **Table 1**. The intention is to provide a naming convention that can be applied statewide. Additional columns within the project tables include the route or transit agency, the respective Metropolitan Planning Organization (MPO), and county. These columns will allow the stakeholders to sort based on the specific needs.

Table 1. Overview of Project ID Structure

Generic Project ID: AAAA-BBBB(R)-CCCC		
<i>Portion of Identifier</i>	<i>Description</i>	<i>Example</i>
AAAA	Region	FAM (FAMPO)
BBBB	Service package	ATMS
	Route / Transit	
R	System Preservation Projects	
CCCC	Numerical Count	001; 003; 003
	Communications Deployment	Comm

Below includes a list of proposed projects with example project ID structure and the associated project description.

- **FAM-ATMSNC24-87-001** Deploy ITS on NC 24-87. Add (4) CCTV cameras and (2) DMS;
- **FAM-ATMSI295-002** Add ITS Devices. Add (8) CCTV cameras and (8) DMS on I-295 from NC 24-87 (Bragg Blvd) to north I-95.;
- **FAM-ATMSI74R-001** Life Cycle Replacement. Replace CCTVs on I-74 in Robeson Co. (8);
- **FAM-ATMSI74R-002** Life Cycle Replacement. Replace DMS on I-74 in Robeson Co. (7)

3. IDAS METHODOLOGY

This section includes a brief overview of the IDAS software used to conduct the cost/benefit analysis for this project. More detail about the IDAS software is included in the tailored IDAS manual prepared for the study as part of this project. The development of IDAS was funded by the Federal Highway Administration (FHWA) to assist state, regional, and local agencies in integrating ITS projects into the transportation planning process.

Planners and others can use IDAS to calculate the relative costs and benefits of ITS investments. IDAS currently can predict costs, benefits, and impacts for more than 60 types of ITS investments in combination or isolation. **Figure 1** shows how IDAS fits into the overall ITS architecture and planning process. As shown, the model is used to help evaluate new or expanded ITS deployments, or to evaluate the benefits realized from existing deployments. IDAS also can help in developing planning-level cost estimates for both replacement and new deployments.

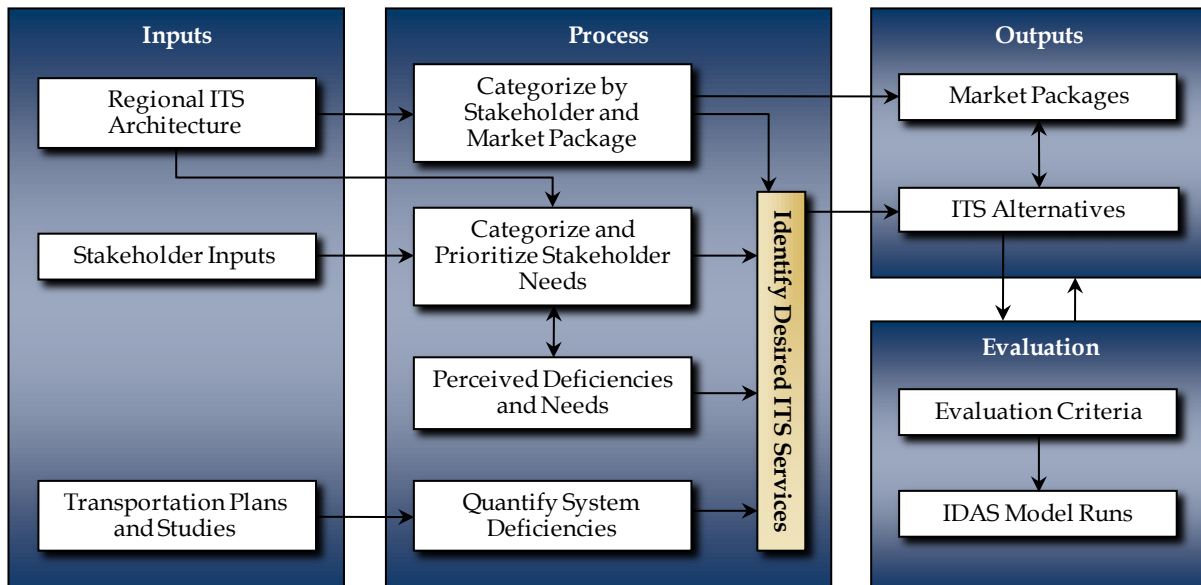


Figure 1. IDAS in the ITS Planning/Architecture Process

In order to be consistent with current transportation planning processes, IDAS operates as a postprocessor to travel demand models used by MPO and by state Departments of Transportation (DOTs). ITS alternatives are coded into the model with a graphical user interface (GUI), similar to that used in many travel demand forecasting programs. For the FAMPO region analysis, travel demand model files with loaded volumes, speeds, and volume/capacity (V/C) ratios are used.

There are a number of ITS improvements that can be assessed in IDAS, such as ATMS, APTS, EM, and ATIS. The set of impacts evaluated by IDAS includes changes in user mobility, travel time/speed, travel-time reliability, fuel costs, operating costs, accident costs, emissions, and noise. The performance of selected ITS options can be viewed by market sector, facility type, and district. IDAS is comprised of the following five analysis modules:

- Input/Output Interface Module (IOM)
- Alternatives Generator Module (AGM)

- Benefits Module
- Cost Module
- Alternatives Comparison Module (ACM)

The input/output interface is used to specify and translate the data files provided by the regional travel demand models, and convert the data into a format that can be used internally by the IDAS model. The alternatives generator module allows an analyst to use a GUI to define and code ITS improvements into IDAS as shown in **Figure 2**.

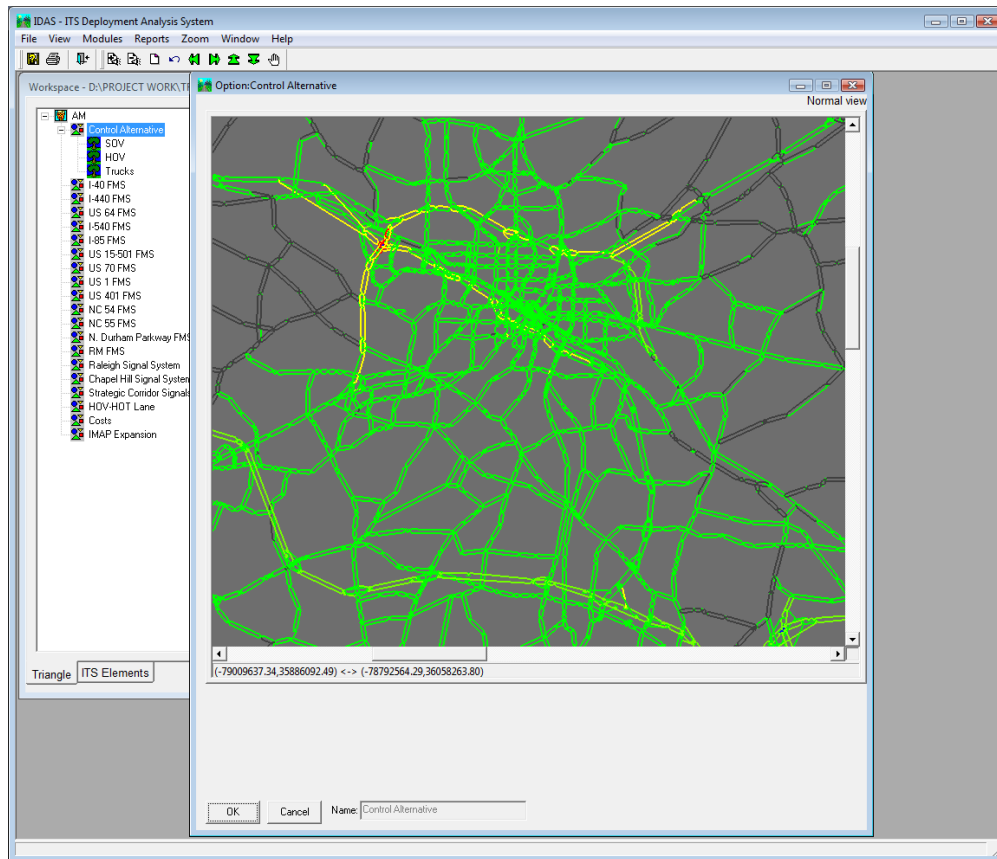


Figure 2. IDAS Graphical User Interface

IDAS estimates both traditional benefits of ITS deployment (e.g., improvement in average travel time) and non-traditional benefits (e.g., reduction in travel-time variability). The cost module helps to define the incremental costs of the various ITS deployments being studied, including capital costs and operating and maintenance costs. Finally, the alternative comparison module provides the analyst with information regarding the value of user benefits from ITS deployments, the associated costs of the deployments, and a comparison of the benefits and costs for different ITS deployment options. The structure of the IDAS model is shown in **Figure 3**.

Figure 3. IDAS Model Structure

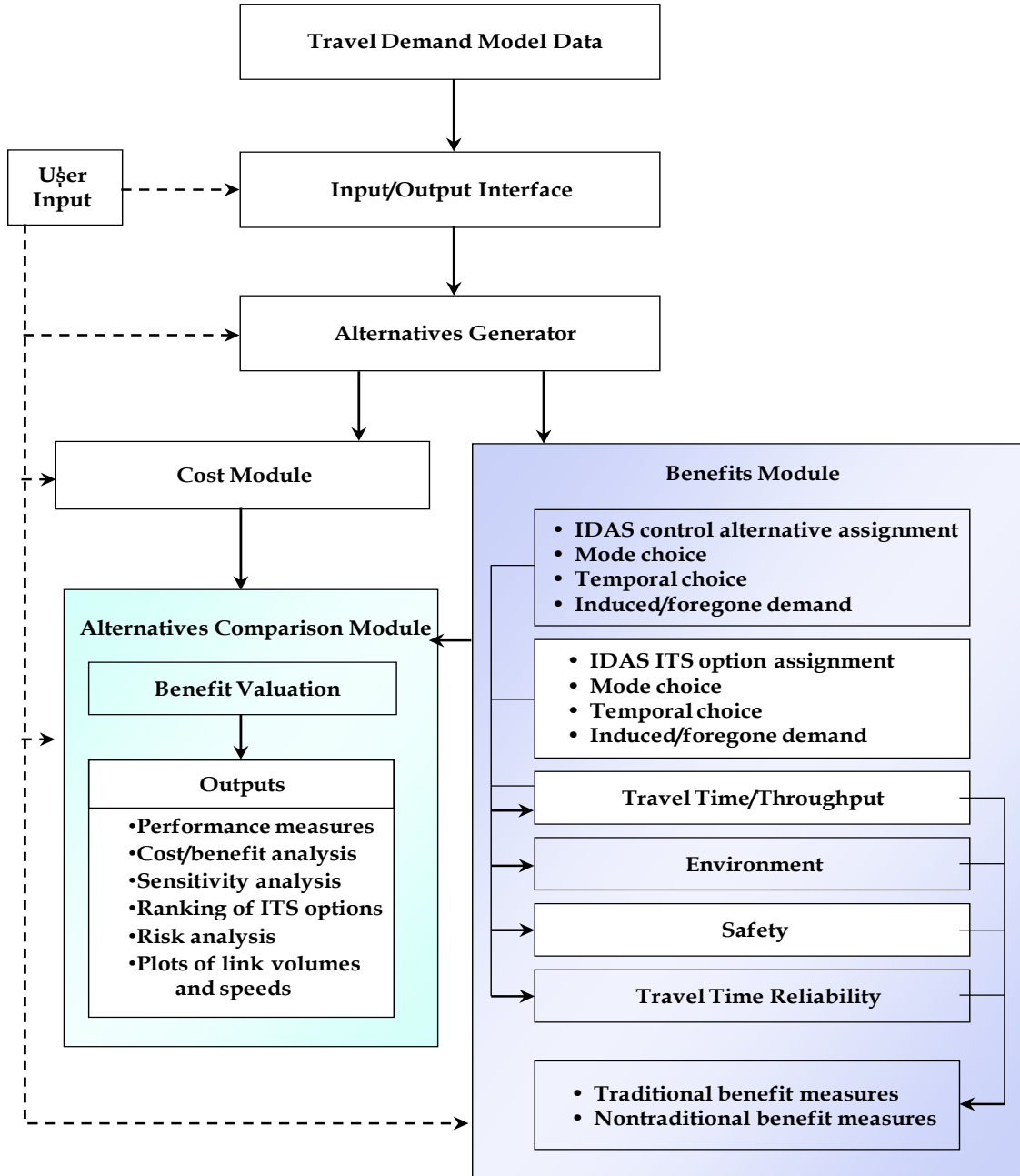


Figure 3. IDAS Model Structure

The specific evaluation measures generated by IDAS include:

- Vehicle miles of travel (VMT)
- Vehicle hours of travel (VHT)
- Average speed
- Person hours of travel (PHT)
- Number of person trips

- Number of accidents
 - Fatality
 - Injury
 - Property damage only
- Travel-time reliability (hours of unexpected delay)
- Fuel consumption (gallons)
- Emissions
 - Hydrocarbon and reactive organic gases
 - Carbon monoxide
 - Nitrous oxides
 - Particulate Matter (PM-10)

The IDAS Cost/Benefit Summary details the results of the benefits evaluation (value of time saved, value of accident reductions, etc.), cost analysis of the ITS option, net annual benefit, and benefit/cost (B/C) ratio. These include:

- Annual Benefits
 - Change in user mobility
 - Change in user travel time (in-vehicle, out-of-vehicle, and travel-time reliability)
 - Change in costs paid by users (fuel costs, no fuel operating costs, and accident costs – internal only)
 - Change in external costs (accident costs – external only, HC/ROG, NO_x, CO, PM₁₀, CO₂, global warming, noise, other mileage-based external costs, and other trip-based external costs)
- Annual costs
 - Average annual public sector costs
 - Initial capital
 - Operations and maintenance
 - Capital replacement
 - Net benefit (annual benefit minus annual cost)
 - B/C ratio (annual benefit/annual cost)

3.1 Benefit Parameters

The following section summarizes the benefit parameters used in the current study. The parameters were developed based on: 1) national default parameters collected for FHWA's ITS Benefits Database and incorporated into the IDAS software on a regular basis, 2) experience gained by conducting cost/benefit analysis in various regions of the country, and 3) survey data on the public's use of ITS deployments conducted in Michigan, Ohio, Florida, and Indiana.

3.1.1 Advanced Traffic Management System (ATMS)

It is assumed that ATMS, or FMS, includes surveillance, detection, and a staffed transportation management center (TMC). The parameters used to evaluate the ATMS deployment varies depending on the use of DMS.

In the scenario of CCTV cameras and a staffed TMC *with* DMS, incident management response is improved and the benefits calculated are based on the response of motorists to the DMS messages. While multiple traveler information sources may be utilized, the DMS is considered the primary means of communication for motorists on the highways. Benefits are achieved by providing motorists with advance notice of congested conditions and providing them with an option to take an alternate route. Thus, the three parameters used to estimate benefits are: 1) percent of the time when relevant information is being displayed on signs; 2) percentage of motorists who divert due to the information provided; and 3) the time saved by each motorist who diverts. Relevant information is considered notice of a delay ahead that is severe enough to consider diversion. Generally, estimates derived from motorist surveys conducted in the Detroit, Michigan and Cincinnati, Ohio regions, as well as in Florida and Indiana, are used to help develop these parameters. In these areas, motorists reported that they changed routes in response to DMS messages on average about 25 to 30 percent of the time. This response was consistent across all parts of both metropolitan areas. Survey estimates of time saved (generally in the range of 10 to 15 minutes) were reduced since they seemed to be exaggerated and produced unrealistic estimates of benefits. Approximate estimates of 5 minutes in travel time savings is generally used in IDAS applications, as shown in **Table 2**.

Table 2. ATMS Benefit Parameters with DMS

Freeway Management System (DMS, CCTV, Detection, TMC) – urban areas	Percent of drivers who divert	25%
	Percent of time information is provided that may result in diversion	5%
	Estimated time saved	5 minutes

Separate parameters are proposed for areas of the roadway network not covered by DMS. It is recognized that these areas still receive the benefits of having CCTV cameras, detection, and TMC operations personnel observing the system. The parameters proposed for roadway segments with these deployments *without* DMS are shown in **Table 3**.

Table 3. ATMS Parameters for CCTV Cameras and Detection Equipment Only

Additional Benefits from Detection and Surveillance Deployment (CCTV and Detectors) <i>without</i> DMS	Incident duration reduction	5%
	Fuel consumption reduction	1%
	Fatality reduction	1%
	Emission reduction	1%

The impact of incident reduction uses a table of “delay rates” that is arranged by volume/capacity, and number of lanes on the link. The change in the delay rate that is taken from this table is calculated by:

$$dr_y = dr_0(1 - rd)^2, \text{ where:}$$

dr_0 = nominal delay rate

dr_y = improved delay rate

rd = incident reduction time

The incident reduction time (rd) is 5%. Once ($dr_0 - dr_y$) relationship is obtained, this is multiplied by the vehicle miles of travel to obtain the net hours of reduction in unexpected delay.

3.1.2 Emergency Management (Freeway Service Patrols)

Freeway Service Patrols, such as IMAP used in NC, rely on surveillance, detection, and TMC operation, but their benefits are calculated separately. The ability to respond quickly to incidents and remove them from both the road and the shoulder faster reduces delay, but also helps to reduce secondary crashes, fuel consumption, and emissions. Parameters are based on a review of Freeway Service Patrol activity reports in other cities with recommended parameters shown in **Table 4**.

Table 4. Freeway Service Patrols Benefit Parameters

Freeway Service Patrol	Incident duration reduction	5%
	Fuel consumption reduction	1%
	Fatality reduction	1%

3.1.3 Advanced Public Transportation Systems (APTS)

Advanced Public Transportation Systems (APTS) options analyzed in the FAMPO project include 1 AVL (Automated Vehicle Location) deployment, and 1 Traveler Information (kiosk) deployment. The AVL deployment provides benefits to both the transit agency and to the traveling public. The agency will see a capital cost savings per vehicle, and an operating cost savings, due to higher route assignment efficiencies. The traveling public will realize a travel time savings due to better on-time performance. The traveler information deployment allows passengers to utilize information about the current state of the system and to plan accordingly. This is modeled as a travel time savings.

The impact parameters used in the FAMPO analysis are shown in **Table 5**.

Table 5 APTS Benefit Parameters

AVL Systems	Annual capital cost savings per vehicle, \$225K cost per vehicle assumed	1%

	Annual Agency operating costs savings	5%
Traveler Information Systems	Percent travelers utilizing system	5%
	Percent of those who save time	20%
	Amount of time saved per traveler saving time	2 minutes

3.2 Economic Parameters

In order to compare benefits across various categories, the results of the IDAS evaluation will need to be monetized. **Table 6** presents a series of factors originally developed by the Wisconsin DOT (WisDOT) for this purpose. These parameters are documented in the WisDOT *Traffic Guidelines Manual, 16-20-70, Financial Assumptions for Engineering Economic Analysis, January 2008*. The parameters then were modified for use in analysis for the Virginia DOT, which is considered more comparable to North Carolina. Several factors were divided by region in Virginia and the factors developed for Northern Virginia were used in this study.

Some additional adjustments were made to this table to more accurately address conditions specific to the needs of NC. For evaluating transit time savings, it was assumed that the average income for transit riders generally is lower than the general commuting public. Except for larger metropolitan areas that provide an extensive rail transit system, this statistic is consistent in most urban areas. As a result, the value of time for transit riders was assumed to be half that of the general commuting public, or \$12/hour.

For analysis, separate values of time can be used for commuting trips, off-peak trips, and commercial vehicle trips. For North Carolina Analysis, the \$24/hour value of time represents an estimated composite of all vehicle trips, including commuting trips, non-work trips, and commercial vehicle trips. Commercial vehicle trips generally have a higher value of time than non-commercial trips, but a commercial vehicle market sector was not available for this analysis.

Table 6. Monetary Values of IDAS Default Parameters in Constant 2010 Dollars

	Parameter Values
<i>Benefit Parameters</i>	
Number of Travel Days in a Year	247
Year of Dollar Values	2010
Inflation Rate	3%
Value of In-Vehicle Time	\$24.00
Value of Travel Time for Transit	\$12.00
Fuel Costs (Gallon)	\$2.50
<i>Emissions Costs (Dollars/Ton)</i>	
HC/ROG	\$3,020
NO _x	\$6,351
CO	\$6,620
PM ₁₀	\$18,839
CO ₂	\$6.06
SO ₂	\$6.06
GW	\$0.00
<i>Accident Costs</i>	
<i>Internal</i>	
Fatality	\$4,490,000
Injury	\$86,415
Property Damage	\$7,760
<i>External</i>	
Fatality	\$696,213
Injury	\$15,250
Property Damage	\$847
No Fuel Operating Costs (Dollar/Mile)	\$0.11

4. PROJECT EVALUATION MEASURES

The North Carolina Department of Transportation (NCDOT) desires to have a process in place for MPOs and other agencies to use when determining ITS projects to implement. Currently, NCDOT uses several factors in ITS project priority, including available funding sources, agency priorities, and project investment. NCDOT has developed a new approach to project programming through the Strategic Planning Office of Transportation (SPOT). It was envisioned that the project evaluation approach presented through the SDP will coordinate with the SPOT to arrive at an effective approach for selecting and prioritizing projects. Each of the proposed projects in the FAMPO study region were evaluated to determine the best investment with regard to the motorists and the surrounding area, the timeframe, and which project would provide the highest return.

As part of the SDP, an evaluation matrix was developed for stakeholders to use as a tool to compare projects based on specific project evaluation measures including IDAS results. The matrix consists of five criteria used to evaluate each project. The cost/benefit criterion is just one that is used to guide the decisions regarding the best investment to yield the best return. The data compares the benefits to the costs between the different project packages. Other project evaluation measures captured in the matrix include travel time reliability, emission reduction, V/C ratio, and system preservation. This section provides an overview of the project evaluation measures used in the analysis.

4.1 Evaluation Matrix

The evaluation matrix is segmented into four major categories. These include Project Information, User Benefits and Mobility, Preservation, and Environmental. The project information captures specific characteristics about the project (shown in **Figure 4**) including the project ID, project name, description, the route covered by the project, MPO, county, type of project, the architecture service package(s) that represent the project, the area of ITS which the project covers (user service category), the expected year of implementation, the expected life of the infrastructure deployed, and costs related to the project.

ID	Project Description	Route/ Transit Agency	County	MPO	Project Type	Architectu re Market Packages	User Service Category	Year of Implementat ion	Expected Project Life	Estimated Capital Cost	Operating and Maintenance Cost (per year)
FAM-ATMSI295-006	Add ITS Devices. Add (8) CCTV cameras and (4) DMS on I-295 West of NC 24-87 (Bragg Boulevard) to south I-95 in Robeson Co. I-295 from NC/24/N87 (Bragg Boulevard) to South I-95.	I-295	Cumberland Robeson	FAMPO	Highway	ATMS01-1; ATMS06-1	Travel and Traffic Management	2017	12	\$1,035,906	\$24,040
FAM-ATMSUS401-001	Deploy ITS on US 401 Bypass from Ramsey St. to Robeson Co. line. Add (4) CCTV cameras and (0) DMS. US 401 Bypass from Ramsey St. to Robeson Co. line	US 401 Bypass	Cumberland	FAMPO	Highway	ATMS01-1; ATMS06-1	Travel and Traffic Management	2022	12	\$80,862	\$5,464
FAM-ATMSNC24-87-001	Deploy ITS on NC 24-87. Add (4) CCTV cameras and (2) DMS. NC 24-87 from I-295 to NC 27	NC 24-87	Cumberland	FAMPO	Highway	ATMS01-1; ATMS06-1	Travel and Traffic Management	2017	12	\$517,953	\$12,020

Figure 4. Evaluation Matrix – Project Information

The evaluation matrix is a weighted system that ranks the ITS projects developed as part of the deployment plan. The data incorporated in the matrix includes the results from IDAS, the FAMPO model, and project specific information. Each category is considered independently and normalized based on the maximum number of available points. It is important to normalize the

data before all of the projects in the matrix are compared so that outliers do not skew the results to produce ineffective rankings. The normalization methodology is explained further in Section 4.2. There are five categories that are considered, three of which will obtain data from IDAS. In addition, there is a score associated with system preservation and for projects on high volume/capacity (V/C) facilities. The 2006 travel demand and IDAS models were used to obtain the majority of the data. However, projects that were located on facilities that were not present in 2006 travel demand model were evaluated using 2035 data. Within the evaluation matrix, these projects are designated with an „**“ for clarification.

Operations and maintenance costs for the projects also are captured within the evaluation matrix. The O&M costs used in the evaluation matrix are the same values imported into IDAS for the purpose of managing costs in the analysis. The O&M costs used in the IDAS analysis are the same as those used in the Triangle effort. These costs are detailed in **Appendix B**.

Freeway Service Patrol (FSP) are the only project type that use a different strategy for the O&M values. FSP requires the addition of vehicles, which is captured in the capital costs, but also requires additional drivers to cover expanded routes. In keeping with the prior analysis – a cost of \$35k is assumed for each new vehicle – and a salary, or driver cost, of \$85k is added to the capital cost. The O&M is assumed to be this salary – at \$85k per vehicle. The useful life for vehicles is set to 5 years.

4.1.1 Benefit/Cost Ratio

The benefit/cost ratio is the first project evaluation measure under the User Benefits and Mobility category. The value is taken from IDAS and inserted into the matrix. IDAS generates a benefit/cost ratio based on the total monetized value of the benefits calculated for the project divided by the annualized cost of the project. The annualized cost encompasses the total capital cost, the operations and maintenance costs, and the life expectancy of the deployment components. **Figure 5** shows examples of benefit/cost data inserted into the matrix.

		User Benefits and Mobility					
Estimated Capital Cost	Operating and Maintenance Cost (per year)	Benefit / Cost		Travel Time Reliability		On or Adjacent to High V/C Facility	
		Raw Data	points	Raw Data	points	Raw Data	points (if applicable)
			20.0		20.0		20.0
\$1,035,906	\$24,040	9.6	20.0	\$778,690	20.0	0.895	9.5
\$80,862	\$5,464	7.2	14.4	\$0	0.0	1.425	20.0
\$517,953	\$12,020	9.5	19.7	\$232,668	6.0	less than 0.8	0.0

Figure 5. Evaluation Matrix – Benefit/Cost

4.1.2 Travel Time Reliability

Travel time reliability also is included within the User Benefits and Mobility category. It is a dollar value extracted from the IDAS output. It is defined as the estimated non-recurring delay associated with implementation of the associated project. IDAS uses a formula to compare the variation in incident frequency and incident duration to measure the benefit of a project. The value is provided in dollars and example values are shown in **Figure 6**. **Figure 7** demonstrates where within the IDAS software the IDAS results and specific Travel Time Reliability results can be found.

		User Benefits and Mobility					
Estimated Capital Cost	Operating and Maintenance Cost (per year)	Benefit / Cost		Travel Time Reliability		On or Adjacent to High V/C Facility	
		Raw Data	points	Raw Data	points	Raw Data	points (if applicable)
			20.0		20.0		20.0
\$1,035,906	\$24,040	9.6	20.0	\$778,690	20.0	0.895	9.5
\$80,862	\$5,464	7.2	14.4	\$0	0.0	1.425	20.0
\$517,953	\$12,020	9.5	19.7	\$232,668	6.0	less than 0.8	0.0

Figure 6. Evaluation Matrix – Travel Time Reliability

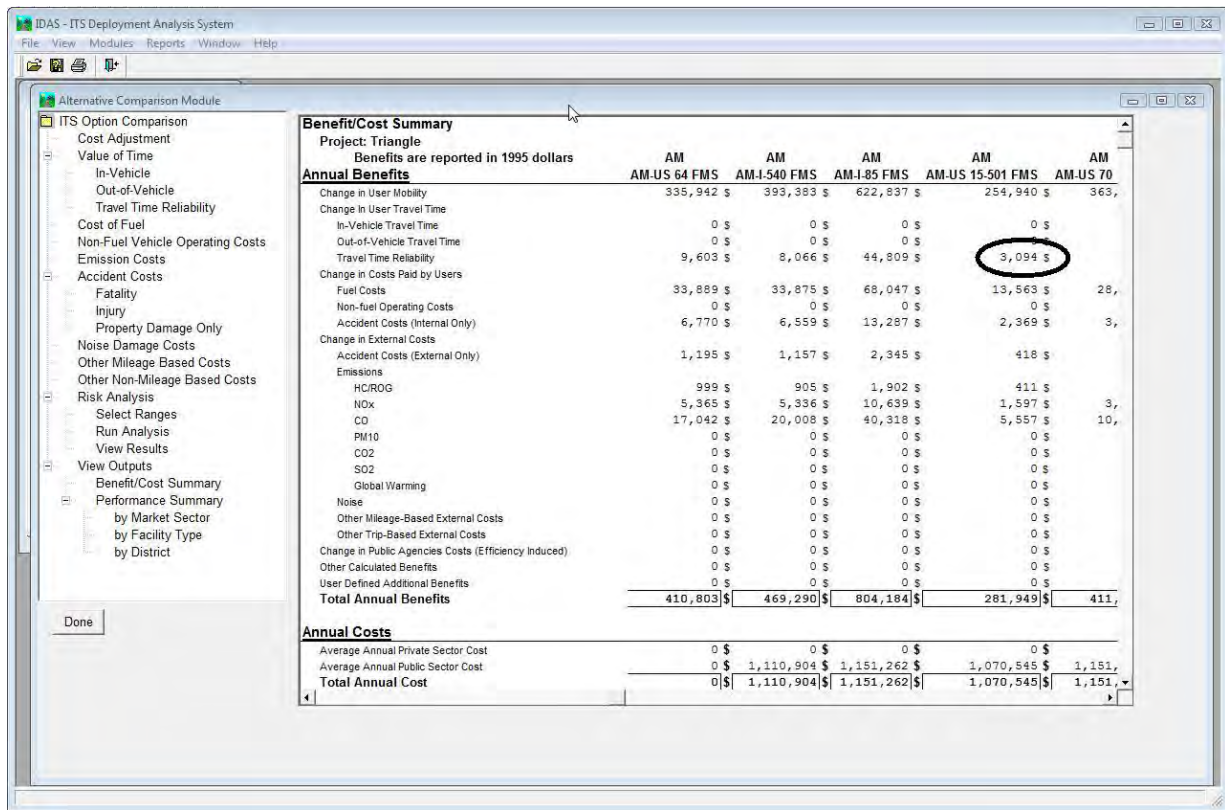


Figure 7. Travel Time Reliability Data Within IDAS

4.1.3 V/C Facility

The third and final metric included in the User Benefits and Mobility category is associated with the volume/capacity (V/C) ratio. The V/C ratio indicates where high levels of congestion exist; a high V/C ratio signifies greater congestion. In recent project development strategies, the NCDOT has identified V/C ratio as a key performance measure when evaluating the statewide network. For the analysis within the SDP, V/C ratio is defined as a project evaluation metric, which is different from the application used for performance measuring evaluation. Within the SDP, a weight is assigned to those applicable corridors with high V/C ratios to quantify the significance of the project location.

For each project, an average V/C ratio is computed by the sum of each link V/C ratio weighted by VMT then divided by the sum of the link VMTs. It only applies for those projects along specific corridors. It also is assumed that the V/C ratio will be from the PM peak assignment from the existing plus committed scenarios.

Note: The prior study (Triangle Region) – used the AM and PM peak values for V/C ratio calculation. However, in the FAMPO model – it was found that the PM period of the model is more congested than the AM period, so the volumes from the PM period were used exclusively here.

The ratio will help select projects based on their ability to contribute to the system-wide V/C ratio. This data is extracted from IDAS. It is important to remember, however, that the IDAS database *contains* the exact volumes and capacities as the model does *in* the base network links table. Therefore, if the model link information is easily accessible to the user, those values would provide the same results.

Note: In the FAMPO area study – many projects are *outside* of the region covered by the model. In these cases, IDAS in a Spreadsheet was used to evaluate the ITS benefits. Because of this, *daily* volumes, not peak period volumes, are used. Therefore, V/C will never be higher than the low threshold described below. Thus, the V/C value in the raw data is 0.0.

Figure 8 highlights the V/C column within the evaluation matrix. The V/C ratio data used will be assigned values as shown below.

- For V/C ratios less than 0.8, 0 points are assigned
- For projects with V/C ratios of 0.80 to 1, $(V/C - 0.8) / 0.2$ of the points available in this category will be assigned.
- For V/C ratios greater than 1.0, 100% of the points will be assigned.

		User Benefits and Mobility					
Estimated Capital Cost	Operating and Maintenance Cost (per year)	Benefit / Cost		Travel Time Reliability		On or Adjacent to High V/C Facility	
		Raw Data	points	Raw Data	points	Raw Data	points (if applicable)
			20.0		20.0		20.0
\$1,035,906	\$24,040	9.6	20.0	\$778,690	20.0	0.895	9.5
\$80,862	\$5,464	7.2	14.4	\$0	0.0	1.425	20.0
\$517,953	\$12,020	9.5	19.7	\$232,668	6.0	less than 0.8	0.0

Figure 8. Evaluation Matrix – V/C Ratio

4.1.4 System Preservation

System Preservation is intended to give weight to projects that are necessary to maintain current systems or technologies, such as replacing or upgrading existing equipment to maintain function. In most circumstances, the costs associated with maintaining the current infrastructure will outweigh the importance of expansion projects. Values for the system preservation projects are not extracted from IDAS. The projects are input into IDAS so the cost stream associated with the operations and maintenance costs and eventual replacement costs are captured with proposed projects. **Figure 9** shows the System Preservation portion of the evaluation matrix.

For the evaluation matrix, the system preservation projects were weighted within the *System Preservation* column based on their relationship to the current year. To calculate the *Expected Year of Implementation*, the matrix references the year of implementation for the existing deployment components and adds the *Expected Project Life*. To generate a *System*

Preservation raw data score, the current year is then subtracted from the Expected Year of Implementation.

$$\text{System Preservation Raw Data} = \text{Expected Year of Implementation} - \text{current year}$$

Points for each project then are determined through the normalization process described in Section 4.2.

				User Benefits and Mobility						Preservation	
Year of Implementation	Expected Project Life	Estimated Capital Cost	Operating and Maintenance Cost (per year)	Benefit / Cost (20 Points)		Travel Time Reliability (20 Points)		On or Adjacent to High V/C Facility (20 Points)		System Preservation (20 Points)	
				Raw Data	points	Raw Data	points	Raw Data	points (if applicable)	Raw Data	points
					20.0		20.0		20.0	2012	20.0
2006	10	\$15,079,633	\$1,507,963	N/A	N/A	N/A	N/A	1.272	20.0	4	20.0
2006	12	\$222,370	\$15,025	N/A	N/A	N/A	N/A	1.019	20.0	6	16.9
2006	12	\$222,370	\$15,025	N/A	N/A	N/A	N/A	0.9	10.1	6	16.9

Figure 9. Evaluation Matrix – System Preservation Projects

4.1.5 Emission Reduction

The fifth metric is emission reduction and its values are extracted from the IDAS output. The emission reduction is determined by calculating the difference between emissions associated with the control alternative and the ITS project evaluated. The emissions rate is determined for each pollutant under study by characterizing links by facility type, travel mode and type, year of study, and speed range. It then is multiplied by the volume on the link to determine the mass pollutant emitted for that link. All links associated with the project are then summed to calculate the aggregate emissions for the project. Additionally, three types of emissions are calculated and must be summed for the total emission reduction value that is entered in the evaluation matrix. **Figure 10** contains example values for this category.

		User Benefits and Mobility						Preservation		Environmental	
Estimated Capital Cost	Operating and Maintenance Cost (per year)	Benefit / Cost		Travel Time Reliability		On or Adjacent to High V/C Facility		System Preservation		Emission Reduction	
		Raw Data	points	Raw Data	points	Raw Data	points (if applicable)	Raw Data	points	Raw Data	points
			20.0		20.0		20.0		20.0		20.0
\$1,035,906	\$24,040	9.6	20.0	\$778,690	20.0	0.895	9.5	N/A	N/A	-0.04319	20.0
\$80,862	\$5,464	7.2	14.4	\$0	0.0	1.425	20.0	N/A	N/A	-0.01531	5.7

Figure 10. Evaluation Matrix – Environmental Category

4.2 Normalization of Data

Once the data is input into the evaluation matrix, each category must be normalized and points assigned. Each category has a maximum number of points available and a project achieves points based on a comparison of results between all of the projects. The project with the lowest reduction, hours, or net return will be given zero points. The project with the highest reduction, hours, or net return will be given the maximum number of points specific to each category. All of the projects in between will be given points according to categorical formulas established. The data is normalized based on the following formulas for each category.

Benefit/Cost and Travel Time Reliability:

$$\text{Points} = \left(\frac{R - \text{MIN}}{\text{MAX} - \text{MIN}} \right) \times (\text{Points Possible})$$

Where: R = raw data from IDAS

MAX = maximum value of all raw data

MIN = minimum value of all raw data

V/C Ratio:

For $R < 0.8$, Points = 0 Points

For $R > 1.0$, Points = Maximum Points Possible

$$\text{Points} = \left(\frac{R - 0.8}{0.2} \right) \times (\text{Points Possible})$$

Where: R = raw data; maximum V/C ratio for the given corridor

MAX = maximum value of all raw data

MIN = minimum value of all raw data

System Preservation:

$$\text{Points} = \left(\frac{R - \text{MAX}}{\text{MIN} - \text{MAX}} \right) \times (\text{Points Possible})$$

Where: R = raw data; number of years until the project will require replacement

MAX = maximum value of all raw data

MIN = minimum value of all raw data

Emission Reduction:

$$\text{Points} = \left(\frac{R - \text{MAX}}{\text{MIN} - \text{MAX}} \right) \times (\text{Points Possible})$$

Where: R = raw data from IDAS

**emission reduction raw data is given with negative numbers being more advantageous, therefore the normalization formula was modified to reflect more points for a smaller number. This formula only considers values less than 0 (reduction in emissions).

MAX = maximum value of all raw data

MIN = minimum value of all raw data

After points are assigned for each project they are tallied for the *Total Points*. The *Out of Possible Number of Points* column captures the total possible points that a specific project can achieve. For example, a system preservation project will not have IDAS generated values since the deployments exist and it is difficult to calculate their benefit since the benefits are currently realized within the travel demand model. Finally, the *Total Ranking* is determined as a percentage of points that are possible to obtain for each given project. The formula is shown below.

$$\text{Total Ranking} = \text{Total Points} / \text{Out of Possible Number of Points}$$

This provides a value for each project that can be compared for the prioritization of projects.

5. RESULTS OF ANALYSIS

Appendix C contains the complete evaluation matrix for all of the projects. As previously stated, the matrix includes columns for county, MPO, project type, and route/transit agency so stakeholders can sort projects by a combination of score and other descriptors. Within each of the defined categories, the projects are sorted based on their total score and rank. The projects then are assigned a timeframe of short, medium, or long term. This timeframe is for packaging and prioritizing projects and does not specify the anticipated year of implementation for unfunded projects. NCDOT and local stakeholders assigned a timeframe to each project as a starting point. As defined in the Regional ITS Architecture Document, projects scoring within the top tier will be classified as short term (0-5 years); second tier projects will be classified as medium term (6-10 years); and the lowest scoring tier projects will be classified as long term (over 10 years). This also is controlled for capability of the project to be built (e.g. a project may show high evaluation score, but may be located on a facility that is not to be constructed for 10 years). It is expected that stakeholders will assess within each category to refine the phases of deployment. Additionally, the project architectures within the Turbo Architecture database will be revised to include the assigned timeframe.

The analysis process determined a preliminary phasing, based on the ranking and the initial phasing category for each of the projects to provide a second point for stakeholder discussion. The short term phase included the smallest number of projects assuming that less funding would be available during the first few years, but as projects are more integrated with the regional planning efforts, funding could increase for the medium and long term projects.

5.1 System Preservation Projects

Logically, the System Preservation projects ranking the highest include devices that are nearing or have reached the end of their estimated life expectancy. The only project evaluation measures available to these projects are their location relative to high V/C ratio facilities and the time to the end of their anticipated life expectancy. These allow projects implemented the same year to rank higher if they are located on more congested roadways. The projects with short timeframes are those that are already at the end of their life expectancy or will be within a few years.

5.2 Highway Projects

The Highway projects that rank highly tend to be those with high benefit/cost ratios and that are located on or adjacent to facilities with high volume/capacity ratios and will have a large positive impact on travel time reliability. The types of projects that comprise the highly ranking projects vary widely including signal coordination, ramp metering, and freeway management strategies on certain corridors. It also is interesting to note that no one type of deployment within the highway category scored consistently high or low.

Within the highway projects are 2 implemented on I-295 whose benefit outcomes were widely different from each other. One of these ranks 1st in overall score, while the other ranks 11th. As this may seem counterintuitive the reasons for the difference are described next.

The first project, FAM-ATMSI295-002 (ranking 11th) is implemented along the only portion of I-295 that exists today. Because this is a short term deployment, the 2006 model was used to calculate its benefits. Even though the total length of the facility in this deployment is similar to that of the other (FAM-ATMSI295-006, ranking 1st), it is important to remember that a travel demand model will assign less volume on a facility if it ends in a location that is not likely to be a major destination in the travel demand matrix.

However, that second project is a *medium* term project. For medium term projects, the analysis strategy was to use the 2035 network, and to factor the volumes from the 2006 model *up* by the linear interpolation between the volumes in 2006 and 2035.

Therefore, since I-295 exists in the 2035 model as the complete Fayetteville Outer Loop, the travel demand model will place more volume along the *entire* loop as the facility is then available for its intent, as a freeway bypass around the urban area.

Thus, these higher volumes in the future year account for the discrepancy in the ranking of these two projects.

5.3 Emergency Management Projects

Freeway service patrol is the only project type quantified within the emergency management category. When reviewing the rankings for these projects, it is important to apply another level of evaluation based on the location of each route and the ease of expansion. For example, a route on the eastern portion of the region may generate a high score, but several other expansion routes may exist between the current coverage and that route. Two additional emergency management projects were defined (and are included in the Emergency Management Tab for completeness) although they could not be analyzed using IDAS due to the nature of the projects.

5.4 Transit Projects

Transit deployments analyzed for this project are system wide options. They are not specific to any corridor, route, or between regions of travel. Because of this, the results were obtained using actual FAMPO ridership information in Workbook analysis rather than using the IDAS transit methodologies which are designed to consider portions of the transit market.

Therefore, in contrast to the prior (Triangle region) study, and due to the nature of the majority of the transit options in that study, there are differences in the types of benefits (results) obtained in this analysis and the prior study. Specifically, the prior study included many transit signal priority deployments. When *those* deployments are done, travel patterns along the specified corridor do change to an extent that modeled travel time reliability (TTR) and emissions results are produced by IDAS. However, when systematic changes are applied to transit operations, we don't see any change to network performance anywhere on the network, and thus, TTR and emissions results are zero.

In order to maintain consistency the structure and format of the prior Evaluation Matrix, however, the values in the Transit worksheet of the matrix for these scoring columns are set to "N/A". It is also noted that the "On or adjacent to a High V/C Corridor" classification also has no meaning, since we are not considering any one facility in this analysis.

5.5 Regional Non-infrastructure Projects

This category captures a handful of stakeholder identified projects that are not easily evaluated through an IDAS or regional model approach. The regional need of these projects is noted based on the identification of the stakeholders, but most require a project specific analysis that cannot be accomplished through an IDAS analysis. For example, the regional TDM does not include an evacuation scenario and cannot appropriately evaluate the impact of technology to enhance congestion during an evacuation. Similarly, the idea of a regional fusion center for public safety agencies can provide benefits to coordination efforts and improve response time, but again is not easily evaluated using the IDAS methodology. The projects do not generate a score or rank within the evaluation matrix, but it is important for these identified projects to remain in the deployment

plan as a regional need. As similar projects are evaluated in other regions of the country, more benefit/cost related data will be available for analyzing these projects. Additionally, as specific funds become available or operational requirements within agencies are identified specific to these projects, the stakeholders may chose to move these projects to a higher phase within the deployment plan. The Regional Non-Infrastructure projects are included in a tab in Appendix C for completeness, even though they could not be analyzed.

5.6 Statewide Non-Infrastructure Projects

Statewide Non-Infrastructure projects represent projects identified by the stakeholders as statewide initiatives, but have direct regional implications with their deployment. Most of the projects do not include the implementation of field devices, but instead focus on software customization, the evaluation and development of plans, and customization to statewide traveler information resources. The statewide projects are not easily evaluated using the IDAS software, and do not have values for the prescribed project evaluation measures. Since they were not evaluated, they were not given a rank within the evaluation matrix.

These projects are not assigned to be funded or managed in FAMPO region so they are not included in the evaluation matrix.

5.7 Fort Bragg Projects

Fort Bragg projects represent projects internal to the base. Because Fort Bragg has its own travel demand model analysis effort, these projects were not analyzed as part of this effort. The projects are included in the document for completeness.

APPENDIX A – PROJECT MAPS

Contained in separate Attachment.

APPENDIX B – MEMO PRESENTING OPERATIONS AND MAINTENANCE COST

See Statewide Result

APPENDIX C – EVALUATION MATRICES

Contained in Separate Attachment

Appendix A- Regional Deployment Maps

This appendix provides detailed maps of the ITS device deployments in the Fayetteville Area. The maps identify current, funded, and proposed deployment locations.

Figure A-1: ITS Device Deployments- Overall Regional View with IDAS Model Area Highlighted

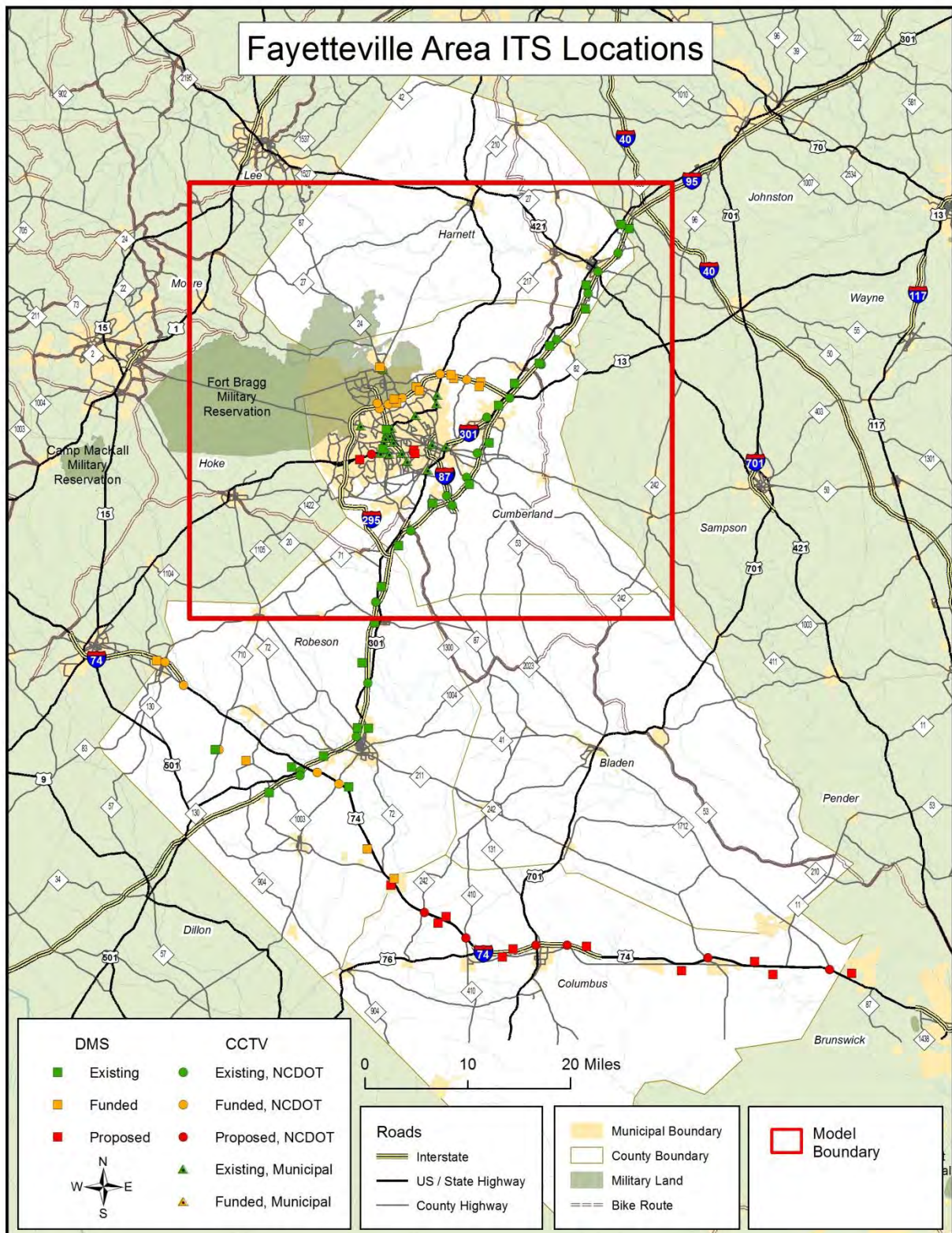


Figure A-2 provides a more detailed view of the device deployments within (and nearby) the City of Fayetteville.

Figure A-2: ITS Device Deployments- City of Fayetteville Details

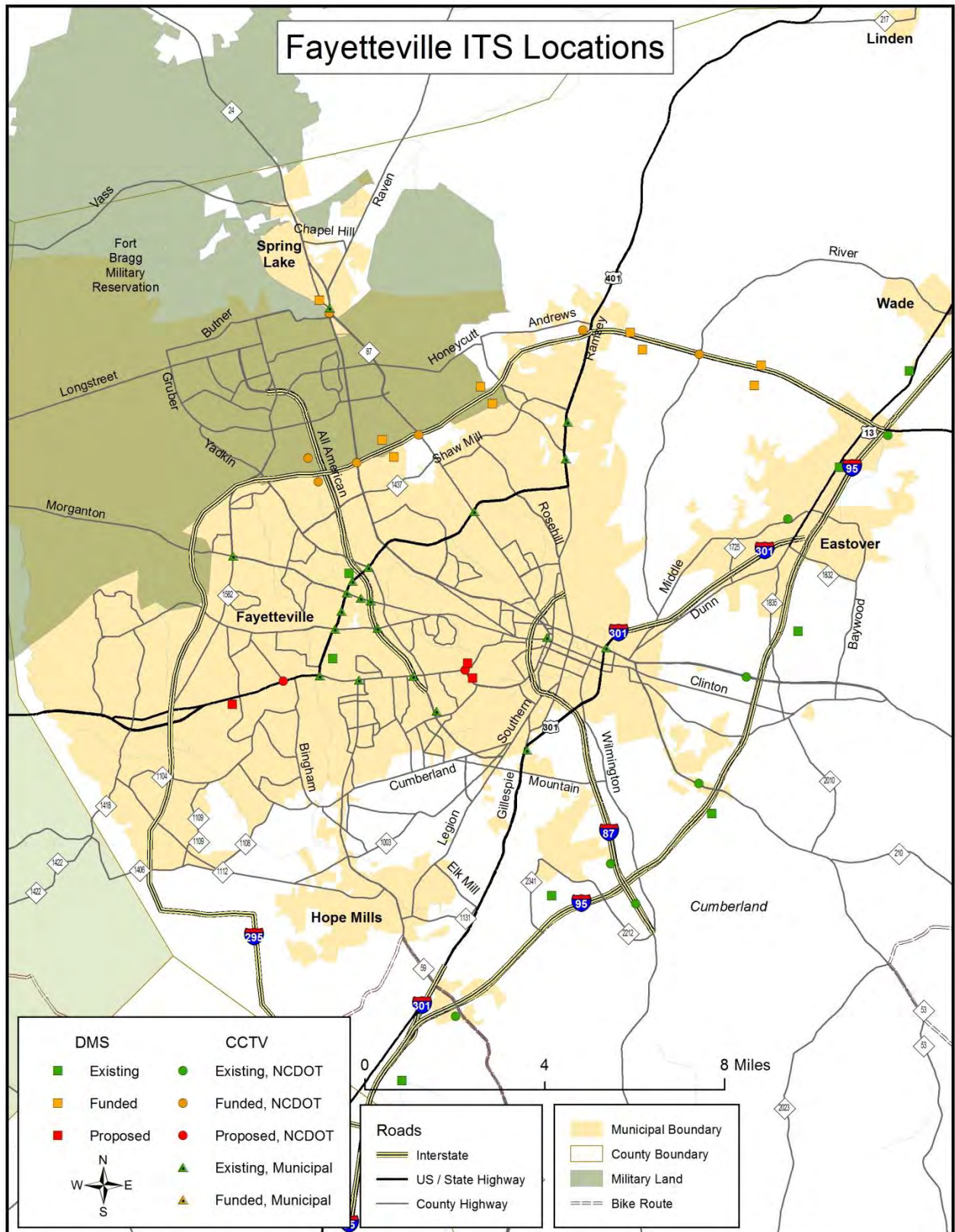


Figure A-3 provides a detailed view of the ITS Device deployments in the northern part of the overall region.

Figure A-3: ITS Device Deployments- Northern Portion of Region

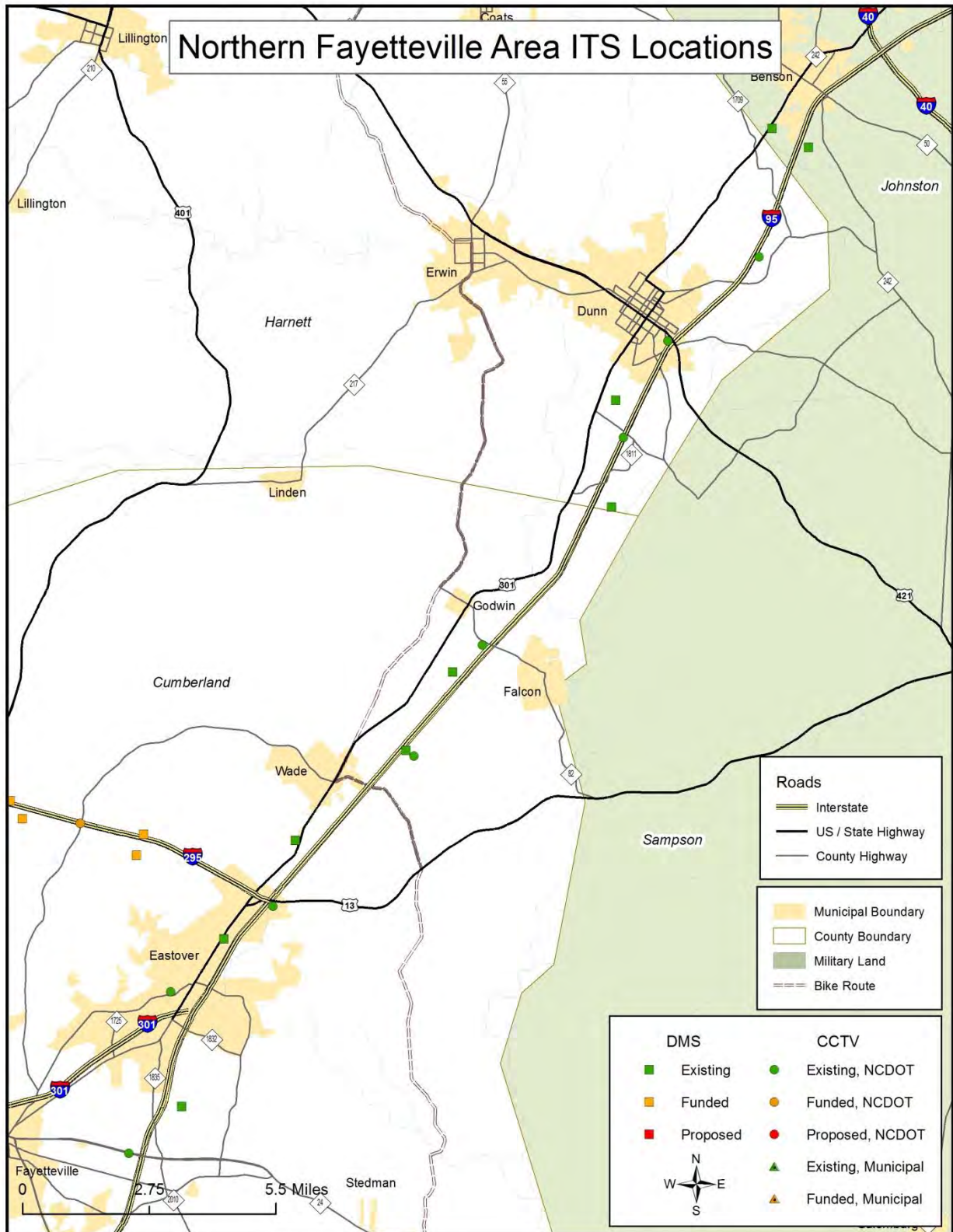
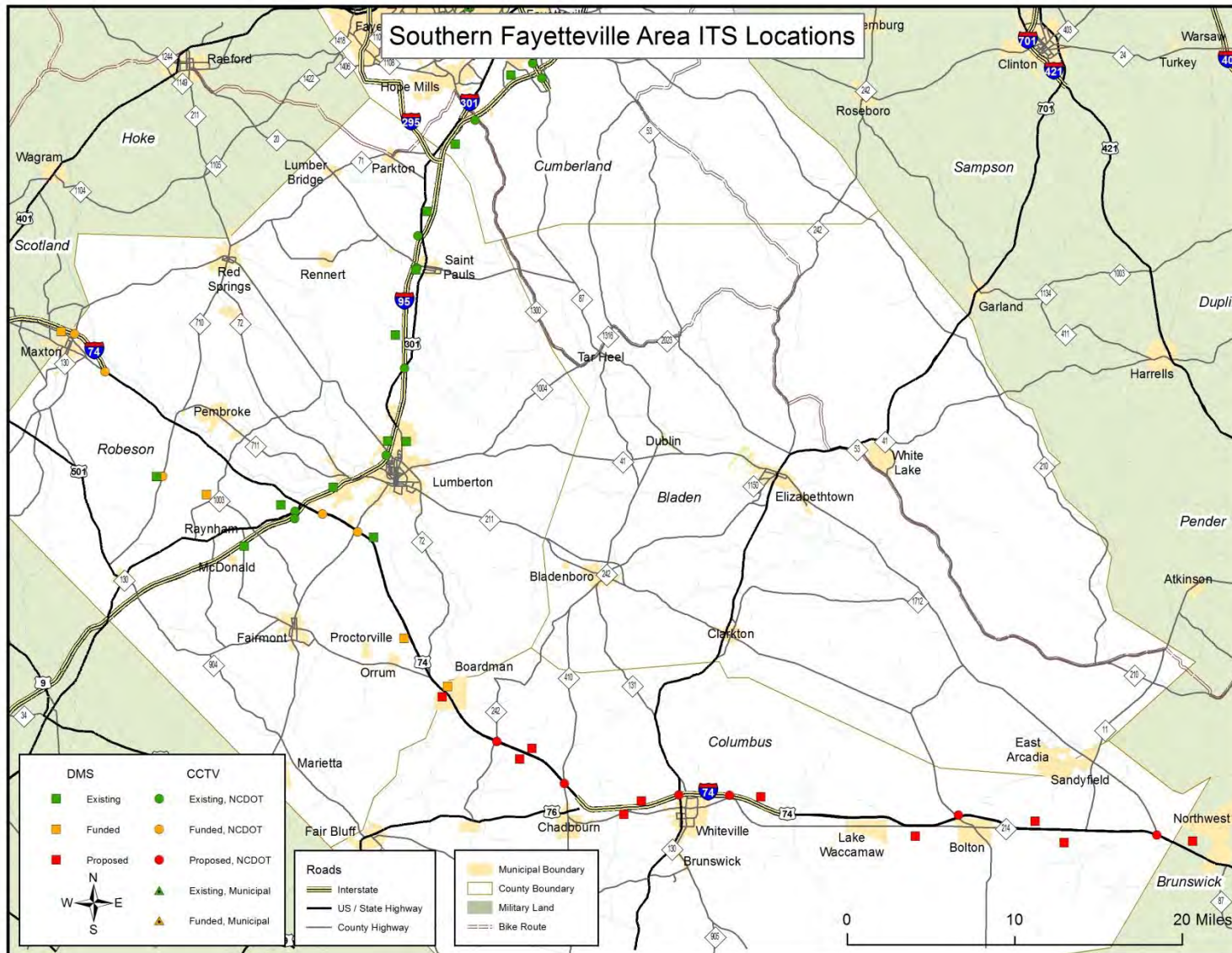


Figure A-4 provides a detailed view of the ITS Device deployments in the southern part of the overall region.

Figure A-4: ITS Device Deployments in the Southern Portion of Region





Kimley-Horn
and Associates, Inc.

Memorandum

■
P.O. Box 33068
Raleigh, North Carolina
27636-3068

To: Ed W. Sirgany, P.E.
North Carolina Department of Transportation
Highway Division 5

From: Mark W. Dunzo, P.E. *M.D.*
Kimley-Horn and Associates, Inc.

Date: February 4, 2010

Subject: Triangle ITS Strategic Deployment Plan Project
Annual O&M Costs

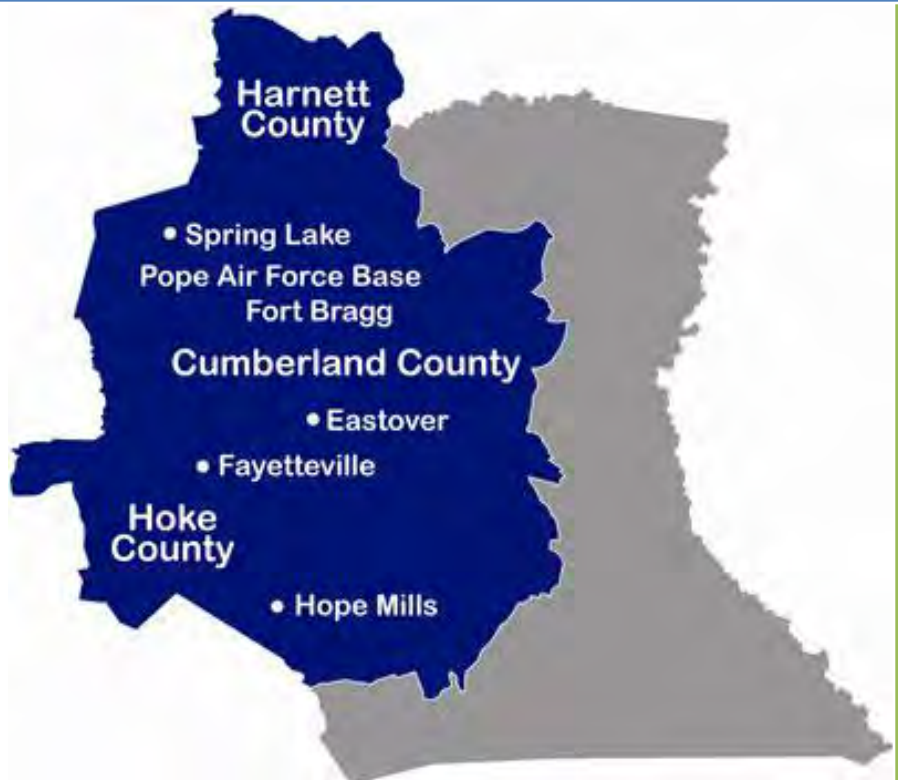
As part of the project evaluation, IDAS looks at capital and annual operations and maintenance (O&M) costs to determine an annualized cost for projects. For the Triangle region, we are applying a value of 10% of the capital cost. The 10% value is based on a sampling of actual O&M costs received from NCDOT Division 5, as well as general guidance from the USDOT ITS Cost Database.

The Triangle Regional Transportation Management Center (TRTMC) in NCDOT Division 5 has documented O&M costs that are approximately 8% of capital costs for closed circuit television (CCTV) cameras, 18% for microwave vehicle detector (MVD) units, and 3% for typical dynamic message sign (DMS) units. Analyzing a sample six-mile freeway management project in the Triangle region, which includes 2 DMS, 12 MVD, 6 CCTV cameras, the NCDOT Division 5 O&M costs for the ITS project is calculated as approximately 8.5% of the capital cost. It should be noted that the costs from NCDOT Division 5 are purely for material costs associated with annual O&M. Including estimations for other costs, such as labor and resources (tools, testing equipment, bucket trucks, etc.), we feel that the annual O&M costs should be 10% of the capital cost. Thus, as part of the IDAS analysis, we recommend that 10% is applied as the O&M for highway deployments.

MWD/KWS

FAMPO Regional ITS Strategic Deployment Plan Update

Final IDAS Manual



Prepared for:
Fayetteville Area Metropolitan Planning Organization
(FAMPO)

Prepared by:



ConSysTec



May 2013

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Revision History

Filename	Version	Date	Authors	Comment
Draft IDAS Manual	0.1	10/22/12	K. Vorhees, N. Clark	Initial Draft
Final IDAS Manual	1.0	12/3/12	K. Vorhees, N. Clark	Final incorporating comments
FAMPO Final IDAS Manual- 2013-04-12	1.01	4-12-13	B. Eisenhart	Update for Final Workbook
FAMPO Final IDAS Manual- 2013-05-24	1.02	5/24/2013	J. Baker	Update Final for Workbook and DVD

Executive Summary

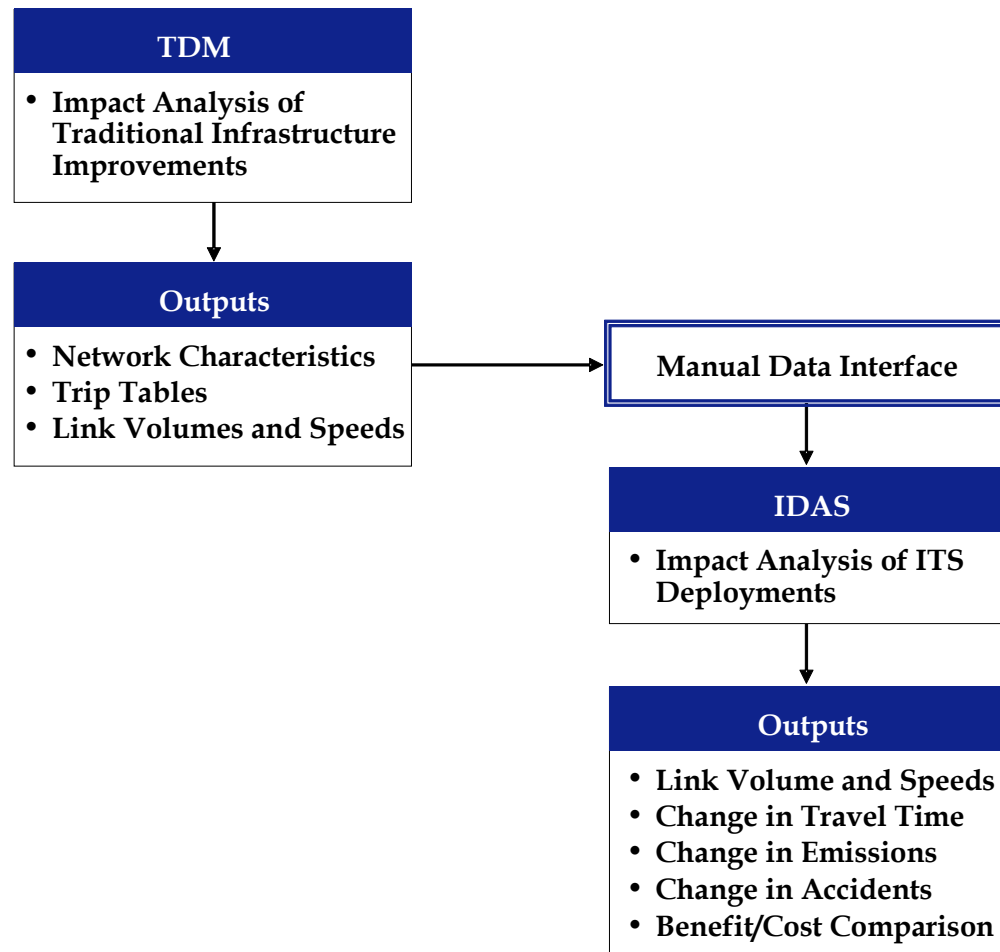
■ ES.1 Background

The intent of the document is to assist future users of IDAS in North Carolina in reaching the full potential of the IDAS system quickly and easily. This document follows the entire process of using the *Intelligent Transportation Systems (ITS) Deployment Analysis System* (IDAS) in the Fayetteville region of North Carolina. The Triangle region, including Raleigh, Durham and Chapel Hill, was used as a prototype for IDAS implementation in North Carolina in 2010. The Fayetteville IDAS analysis is using the same general process as was developed for the Triangle region. As IDAS is deployed in different regions of the state, the manual will require modification to account for differences in travel demand models and ITS deployments.

■ ES.2 IDAS Analysis Process

The ITS Deployment Analysis System software was developed by the Federal Highway Administration (FHWA) as a sketch-planning tool specifically designed to help planners better estimate the potential benefits and costs of proposed ITS deployments. The IDAS software utilizes the same techniques a travel demand model would use to estimate transportation network performance characteristics. Therefore, the point of entry to IDAS involves importing the travel demand model files and parameters into the system for analysis. **Figure ES.1** shows how a travel demand forecasting (TDF) model and IDAS interact with this common data.

The IDAS tool works by importing data from the TDM in order to recreate the validated regional network structure and travel demand within IDAS. The data exchanged between the model and IDAS includes network data regarding the characteristics of transportation facilities in the region and travel demand data, including the number of trips and mode share of travel between different zone pairs in the model. This baseline scenario is then analyzed in IDAS and the results should be compared with the model results for validation purposes.

Figure ES.1 IDAS Data Flows

Once the network and travel demand data have been imported and validated, the IDAS user is then able to create analysis alternatives by selecting ITS components from a menu of over 60 ITS improvement types, and placing these on the desired location on the network. After the analysis alternative has been created, the user may perform analysis within the software to estimate the incremental impacts of ITS deployment, including changes in link speeds and volumes, and travel mode shares. From these impacts, IDAS estimates the changes in a number of performance measures, including travel time, accidents, emissions, noise, and other impacts. These benefits are summarized for the user and form the basis for comparison with other deployment alternatives created by the user.

IDAS was specifically designed to complement the analysis performed by TDMs. Combining the capabilities of the two models provides a useful tool for analyzing and comparing ITS deployments, as well as more traditional types of infrastructure deployments.

The number of ITS deployments involved in most analysis efforts can grow quite large. Because of this, tools have been developed (and described here) that have shown value in assisting users in keeping all information organized and accessible—while at the same time allowing the placement of certain parameters at a single point in the collection of results.

For example, when a single deployment is analyzed, one can obtain the results of that analysis from a single place. However, when many deployments are to be analyzed in different combinations and compared, it is much better to place those results in a single system in which certain inputs, such as the cost of travel time savings or equipment costs, can be applied consistently across a full set of scenarios in one place.

These “back end” support systems are described in this document in parallel with the traditional discussion of IDAS processes with the aim of allowing the reader to prepare for their use from the beginning.

■ ES.3 Conclusions

The interface between TDMs and IDAS, and the tools used to manage the volumes of information produced by the system, as described in this document, follow the actual steps taken during the ITS analysis done using the FAMPO travel demand model.

1.0 Introduction

■ 1.1 Purpose

The purpose of this document is to describe all of the steps, from model data import, to benefits/costs reporting and manipulation, to efficiently analyze ITS deployments in the Fayetteville area of North Carolina using the Intelligent Transportation Systems (ITS) Deployment Analysis System (IDAS).¹ The tools used here can help support planners in evaluating ITS projects and assessing the impacts of ITS investments.

Although this document provides a great deal of information regarding IDAS, it is not intended to fully document the application and use of these tools. The latest IDAS documentation is available at:

<http://idas.camsys.com>

Most of the information presented here is in fact *not* included in the information posted on the aforementioned web site. That information pertains to the methodologies of IDAS as well as information on interfacing a “stock” or “generic” model into IDAS. However, in the present case, we are going through the details of importing a specific model, using tools that were not available when IDAS 2.3 was released (June 2003), and we will be discussing some analysis support tools that have only recently been developed.

■ 1.2 Project Background

This document has been prepared as part of the Fayetteville Area ITS Strategic Deployment Plan Update. The overall purpose of this project is to develop an integrated strategic deployment plan for Fayetteville, specifically, the Fayetteville Area Metropolitan Planning Organization (FAMPO). To that end, there are several key tools, references, and guidance documents that will be developed as part of the effort. These include an evaluation of successful practices in other areas, development of regional vision, goals, and objectives, and a gap assessment for the region. The project also includes updating of the regional ITS architecture and documentation of that process.

These initial activities provide input into the development and implementation of an IDAS model for FAMPO. The model will be used to evaluate proposed ITS deployments,

¹ References to the IDAS software in this document refer to IDAS Version 2.3.

including both updates and replacement of existing equipment and proposed new deployments. A critical part of this effort is to provide documentation and training so that FAMPO and NCDOT staff can maintain the IDAS model on a continuing basis and update it when required. It also is anticipated that this process will be replicated throughout the state with the goal of mainstreaming ITS benefit/cost analysis into the various MPO and NCDOT planning processes. These project objectives generated the need for a tailored manual, specifically oriented toward the Fayetteville area IDAS model.

■ 1.3 What Is IDAS Analysis Intended to Do?

The ITS Deployment Analysis System software was developed by the Federal Highway Administration (FHWA) as a sketch-planning tool specifically designed to help planners better estimate the potential benefits and costs of proposed ITS deployments. The IDAS software operates as a post-processor to travel demand models.

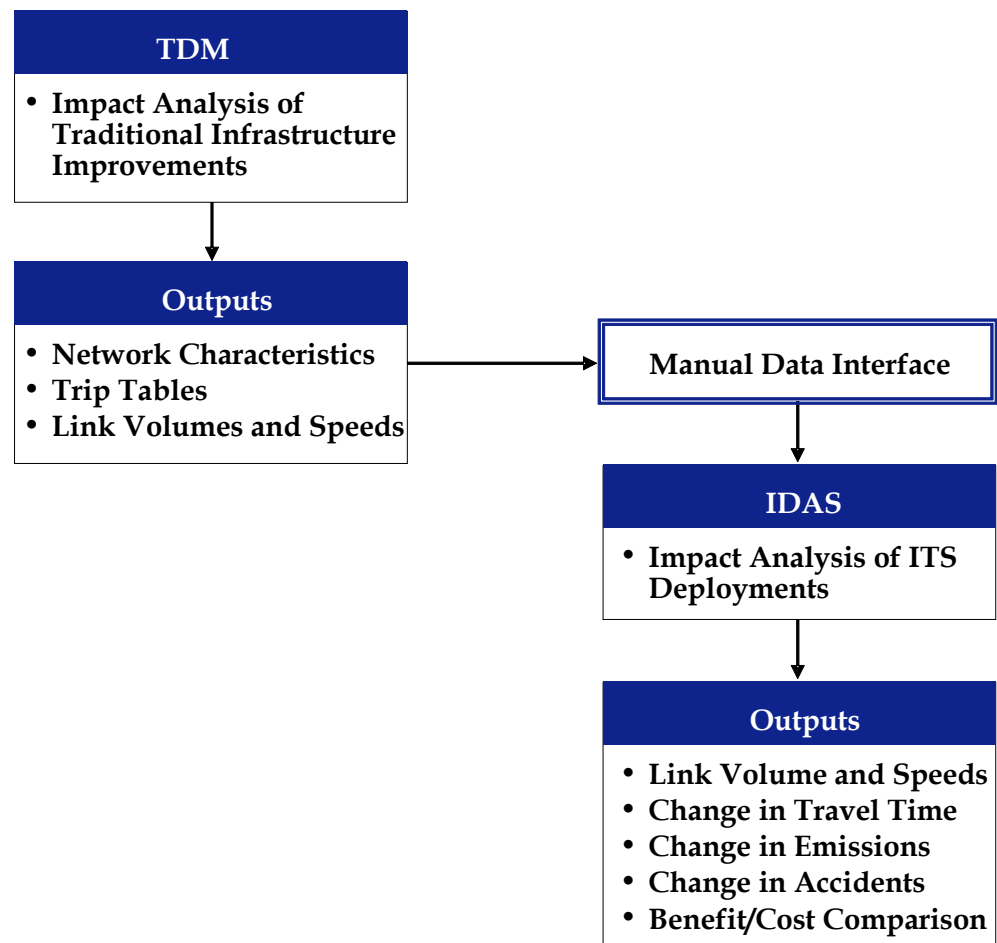
Sketch-planning tools are intended to provide planning-level analysis of various deployment alternatives with a minimum effort, using existing data sources.

Instead of being built from the ground up like a TDM, IDAS is intended to mimic and build upon an existing model. Reliance on data from a validated TDM makes IDAS easier to use since the customization and calibration efforts are significantly less. In fact, IDAS shares many of the same analysis techniques and processes as TDMs but has expanded capabilities that allow analysis of ITS deployments. These capabilities are unavailable in TDMs because they lack the algorithms to apply the necessary characteristic changes to a network. However, it is important to note that IDAS is not as effective as most TDMs in some areas, such as performance analysis when building new facilities or adding lanes.

■ 1.4 What Analysis Can Be Performed Using IDAS?

The IDAS software, as a post processor of travel demand models, represents a useful tool for planners wanting to consider various ITS deployment scenarios. By carefully structuring the development of alternative scenarios and screening approaches, IDAS can be used to answer the following deployment questions:

- What types of impacts/benefits result from different types of ITS components?
- What types of ITS components provide the greatest benefits for the region?
- On which facility types does the deployment of ITS components provide the greatest level of benefits?

Figure 1.1 IDAS Data Flows

- At which geographic locations does the deployment of ITS components provide the greatest level of benefits?
- What is the impact of combining different types of ITS components?
- How do the benefits of various deployment scenarios compare to costs, either on an annualized basis, or over a period of time?

Although primarily developed to answer these types of questions regarding future potential deployments, the IDAS software also has the capability to provide estimates of benefits and costs of ITS components that have been previously deployed and are currently operating. IDAS can be used in various planning efforts, including:

- Deployment of regional ITS architectures
- Statewide, regional, and local ITS plans
- ITS alternatives analysis for long-range planning
- ITS strategies for corridor studies
- Evaluations of ITS components or systems
- ITS strategic plans or pre-deployment studies

Since its initial release in 2000, IDAS has been applied by dozens of different regions to analyze the impacts of ITS deployments. **Table 1.1** presents a sample of the locations and purposes of these IDAS studies.²

Table 1.1 Sample IDAS Applications

Location	Study Type	Type of ITS Deployment
Orlando Region	Regional ITS Long-Range Deployment Plan	• Variable Message Signs • Arterial Signal Coordination • Transit Signal Priority • Transit AVL
Cincinnati, OH	Evaluation of ITS Components	• Incident Management • Variable Message Signs • Traveler Information Systems

² Several of these sample studies have been documented in case studies available on the IDAS web site at <http://idas.camsys.com>.

Location	Study Type	Type of ITS Deployment
Detroit, MI	Short-Range Pre-Deployment Study	• Incident Management • Variable Message Signs • Traveler Information Systems • Traffic Surveillance
Wisconsin	Regional Deployment Plans in Northeast and Southwest Regions	• Freeway Management Systems • Incident Management • Traveler Information Systems • Traffic Gates and Law Enforcement Support
Michigan	Regional Deployment Plans in 5 DOT Regions	• Freeway Management Systems • Incident Management • Road Weather Information Systems • Smart Work Zones
Kansas City SCOUT	Evaluation of Existing and Proposed ITS System	• Freeway Management Systems • Incident Management • Traveler Information • Ramp Metering
St. Louis, MO	Arterial ITS Strategic Deployment Plan	• Corridor-Based Arterial Signal Coordination
Florida DOT District 5	Evaluation of Existing System	• Freeway Management System • Arterial ITS Deployments • Emergency Management ITS Systems • Traveler Information • Incident Management
NCDOT Triangle Region	Regional ITS Strategic Plan	• Freeway Management System • Arterial ITS Deployments • Emergency Management ITS Systems • Traveler Information • Incident Management

■ 1.5 How to Use This Document

This document is formatted to guide users quickly to the relevant sections in which they are interested. Sections 4.0–9.0 specifically describe the steps necessary to interface the model with IDAS and conduct an analysis. Each section provides specific discussions regarding one particular interface issue. Appendices provide additional detail, including the proper setup and use of the interface tools. The topics covered in each of the sections include:

- **Section 2.0 – IDAS Overview.** This section provides a brief description of the IDAS model and its structure.
- **Section 3.0 – Model Overview.** This section provides a brief description of the Triangle Region TDM and instructions for extracting data from it for import into IDAS.

- **Section 4.0 – Getting Started.** This section provides guidance in setting up the IDAS for first-time use.
- **Section 5.0 – Importing Network Data.** This section focuses on issues related to the preparation of TDM data for import and the importing of that data. This data includes the node coordinate and link characteristics files.
- **Section 6.0 – Importing Market Sector Data.** This section describes the process used to generate and import the matrix files representing the zone-to-zone travel demand.
- **Section 7.0 – Volume Delay Curves in IDAS.** This section describes how volume delay curves are calculated, tabulated, associated with facility type and area type, and then imported into IDAS.
- **Section 8.0 – Running the Baseline Analysis.** This section details running the benefits module on the baseline network in order to find the control alternative network performance measures (for validation).
- **Section 9.0 – Validating the Baseline Results.** This section describes how to compare the results from the baseline run against the TDM output to determine whether the IDAS assignment runs will produce reasonable results.
- **Section 10.0 – Creating ITS Options.** This section shows examples of creating ITS options, which are collections of deployments of ITS strategies. An incident management and a transit deployment are given as examples of using the alternative network generator.
- **Section 11.0 – Managing Equipment and Deployment Costs.** This section describes techniques used to keep the complex equipment costs structure under control. These tools also can be used to modify results due to changes in cost information without having to re-deploy ITS options in IDAS while at the same time, ensuring consistent application of costs data across all affected analysis results.
- **Section 12.0 – Using the Alternatives Comparison Module.** This section describes how to use the alternatives comparison module and how to compare multiple ITS options to each other.
- **Section 13.0 – Managing IDAS Results.** This section demonstrates the spreadsheet tools that have been developed to manage the volumes of benefits and costs data that get created during an analysis of an appreciable size.

2.0 IDAS Overview

■ 2.1 What Is IDAS?

The ITS Deployment Analysis System (IDAS) is an ITS sketch planning analysis tool that can be used to estimate the impacts, benefits, and costs resulting from the deployment of ITS components. IDAS was developed by the FHWA to assist public agencies and consultants in integrating ITS in the transportation planning process. IDAS offers the capability for a systematic assessment of ITS, and is used for determining the benefits and costs of various ITS deployments.

IDAS operates as a post-processor to travel demand models, such as TRANPLAN and TransCAD, used by metropolitan planning organizations (MPOs) and by state departments of transportation (DOTs) for transportation planning purposes. IDAS, although a sketch planning tool, implements the modal split and traffic assignment steps associated with a traditional planning model. These steps are crucial to estimating the changes in modal, route, and temporal decisions of travelers resulting from ITS technologies. Because IDAS is a sketch planning analysis system, it is intended for use as an alternatives analysis tool, and not for ITS operations optimization.

■ 2.2 Why Was IDAS Developed?

As the deployment of ITS increased during the 1990s, the FHWA realized that several barriers existed to the analysis of benefits and costs of these types of deployments. Principal among these impediments were:

- Many of the tools available to planners were focused on the analysis of traditional capacity-enhancing infrastructure, and were not sensitive to the operational impacts represented by ITS improvements.
- Planners were often unfamiliar with the specific impacts of ITS, and had difficulty finding data regarding the impacts that were observed in other regions following the deployment of ITS.

IDAS was developed as a tool specifically focused on analyzing the impacts of ITS. IDAS also was designed to serve as a repository of information on the impacts of various types of ITS deployments and of the costs associated with various types of ITS equipment. By providing these capabilities, IDAS has the ability to critically analyze and compare different ITS deployment strategies, prioritize the deployments, and compare the benefits of the ITS deployments with other improvements to better integrate ITS with traditional planning processes.

■ 2.3 How Does IDAS Work?

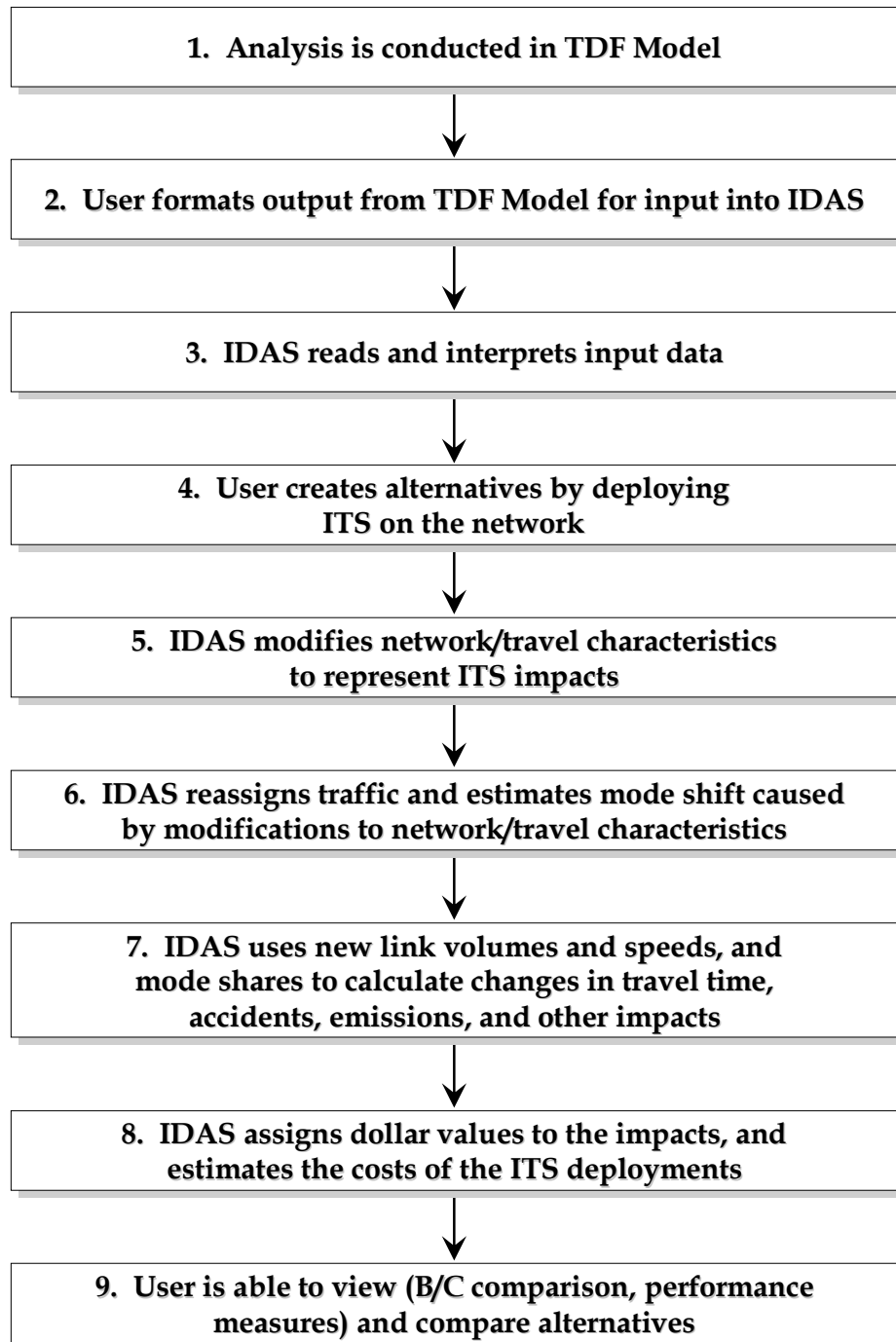
The IDAS tool works by importing the results from travel demand models in order to recreate the validated regional network structure and travel demand within IDAS. The data are imported into IDAS using a special internal input/output interface, which is capable of reading and interpreting ASCII text data files. These input data files are created from data generated by the travel demand model. Depending on the needs of the analysis and the format of the available data, the user is typically required to perform some data conversion prior to import into IDAS. Once the data are imported, they are stored in a database accessible by the IDAS software and may be viewed in a graphical output by the user.

Once the data input is complete, IDAS is capable of operating independently of the model. The IDAS user is then able to create analysis alternatives by selecting ITS components from a menu and placing these on the desired location on the network. The user then provides additional information regarding their deployment, such as the implementation date and proposed operational strategies.

Once the analysis alternative has been created, the IDAS software then modifies the network or travel characteristics to represent the likely impacts of the ITS deployments placed on the network by the user. These modifications are based on either real-world impacts observed in other regions following their deployment of similar ITS components or on local data generated through the existing ITS system or evaluation studies. Modifications may include changes in link capacities or speeds, zone-to-zone travel times, accident or emissions rates, or other impacts specific to the ITS component.

The IDAS model then uses analysis techniques similar to a TDM to analyze the impacts created by the modifications to the alternative network and travel characteristics. A traffic assignment routine is used to estimate the changes in travel patterns caused by ITS deployment, and a mode shift routine is used to estimate any travel mode changes. The results of this analysis are revised link volumes, speeds, and mode shares.

The changes in link volumes, speeds, and mode shares are then used by IDAS in another series of analyses to calculate changes in the travel time, the number of accidents, the amount of emissions, fuel savings, and other impacts. Dollar values then are applied by IDAS to these impacts to provide an estimate of the benefits of the ITS components deployed in the alternative. In a separate process, the costs of the ITS deployments are estimated by IDAS, and are compared with the benefits in the form of a benefit/cost ratio. These outputs are summarized and displayed to the user in several formats. This process is summarized in **Figure 2.1**.



The manual interface presented in this document focuses on procedures necessary to complete Steps 2 and 3 in the figure above. However, it is critical that the user understand and consider the remaining steps in the analysis process when interfacing a model with IDAS. The needs of the analysis conducted in Steps 4 through 9 have a direct and influential impact on how the data are formatted and input into IDAS (Steps 2 and 3). Section 4.0 provides additional discussion on how the needs of the analysis impact the overall structure and conduct of the analysis.

Additional information regarding the structure of IDAS and its processes is presented as **Appendix A**. Even more detailed information is presented in the *IDAS User's Manual*, which is distributed electronically with the IDAS software, or is available on the IDAS web site at <http://idas.camsys.com>.

■ 2.4 Key Terms

Several key terms used in this document are described below. These descriptions are provided to clarify key concepts of IDAS to the user. More detailed descriptions of specific variables are provided in the relevant sections discussing those variables.

- **Network** – A network refers to the collection of zones, centroid connectors, roadway links, and link attributes that represent the transportation system infrastructure.
- **Market Sector** – A market sector is a concept unique to IDAS and is generally defined by a common set of input trip tables that define the zone-to-zone travel demand characteristics. Market sectors within an alternative typically will define the different modes of transportation available for analysis; they also may be used for defining different trip purposes, times of travel, or other variables.
- **Database** – The IDAS database serves as the repository of the data read into the model, as well as outputs from the analysis procedures. Unlike many traditional travel demand models, the IDAS model does not create individual output data files during different phases of the analysis to be passed on to the next analysis phase. Instead, data are stored in various fields of the IDAS database. The different modules access these data directly from the database, perform the required data manipulations, and pass the results back into the database. For some data, the input/output interface can be used to create output files for subsequent input back into travel demand models.

3.0 Model Overview

Travel demand models represent one of the primary tools used in urban transportation planning. Computer simulation models generally are validated or calibrated to represent existing conditions, and are then subsequently applied to forecast future traffic and transit ridership. Most of these models follow a four-step process of trip generation, trip distribution, mode choice, and trip assignment.

TransCAD is a fully integrated Geographic Information System (GIS) planning modeling platform currently used as the travel model platform for models in North Carolina. The model is a traditional four-step model with some enhanced features designed to meet evolving state-of-the-practice multimodal modeling standards.

In this particular study, we received the entire directory structure for the inputs and outputs from the model. With these files, we were then able to simply read the data necessary for IDAS without requiring the modeler to specifically export link information from the model.

In prior work within North Carolina, we had, in this section, documented the necessary steps a modeler would need to perform to prepare data for IDAS input. In this case, we only needed the modeler to export nodes and trip tables after receiving the model data. This has the potential to provide easier access (for IDAS) to other models within North Carolina *if* they also contain the data that TransCAD produced with the FAMPO model.

In any case, on a per model basis, a viable future approach would be to peruse the entire model data structure for the required files, and if available, use them, if not, refer the modeler to the Triangle study documentation provided in March 2010.

Therefore, with the FAMPO model, we retain herein the information about exporting Nodes and Trip tables from the Triangle study documentation, and refer the reader to Section 5 for specific information about how the model data was accessed to read the data required for IDAS.

Topics Covered in This Section

- Network characteristics
 - Exporting the node definitions
- Demand characteristics
 - Vehicle trips
- Volume delay curves
- Provide the information to the IDAS analyst

■ 3.1 Network Characteristics

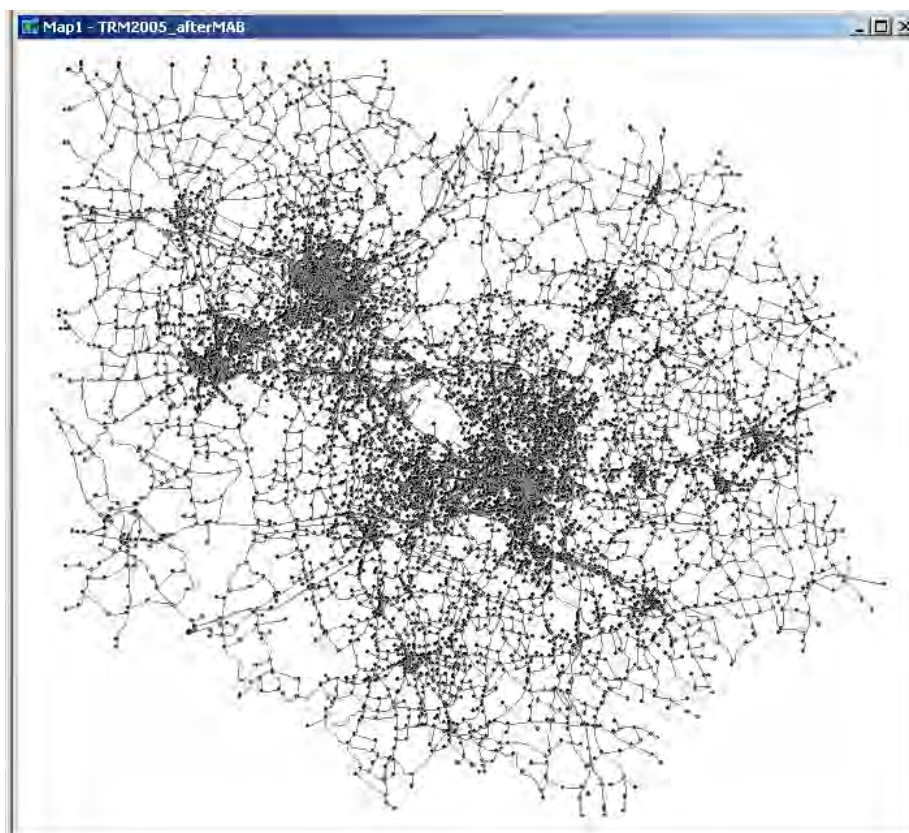
3.1.1 Exporting TransCAD Nodes

The node file is an additional layer that is attached to the master geographic file. When you open the master geographic file, the node layer is there, but may not be visible.

With the master geographic file open in TransCAD, from the TransCAD main menu, choose Map → Layers and click “Show Layer” for the Node layer, then click “Close.”

A network with nodes is seen in **Figure 3.2**. This particular network is from the Triangle region in North Carolina.

Figure 3.2 Example TDM Showing Nodes



Open the node dataview by clicking on the dataview button, then, from the TransCAD main menu, choose File → Save As, change “Files of Type” to Excel Worksheet (*.xls) and save to your desired location.

■ 3.2 Trip Tables (Travel Demand)

Zone-to-zone trip matrices also must be available as input to IDAS. The trip table file is used as direct input to the equilibrium highway assignment process, often an intermediate file, is best used unless some form of transit ITS analysis is required. In the FAMPO model, the input trip table file for the equilibrium highway assignment is divided into four time-of-day periods, with 2 matrices for each period, auto and truck. The trip tables must be converted to an ASCII format using TransCAD export utilities (see Section 6.0).

3.2.1 Exporting Vehicle Trip Tables

The vehicle O-D matrices are located in the Output folder and are TransCAD.mtx files. There are eight separate O-D.mtx files, two (auto and truck) for each period, AM, MD, PM, and Off-Peak.

To export this file, in TransCAD, open the AM peak period O-D matrix file; it should look similar to the **Figure 3.3**.

Figure 3.3 Vehicle Trip Matrix

	1	2	3	4	5	6	7	8	9	1	Sum
1	0.21	0.25	0.25	0.21	0.15	0.04	0.15	0.06	0.00	0.2	74.12
2	0.14	0.24	0.19	0.14	0.13	0.03	0.14	0.05	0.01	0.1	72.71
3	0.14	0.19	0.23	0.14	0.13	0.03	0.15	0.05	0.02	0.1	73.64
4	0.11	0.16	0.15	0.17	0.10	0.03	0.13	0.05	0.01	0.1	58.24
5	0.08	0.27	0.27	0.18	0.24	0.05	0.17	0.07	0.01	0.2	70.95
6	0.03	0.03	0.03	0.02	0.03	0.01	0.03	0.01	0.00	0.0	14.66
7	0.08	0.46	0.47	0.37	0.29	0.09	0.73	0.13	0.01	0.3	150.04
8	0.04	0.07	0.07	0.06	0.05	0.01	0.07	0.04	0.00	0.0	24.95
9	0.01	0.15	0.15	0.10	0.10	0.03	0.08	0.03	0.02	0.1	32.81
10	0.12	0.14	0.13	0.12	0.09	0.03	0.11	0.05	0.01	0.1	56.41
11	0.02	0.14	0.14	0.09	0.09	0.03	0.08	0.03	0.01	0.1	33.69
12	0.01	0.15	0.15	0.11	0.10	0.03	0.08	0.04	0.01	0.1	33.97
13	0.01	0.07	0.07	0.05	0.05	0.02	0.05	0.02	0.00	0.0	17.94
14	0.01	0.04	0.04	0.03	0.03	0.01	0.02	0.01	0.00	0.0	9.16
15	0.03	0.04	0.04	0.03	0.03	0.01	0.03	0.01	0.00	0.0	13.52
16	0.12	0.19	0.19	0.15	0.12	0.03	0.20	0.05	0.01	0.1	79.00
17	0.10	0.40	0.40	0.32	0.24	0.07	0.41	0.10	0.01	0.2	125.37
18	0.02	0.25	0.26	0.21	0.19	0.06	0.18	0.08	0.01	0.2	66.28
19	0.01	0.29	0.30	0.25	0.21	0.07	0.21	0.10	0.02	0.2	77.33
20	0.04	0.88	0.88	0.70	0.53	0.17	0.54	0.25	0.02	0.6	193.19
21	0.01	0.30	0.30	0.24	0.18	0.06	0.19	0.09	0.01	0.2	69.38
22	0.01	0.19	0.19	0.15	0.11	0.04	0.12	0.06	0.00	0.1	45.67
23	0.01	0.41	0.41	0.33	0.24	0.08	0.27	0.12	0.01	0.3	91.83
24	0.05	0.58	0.59	0.48	0.36	0.11	0.48	0.18	0.02	0.4	152.11
25	0.03	0.11	0.11	0.09	0.07	0.02	0.10	0.03	0.00	0.0	32.13
26	0.05	1.82	1.87	1.42	1.10	0.35	1.63	0.44	0.03	1.3	515.09
Sum	78.67	346.86	350.40	258.66	219.71	72.31	239.37	85.73	9.18	269.7	659225.62

From the TransCAD menu, choose Matrix → Export, select the option “Cell, with a field for each matrix,” and then select to include all matrices (SOV, HOV, and CV). When asked to Save As, change files of type to “comma-delimited text” (*.txt, *.csv) and save to your desired location.

Repeat these steps for all matrices.

Note that the auto and truck files produced this way were later combined to represent all traffic using a technique described in Section 5.

■ 3.3 Volume Delay Curves

The FAMPO model’s link data included the alpha and beta values for the Volume Delay function for each link. This is not always the case, often model data will relate the alpha and beta values to the link through the facility type code of the link.

Because the information was available for each link, we did not have to ask the modeler for the relationship between facility type and specific BPR (Bureau of Public Roads) functions. The method used to relate facility type to BPR curve is therefore outlined in Section 5.

■ 3.4 Provide the Requisite Data to the IDAS Analyst

The IDAS analyst will need to be provided the data files and information provided in this section, along with a few other ancillary items:

- The meaning of facility type codes in the links output file.
- A “mapping” of each facility to a facility class: freeway, arterial, or ramp.
- The details about the capacity figure in the links output file.
- Is the capacity per link or per lane?
- What time period is being evaluated?
- The volume at capacity on each link, if available.
- Whether the link speeds provided from the model are for free-flow or congested conditions.

Any level of link performance information that can be provided, such as total VMT, VHT, or average speed by facility is helpful in conducting the validation.

Sections 4.0, 5.0, and 6.0 detail the required steps to use the model data in IDAS.

4.0 Preparing IDAS for Analysis

IDAS is a database application. The database system that IDAS uses is a relatively simple client-based database that uses a single computer file to manage all of its contents. The simplicity of the database tool assists users in that they can create copies of the database file at any time, essentially archiving stages of the system for later use branching from that stage.

Databases should be backed up at regular intervals during the IDAS development process. For example the database should be backed up after initial setup. This allows the user to skip the setup in the future, and simply copy the saved database to another location and start from there.

This section covers the setup of that initial database up to the point of creating alternatives and networks as described in Section 5.0.

■ 4.1 High-Level Data Required for IDAS

Topics Covered in This Section

- Creating the initial database and copying for later use
- Setting up the high-level TDM data (zone count, area types)
- Setting up the facility type and district definitions
- Explanation of other setup parameters that are not usually used

Creating an Initial Empty Database

- When IDAS is first run, an empty database, which resides in a directory off of the installation directory, is opened. The first thing a user should do is create a new database and indicate it should be stored in another location, related solely to a particular IDAS study, for example.³

EXAMPLE

- **Step 1.** To do this, select **File → Create Database** in the main menu. A file navigation dialog appears in which you can specify the name and location of the database. Note that the database created is simply this file, with the extension .db.
- **Step 2.** Note also that IDAS remembers the name of its database so that when it starts up, it will try to find that database. If the file gets moved or deleted, IDAS prompts the user with a file open dialog to find a database to open.

4.1.1 TDM Zone and Area Type Information

The information IDAS requires is specified by choosing **File → Setup** from the IDAS main menu. This window contains two tabs used to supply the data, and a third that is sometimes used but not required.

On the TDMDData tab, the following must be provided:

- **Step 1. Maximum ID of internal and external zones.** This is the ID of the last *centroid* node from the data that will be used. This value indicates the “size” of the network. All demand matrixes of any type (discussed in Section 6.0) subsequently imported must be the same size as this number.⁴ **For the FAMPO analysis, this value is 1,051.**
- **Step 2. The meaning of the Area Type code in network import files.** IDAS has only two area types while most TDMs have more. The setting provided here simply sets up IDAS to “map” the TDM area types into one of these two, either Urban, or Suburban/Rural.
- **Step 3.** Select Area Type code by using a “spinner” control. The user can change the number inside the control until the desired code (from the TDM) is reached,

³ It has been found that using a directory off of the “Documents and Settings” directory can be problematic. Some fields in the database contain file names and have a length of 128 characters. Depending on the user’s login name and other factors, full physical file names for files stored here can be larger than this, causing a SQL error at run-time.

⁴ Matrix import files do not actually have to contain all of the nxn entries, they can omit records where the trip count, or other measure, is 0.

then click the radio button for either Urban or Suburban/Rural, then move the spinner to the next code, and so on. The easiest way to do this is to press the “All Urban,” or “All Suburban/Rural” buttons, then change only the remaining codes that are of the opposite meaning. (See **Figure 4.1**). **For the FAMPO analysis, area type 1 is Urban, all others are Rural.** We will be using a “calculated” area type that is described in Section 5 which has a value of 1 or 2.

Figure 4.1 IDAS Setup – TDM Data Settings

The screenshot shows the 'IDAS - Setup' dialog box with the 'TDM Data' tab selected. The 'Regionalized TDM Data' section contains the following controls:

- A label 'Maximum External AND Internal Centroid ID Number:' followed by a spinner box set to '1051'.
- A label 'Translation From TDM Input Area Type to Urban/Suburban Rural'.
- Two radio buttons: 'Urban' (selected) and 'Suburban/Rural'.
- Two buttons: 'All Urban' and 'All Suburban/Rural'.

An 'OK' button is located at the bottom left of the dialog.

4.1.2 TDM Facility Type Information

- Step 1.** On the Facility Types tab, the user provides the name and facility “type” of the facility type codes that the TDM will be using. The “type” of the facility is either Freeway, Arterial, or Ramp. **IDAS refers to these as the V/C curve.** These are set using dropdowns next to each facility type name in the small table containing the facility type information. Note: In the FAMPO network – we have generated a facility type code of 1 thru 6 for convenience, and translated the model’s value to this as described in Section 5. We also “named” the facility types based on the VC curve found to represent them. Basically, 1 and 3 are Urban and Rural freeway, and 2 and 4 are Urban and Rural arterials, respectively.

Figure 4.2 IDAS Setup – Facility Types

Input Facility Type	Description	V/C curve
1	VCCurve 0.56 3.60	Freeway
2	VCCurve 0.71 2.10	Arterial
3	VCCurve 0.83 5.50	Freeway
4	VCCurve 0.83 2.70	Arterial
5	VCCurve 1.00 2.10	Ramp
6	Centroid Connector	Ramp

Below the table are buttons: Delete, File ...

On the right, color calibration sliders are shown for:

- VCCurve 0.56 (Red)
- VCCurve 0.71 (Green)
- VCCurve 0.83 (Blue)
- VCCurve 0.83 (Yellow)
- VCCurve 1.00 (Cyan)
- Centroid

Each slider has three input fields with values: 255 (red), 0 (green), and 0 (blue).

At the bottom is an OK button.

Figure 4.2 shows the table of facility types.

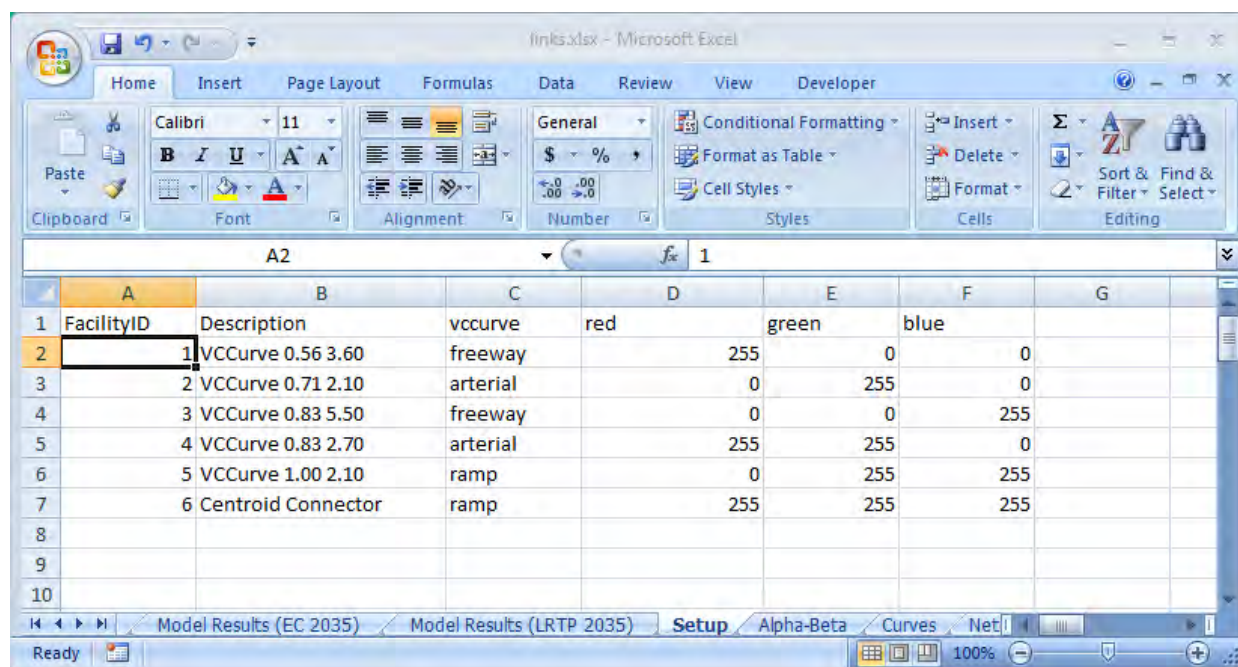
- **Step 2.** The integer number is generated from TDM data as described in Section 5, the Description is simply a label, and it can be anything the user wants, except in the case of the Centroid Connector facility type.
- **Step 3.** Exactly one row in this table must have this description “Centroid Connector”, and it must identify the code used by the TDM to identify Centroid Connector facilities.
- **Step 4.** Each row must be “associated” with one of the aforementioned V/C curve names.
- **Step 5.** Note also in **Figure 4.2** there is a series of color settings for each facility type. This is useful if you want a specific facility type to stand out in the IDAS view of the network, in which it draws the network graphically in what is called the Alternatives Network Generator (Section 7.0). Each color is specified by changing the relative intensity of red, green, and blue.

The value of V/C curve (in combination with the Area type code discussed previously) is used by IDAS during the traffic assignment process to characterize the performance of each network link under traffic load. Please see Section 8.0 for a complete description of the V/C curve setup for IDAS.

Managing Facility Type Data in Excel

Figure 4.2 shows a “File...” button below the table of facility types. This button is used to import all of the data at once from an Excel spreadsheet, which allows the user to avoid manually typing in these settings. **For any facility type table of appreciable size, this technique is highly recommended.**

Figure 4.3 Facility Types in an Excel Spreadsheet



	A	B	C	D	E	F	G
1	FacilityID	Description	vccurve	red	green	blue	
2	1	VCCurve 0.56 3.60	freeway	255	0	0	
3	2	VCCurve 0.71 2.10	arterial	0	255	0	
4	3	VCCurve 0.83 5.50	freeway	0	0	255	
5	4	VCCurve 0.83 2.70	arterial	255	255	0	
6	5	VCCurve 1.00 2.10	ramp	0	255	255	
7	6	Centroid Connector	ramp	255	255	255	
8							
9							
10							

- **Step 1.** To use this, create an Excel spreadsheet and enter the table of facility types there. The table (shown in **Figure 4.3**) is then used to create an Excel “Named Range” that IDAS reads and imports from.
- **Step 2.** The header row (row 1) must be entered exactly as shown (case is not important).
- **Step 3.** In Excel, if the entire table is selected with the mouse (cells A1-F7), one performs an Insert-Name-Define. Using [ALT]-I-N-D brings up the Excel named ranges dialog.
- **Step 4.** While creating the named range, use the name **FacilityTypes** (case is not important but there should be no space in the name), then, dispatch the named ranges dialog and save the workbook.
- **Step 5.** Now return to IDAS, press the File... button (**Figure 4.2**), navigate to the Excel workbook just created, and select it. The facility type table in IDAS automatically updates.

Note: In the FAMPO work, we placed the facilities type table within the main Links.xlsx file used to manage all information about the network. However, when you want to

specify the file used to import via the “File” button in **Figure 4.2**, it *must* be an ‘.xls file (not ‘.xlsx), or IDAS will report an error when importing it. Therefore, it is necessary to save a temporary copy of the ‘.xlsx file in the ‘.xls format.

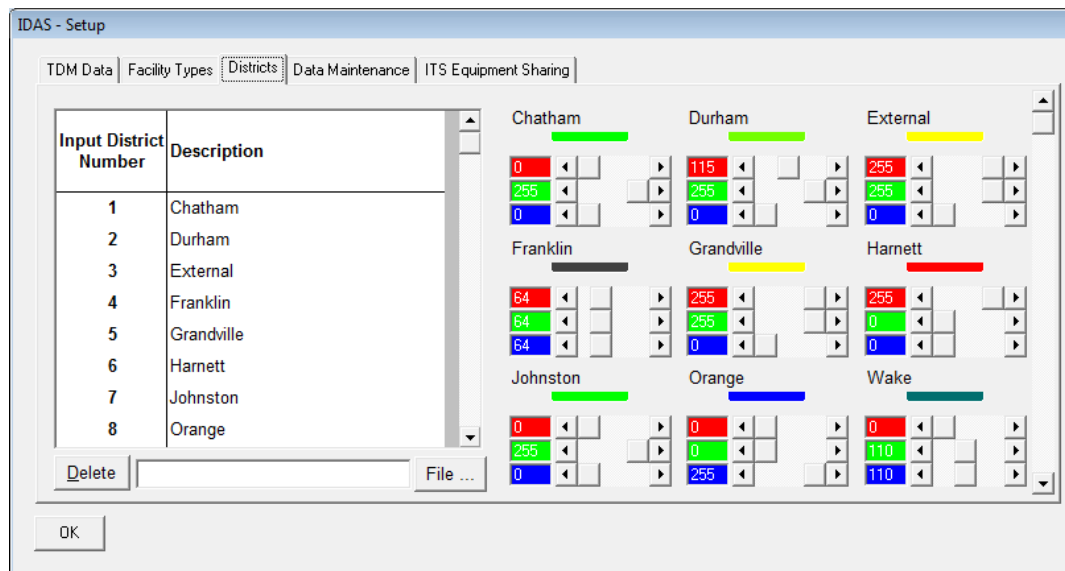
4.1.3 TDM District Definitions

While in the IDAS setup window, the user will see a Districts tab that is used to define the mapping of the district code in the TDM to the descriptive name and color of each district. By supplying a district code on the network links imported into IDAS (see Section 5.0), the user can then view performance measures on the network aggregated by these districts.

This can be a useful and powerful technique to separate certain portions of the network that have a special significance to the analyst and stakeholders. This may include municipalities, DOT districts, public transit agency service areas, or individual corridors. IDAS does not dictate how this separation occurs; even though the name is “District,” it does not mean that this has to be some geographic separation of links. It can be anything desired. All that is required is that the district code be properly setup in the links (network) import file *before* import.

Note: In the FAMPO analysis, there was no requirement to “split” results by district. Therefore, the district definitions were left at their defaults. However, we retain the information from prior IDAS work (Triangle Region) for those interested in how this particular IDAS feature works.

Figure 4.4 IDAS Setup – Districts



Managing District Type Information in Excel

A table of the district definitions can be setup in Excel just as in Facility types. These can, of course, be maintained in the same spreadsheet too, which is a recommended practice.

Figure 4.5 District Names in an Excel Spreadsheet

DistrictID	Descriptive	Red	Green	Blue
1	Chatham	0	255	0
2	Durham	115	255	0
3	External	255	255	0
4	Franklin	64	64	64
5	Grandville	255	255	0
6	Harnett	255	0	0
7	Johnston	0	255	0
8	Orange	0	0	255
9	Wake	0	110	110

Figure 4.5 highlights some minor but important differences with the Facility types named range (table).

- **Step 1.** First, the “ID” column is labeled “DistrictID,” and the “VCCurve” column is missing, thus, the named range (called “DistrictNames”) is cells B3 → F12 in this particular case.
- **Step 2.** To import this table, visit the Districts tab in file setup (**Figure 4.4**), press File..., and navigate to the spreadsheet.

4.1.4 Other Data Used in IDAS Setup

Figure 4.1 shows other tabs in the IDAS setup window, Data Maintenance and Equipment Sharing. These are briefly explained in the event someone might want to use them. However, they are rarely used.

Data Maintenance

IDAS has the ability to import large amounts of external data (maintained in Excel named ranges) into its database. The three sets of this data available on the Data Maintenance tab of File → Setup are:

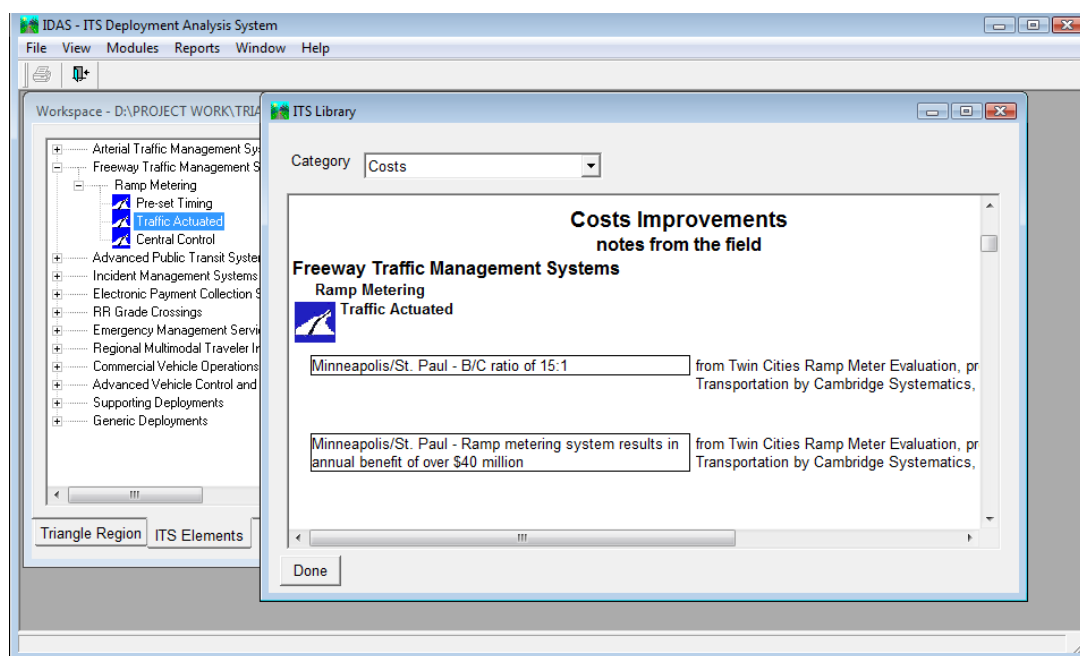
1. **ITS Components** – These are the Direct Benefits anecdotal entries put together by the IDAS team during document research efforts performed during the early development period of IDAS.

They are simply statements of utility for various ITS strategies (organized by performance measure and ITS strategy) that an IDAS user can peruse to determine the level of effectiveness of the ITS deployment they are about to analyze.

EXAMPLE

- **Step 1.** For example, if a user is considering ramp metering, and wants to know what other agencies might have achieved in terms of, say, congestion relief, that user can look at the notes from other agencies about what percentage of delay might have been reduced by their actual application of ramp metering.
- **Step 2.** To accomplish this, the user can right-click on any ITS Strategy in the elements tab of the IDAS work prompter.

Figure 4.6 ITS Direct Benefits for Traffic Actuated Ramp Metering



- **Step 3.** Figure 4.6 shows an entry from the Direct Benefits data that can be imported into IDAS. Here, the user has right-clicked on the “Traffic Actuated” ITS Strategy in the ITS Elements tab, and chose “ITS Library” from the menu.

These entries simply relate the experience of others that have used this strategy. For example, Minneapolis/St Paul believes a \$40 million benefit was achieved. Some of these “notes from the field” actually go into more detail than this.

2. ITS Equipment

The Equip2_3.xls workbook last updated and shipped with IDAS 2.3 (June 2003), contains all of the logic and costing levels of the automated equipment management procedures built into the IDAS ITS deployment mechanism.

During the deployment of ITS strategies onto the IDAS network (Section 7.0), the system maintains the actual equipment that is typically required for that deployment to work. This “behind the scenes” population of equipment is driven by the information in the spreadsheet that can be imported at this point in File → Setup.

The IDAS equipment mechanism works as intended, however two factors usually rule out the widespread reliance on the IDAS equipment (costing) procedures. These are discussed in detail in Section 11.0, but the synopsis is that:

- The IDAS mechanism is extensive but generalized.

The list of equipment that was generated as “usually required” by the National ITS Architecture (the source of the ITS Equipment spreadsheet) is very detailed, generally more detailed than required for most IDAS analyses. It also lacks flexibility in that it assumes all of the required (and supporting) facilities also need to be built to accomplish a deployment.

It is possible to go into the IDAS equipment list for a deployment and choose certain parts of this equipment list to be “already existing” or “shared.” However, this is a complex and error prone activity in which a step can easily be forgotten.

- Agencies usually have a very precise understanding of equipment needs and costs.

Equipment expenditures, lifetimes, and needs (especially the extent to which existing or planned supporting facilities can support ITS) are something which vary from one area to another and most transportation agencies can provide detailed information on their own costs. This information is clearly preferable to using generic cost estimates.

These factors together have driven the development of a more locally oriented set of procedures for equipment cost information. Again, this is explained fully in Section 11.0.

3. ITS Entry Defaults

When a user is deploying ITS Strategies on the IDAS network, certain “Impact Levels” are applied based on the type of deployment being made. For example, when ramp metering is deployed, the user will provide an assumed percentage level of capacity increase on affected freeway links.

Based on the type of deployment being done, the “level of effectiveness” is essentially embodied in these link(s) impact values.

The spreadsheet imported here can be used to replace the “default” values for these impact parameters, so that when subsequent deployments (after

importing) are done, the user does not have to actually go in and change the impact parameters for those deployments. In essence, the ITS Entry Defaults spreadsheet can be used to set the “local policy” in regards to the effectiveness of ITS.

In this regard, it is likely the most useful of the spreadsheets that can be imported into IDAS. A state agency, for example, could decree that all ramp metering analysis utilize an assumed effectiveness level, and comparisons by the state would then be comparing apples to apples in looking at IDAS results from multiple agencies.

ITS Equipment Sharing

This final tab on the File → Setup configuration window details aspects of how the equipment population mechanism works while ITS deployments are being made.

The choices selected on this screen state how the different combinations of equipment are deployed. Population logic should complete its task(s). For example, when certain ITS Strategies are deployed in one ITS Option,⁵ the same combinations can be applied to other options. A Freeway Management System could include detection, CCTV, and certain communications equipment. This specification avoids having to enter individual pieces of equipment for each deployment.

As an example, the Transportation Management Center will provide support to both Freeway Service Patrols and the Freeway Management System, which may include CCTV, detection systems, and Dynamic Message Signs. Costs can be allocated among different systems based on the percentage of time on different activities by operators, or other criteria. Another setting on this window is the costing level of equipment. In the ITS Equipment spreadsheet, there are three levels of costs for each item of equipment. The user can choose to use the low, medium, or high values of these costs when calculating the costs side of the B/C ratio.

■ 4.2 High-Level Data for IDAS – Saving the Work

As mentioned at the start of this section, IDAS uses a database to manage its information.

Having populated the first database used with the information detailed in this section, now is a good time to make a copy of the database. This copy, then, can be provided to anyone else that would want to start from this point, which provides the assurance that the analysis they do would be starting from the same place.

⁵ An ITS Option is a “collection” of ITS Strategies that is maintained as a package in one place. One of the reasons IDAS has this grouping is to enable cost savings due to sharing.

5.0 Importing Network Data

■ 5.1 Understanding Network Data

Topics Covered in This Section

- Requirements for importing TDM data into IDAS
- Preparing for analysis
- Ensuring that IDAS will be able to correctly analyze the network

■ 5.2 Extracting Data from the TDM

Building the network involves importing links and nodes into IDAS.

For the Fayetteville area analysis, it became necessary to find a new way to export the model data. Upon inspection of the TransCAD model structure for FAMPO, it was found that certain link characteristics were slightly changed in a dynamic way during TransCAD model initialization, which meant that the inputs obtained through the methods used in the Triangle Region study would not have been the right values.

Because the entire TransCAD model input and output structure was available to us, it was possible to use certain output files that TransCAD creates at runtime to find our network data.

These files and the techniques used to extract their data is the subject of the following discussion.

5.2.1 Network Nodes in TransCAD Models

IDAS needs both Nodes (coordinates) and Links to construct its network. Many TransCAD models do not have numbers for the A and B (or I to J) nodes in their associated GIS shape file's database. There have been many occasions where these can be easily placed into the data, but in some cases they are not strictly necessary in TransCAD and therefore must be placed into the data by the modeler which entails an extra step.

That extra step was performed by the FAMPO modeler – and involved creating a Node shape (GIS) file by exporting it out of TransCAD, as described in Section 3.

5.2.1.1 Creating the Nodes import file

For this purpose, we obtained the Node shape file and used the Extract Data tool described at length in the Triangle Study documentation. That tool can be used to create a flat file out of any GIS shape file available, so we use it to obtain the Node ID along with the latitude and longitude of each node. We need no other information about nodes.

Since we only used the Extract data tool for two purposes in the FAMPO analysis; Creating Nodes, and Splitting links, our coverage of it here is less detailed than within the Triangle Study documentation. We refer the reader to that document for detailed information about creating the link network data.

Description of the Extract Data Screen

Figure 5.1 shows the initial setup screen of Extract Data when used to export nodes. The FAMPO model Node GIS shape file has been opened with the File button at the top.

Figure 5.1 The Extract Data Selection Window

Import Shape file

Import

D:\project work\FAMPO\Model Data\Node.shp

File

Settings

If not selected in the mapping, use:

TS Indicator: Area Type:

Travel Mode: 1 ☐ Divide Capacity by lanes

District: ☐ Convert time (min) to mph

Set when FT = 0:

Link duplication

Direction = ☐ duplicate

Direction = ☐ link is A->B

Direction = ☐ link is B->A

☐ Divide lanes by 2 (if no AB,BA control selected)

Field	Type	IDAS fields	Control fields
ID	integer	ID	
ID1	integer		
TAZ	integer		
TAZ_ID_OLD	integer		
SAVE_NODE	integer		
TRANSIT_NO	integer		

Limits

Longitude:

Latitude:

Include only facilities with name like:

Include only facilities with facility type in:

Omit facilities with facility type in:

Export Exit

Note in the above figure that the ID field is the only exported data. Our goal here is to simply create a file suitable for importing the node IDs and their coordinates into IDAS.

No other input is required for exporting nodes. Specifically, all the input fields, other than the selection of the ID field, are left empty. The entry in Travel Mode is simply a default and has no effect.

When the user clicks Export, a file called "Node-links.txt" will be created.

This file contains *generated* A and B Node numbers, the selected ID field, and the latitude and longitude of each node, or "record" found in the file.

In this case – we **discard** the generated A and B values in the file – and use only the ID field and the coordinates (lat/lon).

At this point, we create our master Links Excel workbook and import the node file created into its own worksheet, in which, we delete the generated A and B values. When it comes time to import the nodes into IDAS (Section 5.3) we save this sheet to a Nodes.csv file.

5.2.1.2 Obtaining the required link data

Even though we cannot use the data generated with the Extract Data tool for the FAMPO model – we still need to use the tool in order to split the FAMPO links, which are both 1 and 2 direction links, into all 1 way links as required by IDAS.

Figure 5.2 Extracting links for direction information

Import Shape file

Import

D:\project work\FAMPO\Model Data\Highway_Network_06_18_2009.shp File

Settings

If not selected in the mapping, use:

TS Indicator: Area Type:

Travel Mode: ☒ Divide Capacity by lanes

District: ☐ Convert time (min) to mph

Set when FT = 0

Link duplication

Direction = duplicate

Direction = link is A->B

Direction = link is B->A

☐ Divide lanes by 2 (if no AB,BA control selected)

Field	Type	IDAS fields	Control fields
ID	integer	ID	ID
LENGTH	float	Distance	Distance
DIR	integer	Direction	Direction
SRNUMBER	character	Name	Name
STREETNAME	character	Name	Name
CONNECTOR_	character	Name	Name
CONNECTOR1	character	Name	Name
PROJ_NO	character	Name	Name
COUNTY	character	Name	Name
DISTRICT	integer	Name	Name
AREA_TYPE	integer	Name	Name
FACTYPE_CD	integer	Name	Name
MODEL_FACI	character	Name	Name

Export Exit

Limits

Longitude:

Latitude:

Include only facilities with name like:

Include only facilities with facility type in:

Omit facilities with facility type in:

Note in **Figure 5.2** that ID and Direction are chosen to be exported, and that the entries in the “Link duplication” group are specified. The other data, Distance and Name, are not strictly necessary.

When the file is created from the above, we get an output file that contains all one-way links, and a value for direction (0, 1, or -1), and either AB, or BA depending on how that link was “split” by the Extract Data tool. The specific way in which links are split based on the direction code can be understood by looking at the “Link duplication” settings in **Figure 5.2**.

The IDAS data will contain roughly twice the number of rows (links) as does the source TransCAD data. In each TransCAD row of data (from other sources, not just the network links file shown above), there will be both AB_... and BA_... columns for 2 way links. Because IDAS is using 1-way links, we must utilize the appropriate *column* of data for each of the (usually) 2 *rows* of IDAS link data.

The file generated is imported into our Excel workbook and comprises the root worksheet for the links. In other words, the input file for IDAS will be saved from this worksheet, but there will be several more “supporting” sheets containing data to link up with this root sheet.

It is also important to note that, though not visible in the above figure, there are flags in the FAMPO data that indicate whether each link is actually present in the 2006 network. In other words, there are “future” links that will be used in the 2035 network and its analysis.

In large part, links that are not in the 2006 network must be manually deleted from the Excel worksheet (for loading the 2006 network only, of course). Thus, there are basically 3 main network worksheets, one for each of the 3 networks.

These 3 base network link data sets form the set of links with the model ID # and the direction specification (AB or BA) that can then be used to match to the data imported from certain TransCAD output files as described next.

5.2.1.3 Obtaining specific link information

As mentioned previously, using the data stored in the TransCAD raw input data is not sufficient for the FAMPO model.

However, because the intermediate output (from the model) files were available, we did find a way to obtain the necessary link data for use in IDAS.

Because these files are binary files, a special tool was written to extract the data and create flat files for import into our master links workbook, then, using Excel formulas, match up these fields with each row in the network links worksheets.

The tool developed here is called readDCB and is a small C++ program built to extract data from the TransCAD binary files with guidance from an associated “contents” file with the extension ‘.DCB.

The source file for this tool is provided within the FAMPO analysis directory structure.

Note that the tool was developed for the purpose of importing the FAMPO model data into IDAS. It is likely, however, to work with any of the large numbers of ‘.DCB and ‘.BIN file pairs TransCAD is creating.

Since this tool is a simple DOS application it has no graphical interface. Running it is a matter of navigating a DOS prompt to the location of the input files, and typing the name of the program followed by a root file name.

For example, one of our useful TransCAD files is called “Highway_Network_06-18-2009”. For this there are 2 important files, a ‘.dcb and a ‘.bin file. There are other files which are of no concern to us.

In the model data structure, these files are in:

`.\Model_Interface_V7\Input`

Therefore, to produce a “Highway_Network_06-18-2009.csv” file, we perform the following:

- Open a DOS prompt. In the Windows Start Menu, choose run, and type:

cmd

into the “Open:” entry field and press enter

- Navigate to the location of Highway_Network_06-18-2009.dcb by typing:

CD “<drive>:<directory>”

If the DOS Prompt does not indicate the current drive is the correct drive, then type the correct drive letter, followed by “:”, then press enter. This can be done either before or after the CD command

- Run readDCB with the root name of your data file.

..\readDCB Highway_Network_06-18-2009

Note that in the above case, the readDCB.exe program has been copied to the *parent* directory of our data location. This can be placed anywhere, but wherever it is (unless it’s copied to a location on the computer’s path variable, or, to the location of the data), the path to it must be supplied.

When successful, the above will result in a Highway_Network_06-18-2009.csv file, which can then be imported into Excel.

We import the result obtained into our master links workbook into a sheet named “Network Data”. It is from here that many of the fields for the links will be found and pulled into the 3 network sheets. These include:

- # Lanes
- Length
- Facility name
- Speed

Using the same tool, we imported 3 capacities files into the links workbook. These files are found in:

..\Model_Interface_V7\Output\2006\Link_Capacity.bin

for the 2006 model year, replacing 2006 with “2035_EC” and “2035_LRTP” for the future networks.

The generated Link_Capacity.csv file was imported into the master links workbook into its own sheet. The 2006 capacities were put into the “Link Capacities” sheet, the 2035 capacities into “Link Capacities (EC 2035)” and “Link Capacities (LRTP 2035)”.

Once this is done, for each of the 3 base network sheets, the Capacity column is populated with an Excel VLookup function that finds the appropriate capacity in the capacity sheet using the ID field from the model as a key. With the additional constraint that it takes the capacity from either the AB_LOS_E_AM⁶, or the BA_LOS_E_AM column depending on the link direction. Recalling that the Extract Data tool creates both an AB and a BA record from 2 way TransCAD links.

Note that capacities are divided by the number of lanes because IDAS uses *lane* capacity for input.

Using the same technique, we also import volumes into the master links workbook. These files are:

.\Model_Interface_V7\Output\2006\Highway_agm.bin

for the 2006 model year, and as above for the future years.

In this case, we import these into 3 sheets “Model Results” for 2006, “Model Results (EC 2035)”, and “Model Results (LRTP 2035)”

Though IDAS does not care what values for volume are imported (the column for volume is a placeholder so IDAS knows where to *export* volume) it is convenient to import the model’s volume in order to compare the IDAS assignment results with the models results within IDAS.

Specifically, after the Control Alternative (baseline) IDAS assignment has run, a user can right click on any link in the network and compare the model volume (or whatever volume was imported) and IDAS volume on the link. This is shown in **Figure 5.3** for I-95 NB north of the northern intersection with I-95 Business. Note that the model volume is 4189 vehicles during the period, where IDAS came up with 4134, a -1.32 percent difference. This comparison is only valid if the imported volumes are known to be from the model results.

⁶ These columns will be used for import into the AM database, there are similar columns for MD, PM, and OP databases.

Figure 5.3 Model and IDAS volume comparison

Baseline		Improvement		Difference		Amt.	Pct
Volume	4188.91	Volume	4133.65	Volume	-55.26	-1.32	
Speed	69.55	Speed	64.60	Speed	-4.95	-7.11	
# Lanes	2	# Lanes	2	# Lanes	0	0	
Lane Capacity	3326.40	Lane Capacity	3326.40	Lane Capacity	0.00	0.00	
V/C	0.63	V/C	0.62	V/C	-0.01	-1.32	

Update Cancel

After setting up all the cross lookup functions in our 3 main network sheets, we can take each one and export to a '.csv' file suitable for importing into IDAS as described next.

■ 5.3 Importing Data into IDAS

It is assumed that the target IDAS database has been setup and is ready for the creation of an ITS Option.

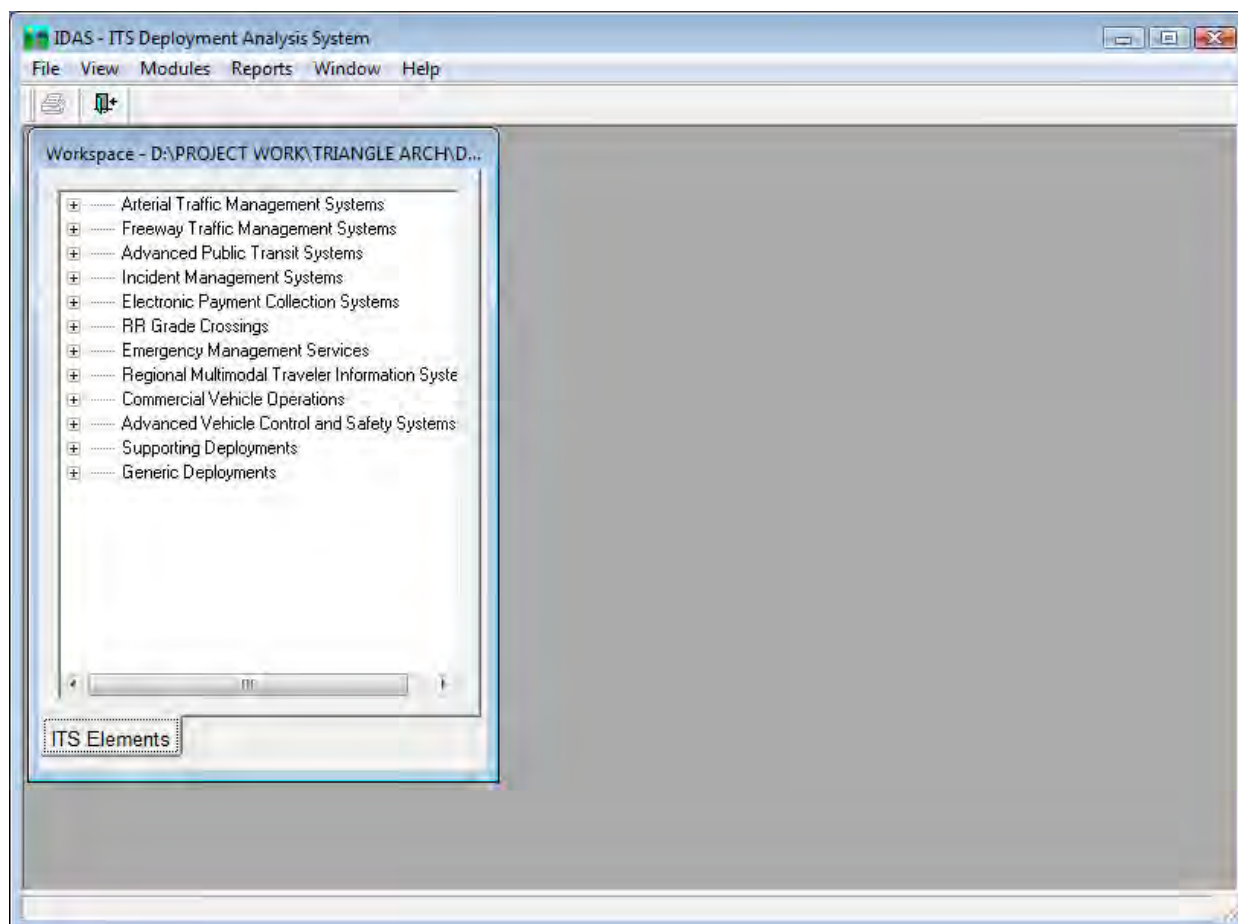
See Section 4.0 for information on setting up the IDAS database.

This section is focused on importing network data into IDAS. Market sector data must also be imported before IDAS can run; that information is found in Section 6.0.

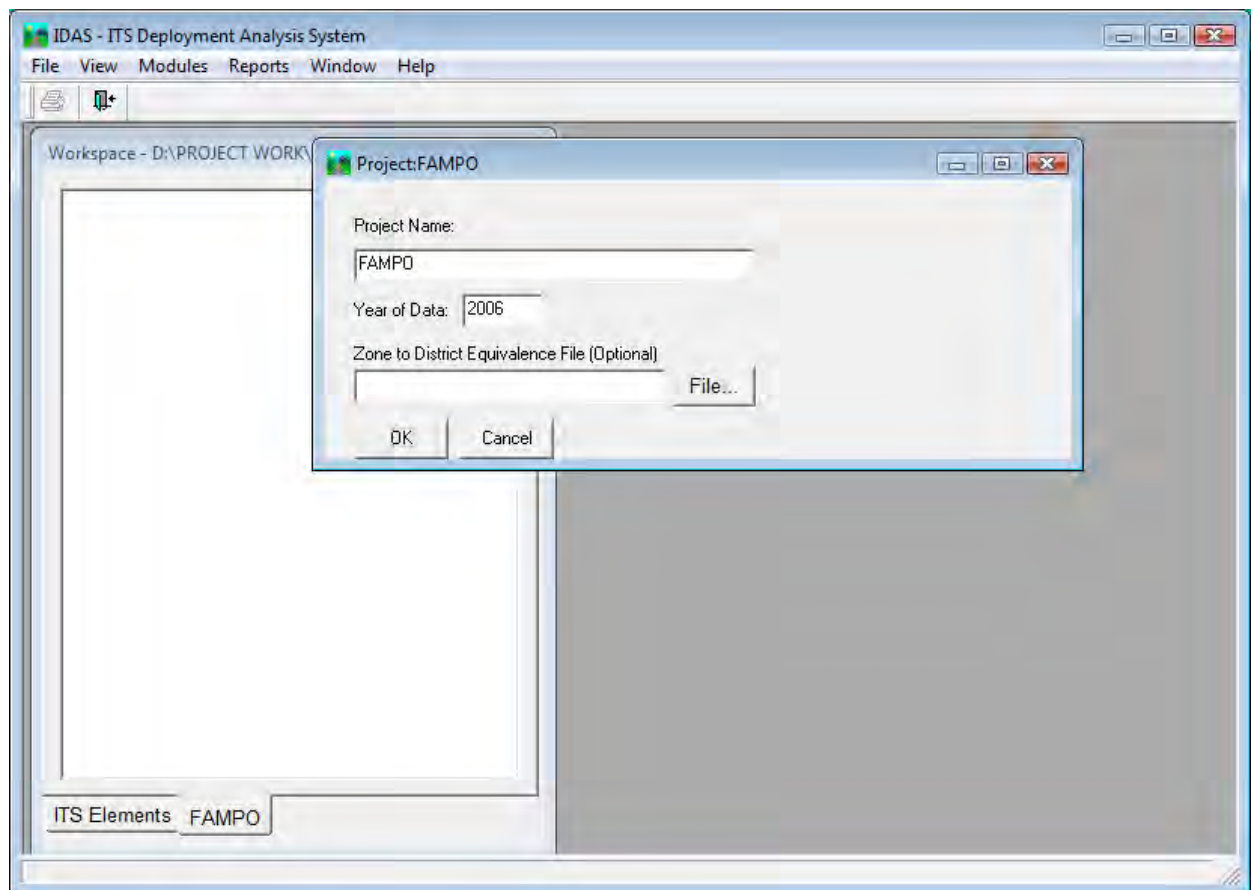
5.3.1 Creating a Project

A "Project" is an entity in IDAS that can contain any number of "Alternatives," described next. Usually, for networks of appreciable size, a database would contain only one project.

- **Step 1.** When IDAS has been setup for the region (Section 4.0), a user will see the "WorkPrompter" (the menu area on the left side of the screen), which contains a single tab called "ITS Elements" as shown in **Figure 5.4** below.

Figure 5.4 An Empty IDAS Database

- **Step 2.** A user creates a project by selecting File → New Project from the main menu.

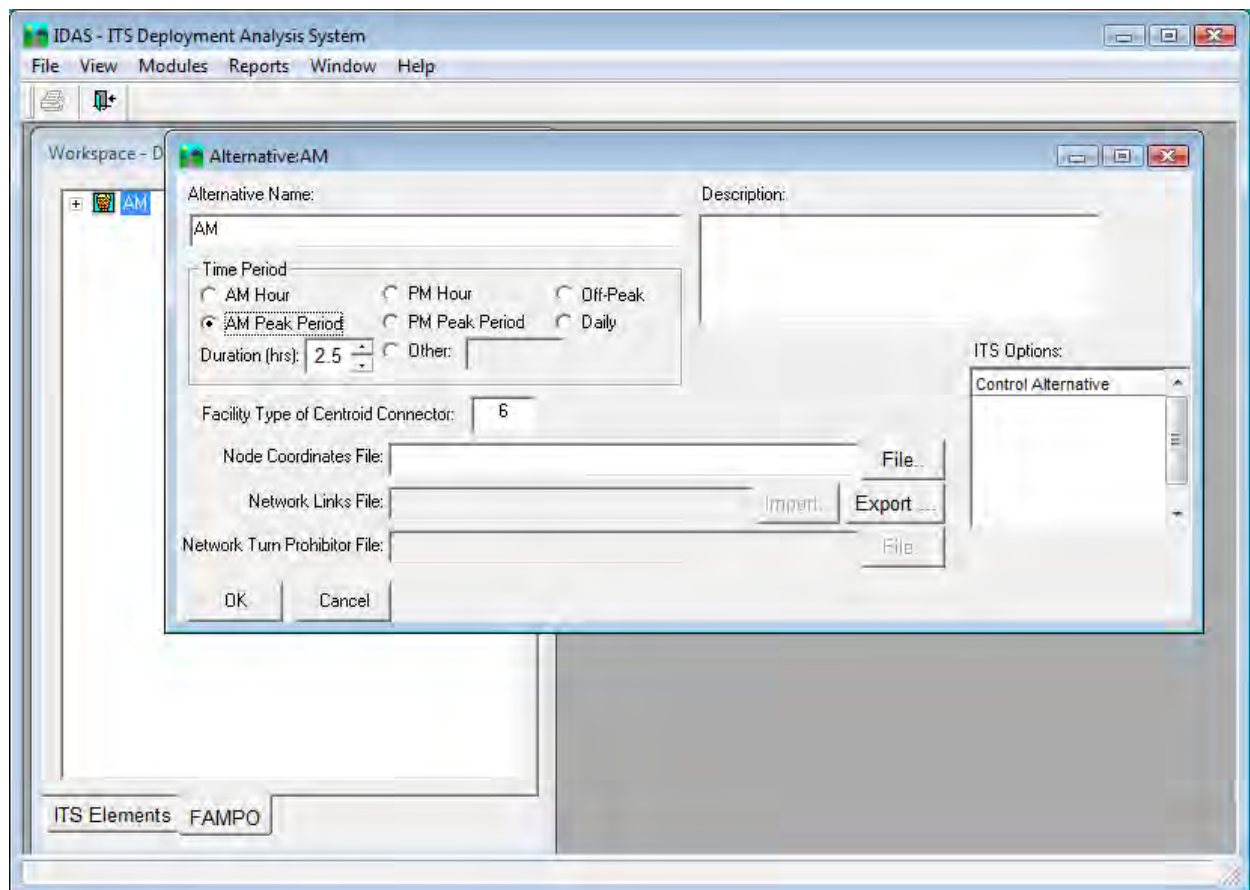
Figure 5.5 Creating a New Project

- **Step 3.** In **Figure 5.5**, the user has entered a name, which can be any name, and the year of data. In our case, the model data provided was from 2006.

Note that the system has created a new tab on the work prompter and has given that tab the same name as the project. Thus, a project is the white container in the interface that is selected by that tab; into which any number of Alternatives can be created.

5.3.2 Creating an Alternative

- **Step 1.** Dispatching the project definition window, then selecting File → New → Alternative from the main window creates an alternative as shown in **Figure 5.6**.

Figure 5.6 Creating an Alternative

An “Alternative” is a collection of any number of ITS Options (described next). The important thing to remember about an alternative is that it is:

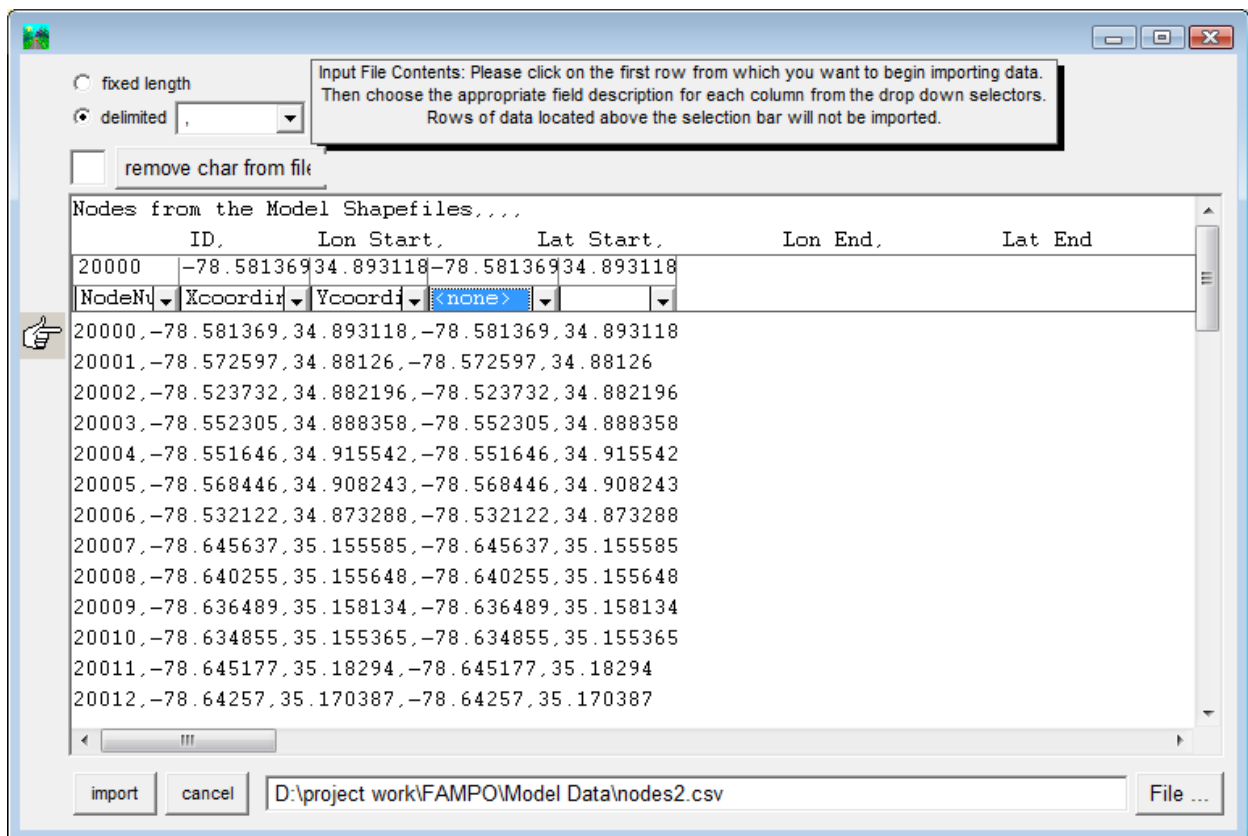
- For a *given* time period. The Market Sectors (described later) define a number of trips during a certain period of time. For this alternative, all market sectors used must be for that same period of time.
- For a *given* network. It is on this window that the user imports nodes and links. It is entirely possible for a given project to have multiple *alternatives* that have different networks. For example, a model that contains projected capital improvements (new links, new facility types) and one that does not.⁷
- **Step 2.** To define this alternative, it is given a name, in this case, one that reflects the time period that will be used, the time period of the market sector data (AM), and the

⁷ It is important to also understand that each network must have its own importable nodes and links from a TDM.

duration of that time period. One can see that the facility type of Centroid Connectors is filled in (done by the system automatically) and that an option already exists in the ITS Options box. The Control Alternative is automatically created each time an Alternative is created. The Control Alternative is the “no option” scenario that represents the baseline performance on the network.

- **Step 3.** Pressing File to the right of “Node Coordinates File” field in **Figure 5.6** opens a file open dialog. Navigating the file selector to the saved Node.csv file created in preparing the network data, the following import specification window appears.

Figure 5.7 Importing Nodes



- **Step 4.** The file shown above is the ‘.csv file exported directly from the Nodes sheet in the master links Excel Workbook.

Note carefully that the delimited option, by comma is shown in the upper left. This must be noted. IDAS remembers most of the structure of these import files once one of them has been imported; however, it sometimes overlooks the setting of this option.

In the above figure, the appropriate column in the input data has been associated with the field in IDAS from the dropdowns across the top of the figure. Note from the position of the index finger that the user first clicked on the third row of data to indicate

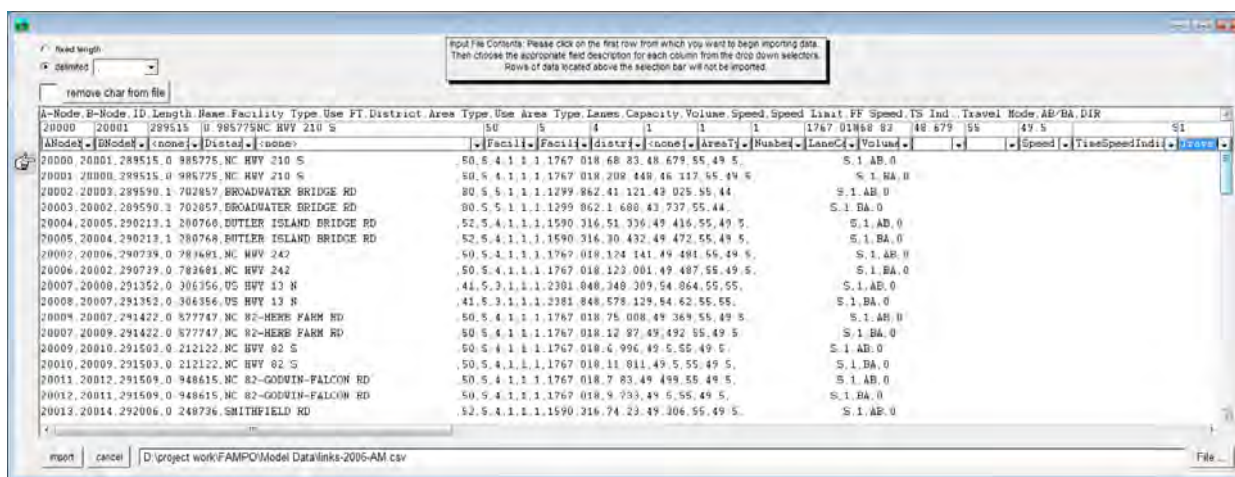
that import should start on that row. This is because the first two rows are used as a note row and a header row with titles.

- **Step 5.** IDAS makes an assumption the first time it imports a file of a certain type (in this case Nodes). The default is that the first column is ignored in Nodes files. (In certain TDMs, an extra field is exported here.) Thus, it is important to double check the field associations. In **Figure 5.7**, it can be seen that the fourth field, the an “extra” longitude value, has just been set to <none>. Any field with the association either at <none> or blank is skipped.
- **Step 6.** Press “Import” in the lower left. The system imports the nodes and waits for the user to press OK.

Import the Links

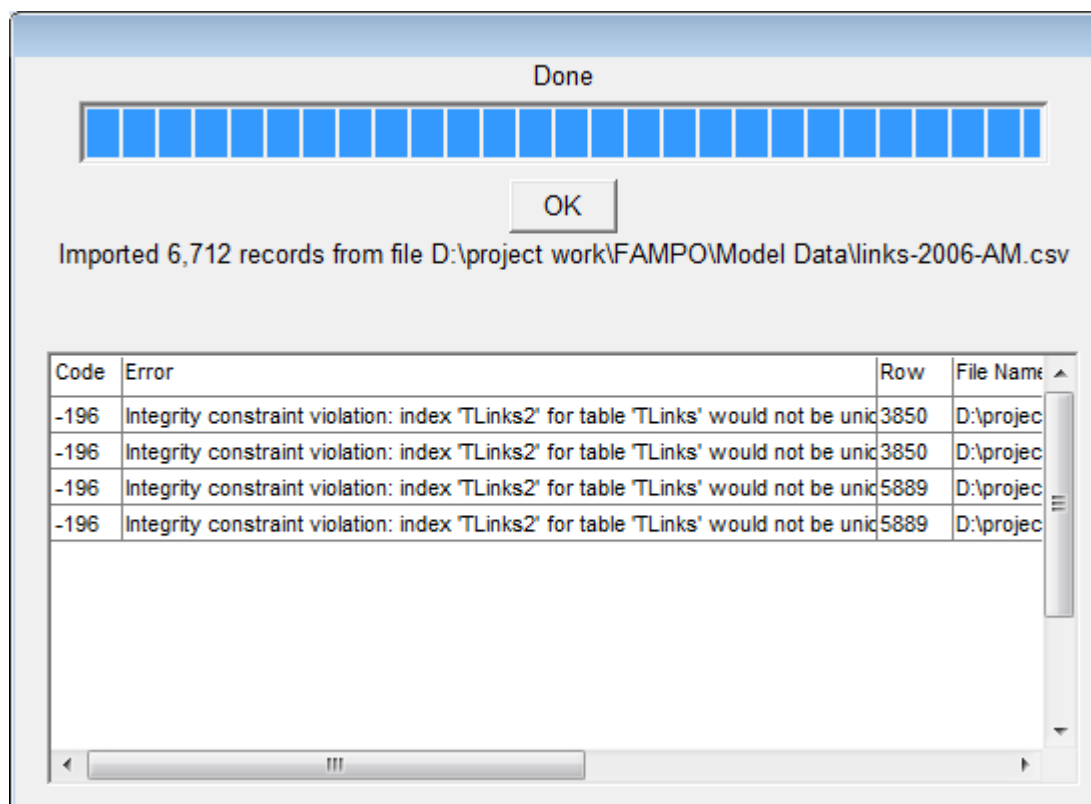
- **Step 7.** When returned to the Alternative window, press “Import” to the right of the “Network Links File.” The system prompts the user to navigate to the links file, in this case, the Links.csv file exported from the main links workbook.

Figure 5.8 Importing Links



- **Step 8.** In **Figure 5.8**, all of the required fields for IDAS have been selected by the dropdowns and the delimited option has been checked as delimited by comma. Pressing “Import” in the lower left will import these links into IDAS.

Note that IDAS uses a database system where links are indexed on the premise that no two links can share the same A-B pair. In other words, there can be at most one link between each unique value of A-B or B-A. Occasionally models will have such links in them, in which case IDAS will ignore any it finds after the first. During import, a message is displayed to indicate such duplicate links exist, and IDAS ignores the duplicate.

Figure 5.9 Links Import Done

The above figure summarizes the link import process for the FAMPO model. It can be seen that there are 2 duplicate links in the network (IDAS is reporting each error twice). One could open the links file and inspect lines 3850 and 5889 to see the detail about the duplicate links. Typically, this situation is benign and can be ignored.

- **Step 9.** Pressing OK on the screen shown in **Figure 5.9** returns the user to the Alternative window.

Import Network Turn Prohibitor File (Optional – Not Used in This Application)

This file is an optional file that instructs the assignment module in IDAS where turns cannot be made between links.

The term “optional” refers to the fact that this typically has little effect on the outcome of the assignment to the network unless the TDM itself relies on the use of turn prohibitors extensively. This latter situation would occur, for example, if the TDM did not include freeway ramps in its network and would use turn prohibitors to prevent assignment from an arterial to a freeway at their common node. That situation makes turn prohibitors mandatory.

In the present effort, turn prohibitors were not used.

6.0 Importing Market Sector Data

■ 6.1 Introduction to Market Sector Data

The use of market sector data by IDAS is described in Section 10.0. This section focuses entirely on preparing market sector data for use and importing that into IDAS.

To recap from Section 5.0, **a market sector contains one or more “counts” of a measure that is spent by the traveling public between each zone pair on the entire network.**

To clarify:

- A zone pair is one of every combination of an “origin” zone number, and a “destination” zone number. Here, “zones” are the special nodes with the ID value between 1 and the “maximum internal and external centroid number,” a critical input value described in Section 4.0.
- All centroid connector links either emanate from a zone or arrive at a zone. No centroid connectors can exist between any two nodes which are both not also zones.
- The “counts” used in IDAS are:
 - Number of trips. How many people made a trip between the given O-D pair?
 - Out-of-vehicle time. How much time was expended by all travelers between the O-D pair in activities related to travel, but not directly within the vehicle?
 - In-vehicle time. How much time was spent by all travelers between the pair while actually underway?

In- and out-of-vehicle time matrixes are only used for transit analysis in IDAS.

■ 6.2 Required Data Conversion

In the case of the Fayetteville area analysis, any conversion of market sector data for vehicle travel must happen before transferring the files for import to IDAS.

We obtained trip tables (in and out of vehicle time matrices were not needed in this analysis) for both Auto and Truck trips for each of 4 analysis periods for each of 3 networks, 2006, and 2 2035 networks.

Additionally, the Auto and Truck trips were actually in *two* files – a “Preload” matrix, and a “Normal” matrix.

Ultimately, this results in a total of 48 input matrix files.

Because we don’t have any specific commercial vehicle ITS deployments planned, we combine the auto and truck matrices into an “All Traffic” matrix for convenience (the more matrices in IDAS, the slower the benefits module runs will be).

We also combine the Preload and Normal matrix and after combining arrive at a total of 12 input matrices, just one for each of 4 time periods, for each of 3 networks.

To combine trips, a simple C++ program was again written to read two matrices and output one. The source for this program (called combineTrips.exe) is provided within the FAMPO area IDAS directory structure.

Since it is a DOS program, there is no graphical user interface to run this tool. However, it is a simple matter to navigate a DOS prompt (as explained in Section 5.2.1.3) to the location of the input matrices, and type:

```
combineTrips matrix1.txt matrix2.txt > matrixCombined.txt
```

which creates the resulting matrix.

This small tool simply reads the inputs from the two files (which are in the form Origin Zone #, Destination Zone #, # Trips) and adds the # Trips values from each (appropriately indexed by the zone #'s) and writes out the resulting data in the same format.

An example which creates the 2035 AM All traffic matrix is as follows:

```
combinetrips OD_Highway_AM_Auto.txt OD_Highway_AM_Preload_Auto.txt > OD_Highway_AM_Part1.txt  
combinetrips OD_Highway_AM_Preload_Truck.txt OD_Highway_AM_Truck.txt > OD_Highway_AM_Part2.txt  
combinetrips OD_Highway_AM_Part1.txt OD_Highway_AM_Part2.txt > AM_TotalTrips.trp
```

In the example, the Preload and Normal are combined for auto, then for truck, and finally the results of these 2 are combined.

A similar procedure was followed for all time periods for all 3 networks.

■ 6.3 Importing the Market Sector Data

The following is the procedure for importing market sector data:

- **Step 1.** Prior to the import of any market sector data, **the maximum zone number used in the model first must be defined in IDAS**. This information is entered using the File\Setup menu option as shown in **Figure 6.1**. In the FAMPO Model, this value is 1,051.

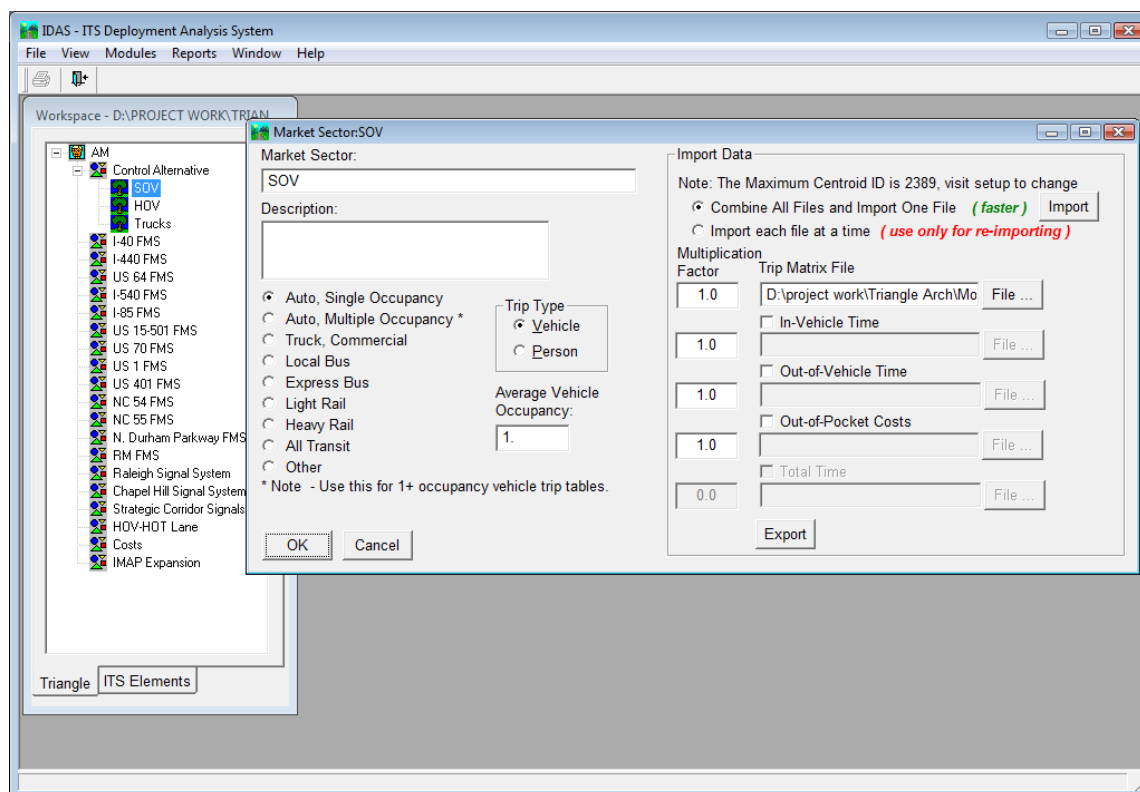
Figure 6.1 Entering the Maximum Zone Number

The screenshot shows the 'IDAS - Setup' window with the 'TDM Data' tab selected. The 'Regionalized TDM Data' section contains the following elements:

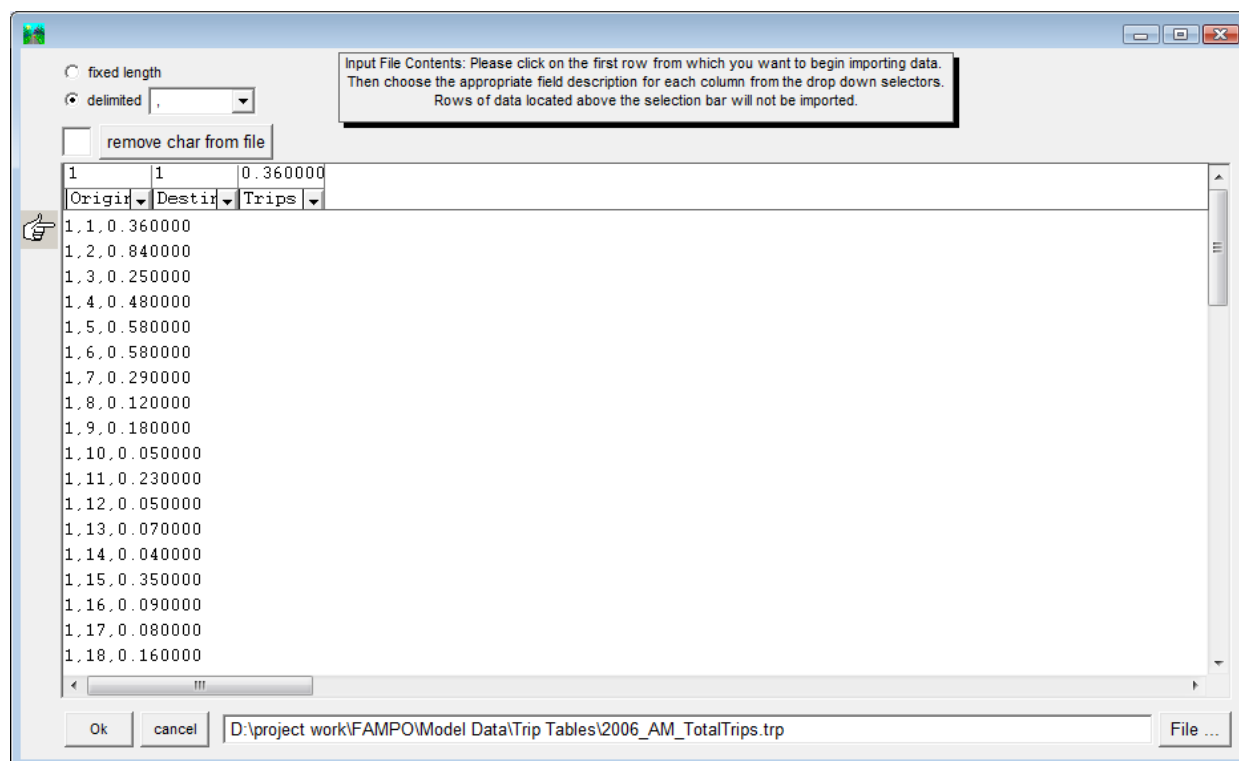
- A text box labeled 'Maximum External AND Internal Centroid ID Number:' with the value '1051' entered.
- A label 'Translation From TDM Input Area Type to Urban/Suburban Rural' above a spin box set to '0'.
- Two radio buttons: 'Urban' (selected) and 'Suburban/Rural'.
- Two buttons: 'All Urban' and 'All Suburban/Rural'.
- An 'OK' button at the bottom left of the dialog.

- **Step 2.** The market sector data are then imported as a new market sector by:
 - First defining the new market sector (by selecting File → New → Market Sector from the main menu)
 - Providing some general parameters for the market sector (e.g., average vehicle occupancy)
 - Indicating the data file name and location
 - Defining the data file contents

Figure 6.2 shows an example of the parameters used in importing the All Traffic market sector data from the FAMPO model.

Figure 6.2 Sample Market Sector Input Parameters

- Step 3.** Figure 6.3 shows the trip matrix data being imported into IDAS from a text file using the IDAS Input/Output Interface. In this particular case, the import file contains one trip count column for all vehicles. The first two columns include the origin zone and destination zone number. The third column is the number of origin trips and number of destination trips for all traffic. To initiate the import process, the user presses the “File” button to the right of the field labeled “Trip Matrix File” in Figure 6.2.
- Step 4.** The user then navigates to the matrix import file, and selects the fields as outlined in Figure 6.3. Different formats of market sector data in these ASCII files can be encountered. For example, often the origin zone number is specified in the first column, the destination in the second, and the number of trips in the third. However, destination repeats in the fourth, and trips again in the fifth. This way, one row can contain values for one origin and many destinations. When this is the case, the user selects the input association as Origin, destination, trips, destination, trips, and so on for all of the fields present.

Figure 6.3 Sample IDAS Import of Trip Matrix from Text File**EXPLANATION**

Note the button in the lower left of this import window says “Ok” rather than “Import” as it does when importing links and nodes. The system does not actually import the data until the user goes back to the Market Sector Window (**Figure 6.2**) and presses “Import” at the top right of that window. The reason for this is that when multiple types of matrixes are being imported for a market sector, for example, trips and in- and out-of-vehicle time, the system imports them more quickly by combining them internally into one file for import.

If the user attempts to exit the market sector window before performing this final import, the system will alert them. Before benefits analysis can be run, the actual import of the market sector data must occur.

- **Step 3.** Once the user has created all the market sectors to be used in the IDAS analysis, they should run the baseline condition of the model to verify that all of the data is correct. This is done by running the Benefits module for the “Control Alternative,” recalling that the Control Alternative is the baseline performance measure. In other words, the network performance values produced for the Control Alternative are the values that are then compared to the TDM output to ensure there is at least some comfort level in how close they match.

7.0 Volume Delay Curves in IDAS

A volume delay curve is a function that specifies the expected speed (dependent variable) of traffic on a link based on what the current volume to capacity ratio (independent variable) is on that link at any given time.

The IDAS assignment module works like a TDM assignment procedure to estimate the loaded volumes and speeds on all links in the network.

Topics Covered in This Section

- A brief introduction on how IDAS relates curves to facility types
- How the V/C curves are maintained outside of IDAS
- How to properly associate each facility type to one of the curves provided
- Importing the V/C curves into IDAS

■ 7.1 V/C Curves Are Related to Facility Type

Each facility type in the TDM will handle traffic volumes differently than others. For example, freeway facility types are able to handle higher levels of traffic before speed is significantly reduced due to volume.

IDAS relates the desired V/C curve to the facility type by a combination of two link attributes that are present and imported for each link:

1. Facility type. The code provided by the TDM and identified to IDAS during the database setup procedure outlined in Section 4.0.

Each facility type is associated to one of the curve “names,” Freeway, Arterial, or Ramp.

Note: To avoid confusion, we will refer to a value of one of the three names – Freeway, Arterial, or Ramp – to **Curve Type** in this document.

2. Area type. A code provided by the TDM and which is converted to a value of 1 or 2 based on settings also outlined in Section 4.0.

There are essentially two “available” area types in IDAS: Urban or Suburban/Rural. The TDM may include up to 99 such area type codes. However, as outlined in Section 4.0, the File → Setup configuration window is used to tell IDAS how each of the distinct codes coming from the TDM are to be interpreted in terms of these two types in IDAS.

The combination of these two attributes, one with three possibilities, the other with two, provides a total of six distinct V/C curves that can be applied to facility types.

V/C curves are applied to a facility type, not on a per link basis.

There is no ability in IDAS to supply a different curve for different links that share the same facility type number. If there is such a situation where certain types of links will utilize a different curve, a new facility type must be added and that value used for links of that type.

■ 7.2 Maintaining V/C Curves Outside of IDAS

To facilitate the later import of V/C curves into IDAS, an Excel spreadsheet should be used to calculate and maintain the curves in tabular form.

Typically, it is recommended a single spreadsheet be used as described in Section 4.0 to manage facility types and district types. **Figure 7.1** shows a screenshot of such a worksheet with a portion of the tabulation.

Figure 7.1 V/C Curve in Tabular Form

	CurveName	AreaType	VCRatio	SpeedFactor
1				
2				
3				
4	freeway	1	0	1.000000
5	freeway	1	0.2	0.986406
6	freeway	1	0.3	0.976961
7	freeway	1	0.5	0.948182
8	freeway	1	0.7	0.889105
9	freeway	1	0.8	0.829254
10	freeway	1	0.9	0.715066
11	freeway	1	1	0.500000
12	freeway	1	1.1	0.294250
13	freeway	1	1.2	0.192090
14	freeway	1	1.4	0.110115
15	freeway	1	1.6	0.076707
16	freeway	1	1.8	0.058776
17	freeway	1	2	0.047619
18	freeway	1	2.5	0.032277
19	freeway	1	3	0.024407
20	freeway	1	4	0.016403
21	freeway	1	5	0.012352
22	freeway	1	6	0.009905
23	freeway	1		

Figure 7.1 shows calculations of the V/C curve over a range of V/C of 0 to 6 (highly congested). This calculation is usually taken out to a V/C of 12.

Note that the tabulation step size is smaller around the area of highest change in the curve (near 1, at a step size of 0.1) and the step size can be larger in other areas of the curve.

Requirements for V/C curve table

To summarize the format of the tabular representation of the curves, note:

- The header row (row 4 in the figure) must be present and organized as shown.
- Each curve type (Freeway, Arterial, Ramp) must be in the table.
- For each type, both area type 1 and 2 must be present.

- They should be in order, that is, first Freeway, area type 1 and 2, then Arterial, area type 1 and 2, and then ramps (both area types).
- Case does not matter, but spelling does.
- There should be no blank rows anywhere in the table.
- The V/C curve table must be given the name “vccurves.” As with other Excel named ranges, select the entire table, including the header row, and insert a named range with this name.
- Importing the tabular data into IDAS is explained in Section 7.4. Before that is done, however, it is necessary to create the mapping between the link facility and area types to the appropriate V/C curve as discussed in the next section.

■ 7.3 Associating V/C Curves to Links

Because the FAMPO model actually does have the two parameters (α and β) present on each link in the data – we set the facility type code for each link based on which curve is indicated by those parameters. This works well because the vast majority of links with a unique combination of α and β are of the same facility type.

Figure 7.2 VC Curves used in the FAMPO analysis

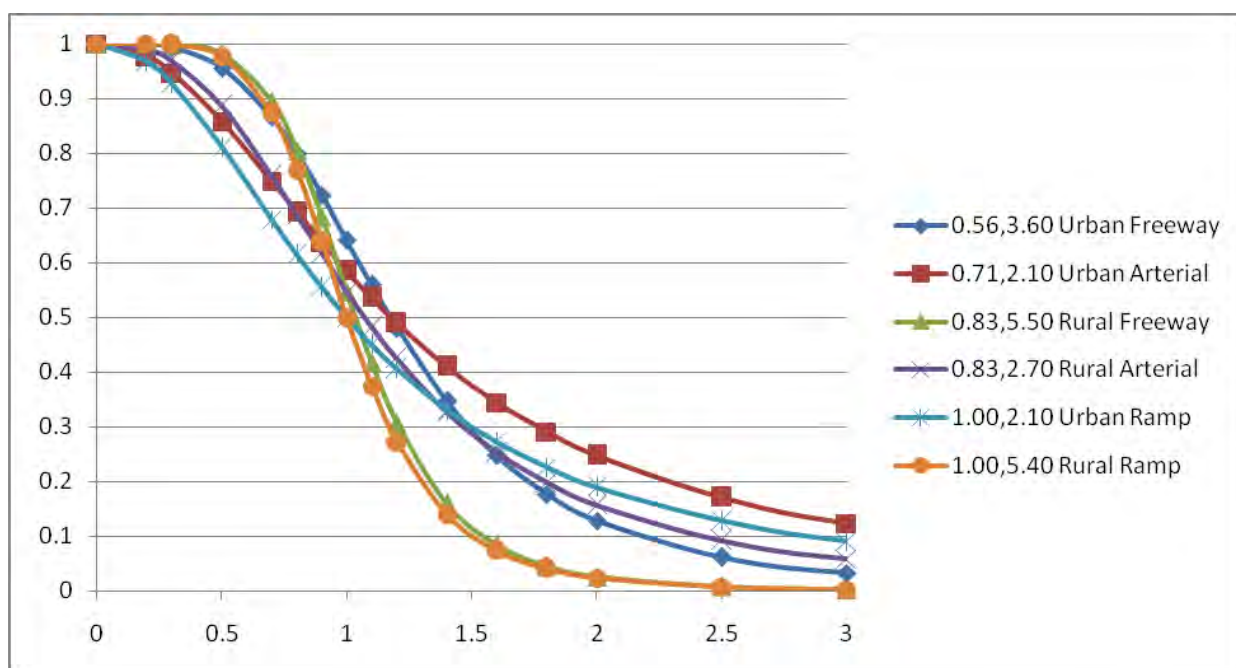


Figure 7.2 shows the curves for the distinct α and β in the FAMPO network. The legend indicates which Facility Type was chosen based on the α and β on each link. The facility

type codes used are 1 through 6 ordered top to bottom in the legend. The Centroid Connectors (where α and β are not important) used facility type 6.

We also note in the above figure that area type is simply used as one of the 2 curve selectors in IDAS, whether or not the link is in the city. The same is generally true for the curve name, the curve name and area type together “choose” the appropriate curve at IDAS assignment run time, and what is important in terms of results is that the proper α and β get applied.

■ 7.4 Importing the V/C Curve Data into IDAS

Note: This step will be performed using the setup parameters for the IDAS benefits analysis module. This means that the action cannot be performed until ITS Options have been created (as described in Section 8.0).

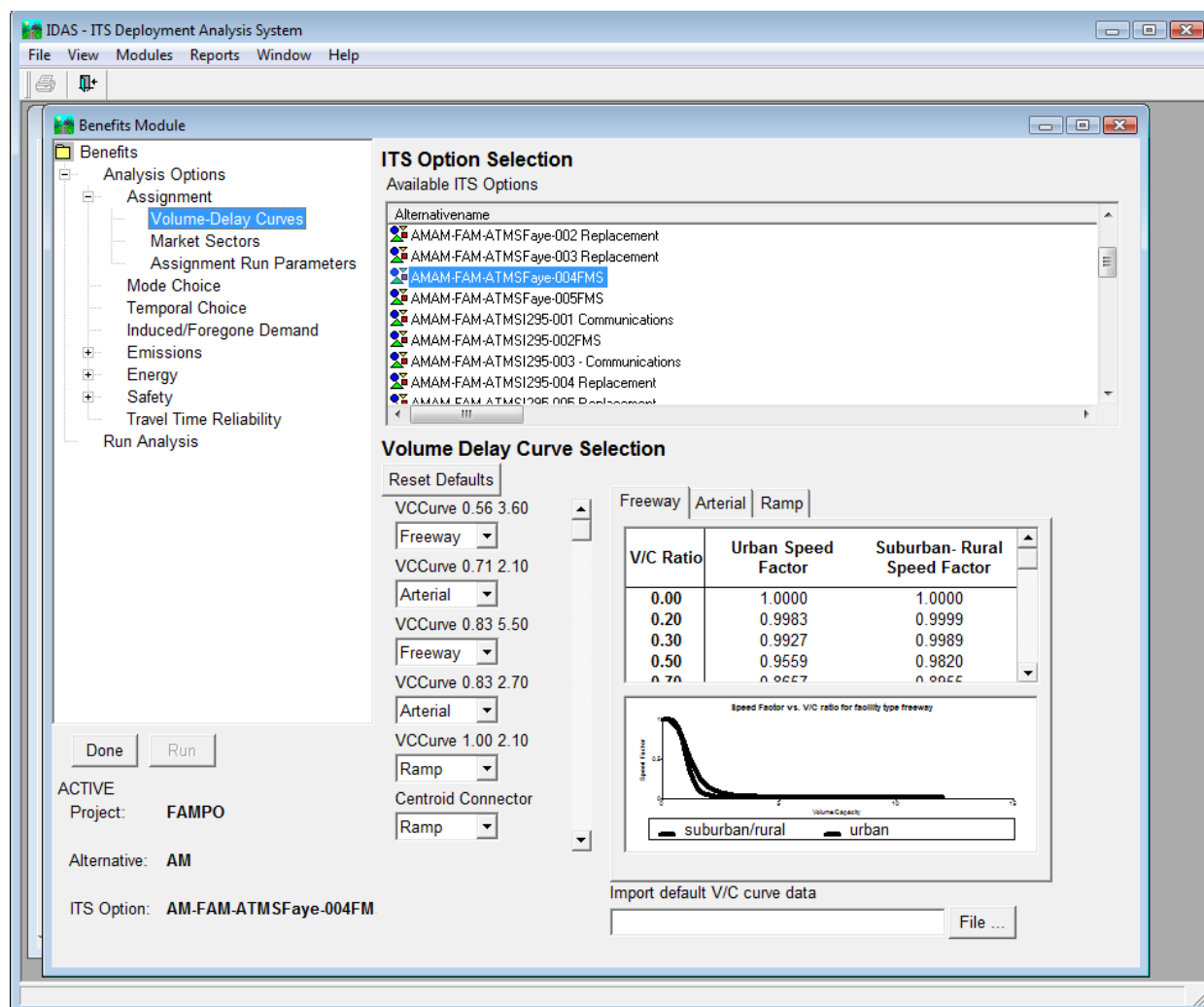
Figure 7.3 IDAS Volume-Delay Curves Input Window

Figure 7.3 shows the mechanism to import the V/C curves into IDAS. The button (labeled “File...”) in the lower right of the window prompts the user for the name and location of the Excel spreadsheet that contains the previously described V/C curves named range.

Note: The values in the dropdown boxes under each Facility Name (middle center of the figure) do not need to be changed. These are set when the facility types table was imported (using File → Setup) and are only here if the user wishes to *override* the curve selection for *this* particular ITS Option.

When you import the V/C curves, IDAS will ask you if you want to reset the V/C curves for ALL ITS options defined. Generally, you would respond Yes. This way – you only need to import these curves once for all of your ITS Options. In fact, you can create ITS Options *after* importing the curves, and those options will also use the imported values.

8.0 Running the Baseline Analysis

After having set up the IDAS database with initial information (Section 4.0), created and imported nodes, links, and market sectors (Sections 5.0 and 6.0), and defined the V/C curves that IDAS will use, we should validate to assure that the IDAS model runs produce results reasonably close to those of the TDM. A reasonable validation should be achieved before investing any more work in building our ITS strategies.

Topics Covered in This Section

- Introduction to the IDAS benefits module
- Set parameters in the IDAS benefits module
- Run the Control Alternative assignment
- Open and save the alternatives comparison module (ACM) Facility type performance spreadsheet

■ 8.1 Introduction to the IDAS Benefits Module

The benefits module within IDAS is used to generate estimates of the impacts of deploying ITS on the model network. The IDAS benefits module is roughly analogous to the mode choice and traffic assignment functions within a travel demand model with the important distinction that **assignment is always done twice, and that benefits in terms of network performance changes are linearly driven from the difference between these two assignments.**

The first time in running the benefits module is called the baseline assignment. All ITS Options have this baseline run associated with them. However, the automatically created Control Alternative is the one ITS Option that does not have the second run (improvement) performed.

We therefore run the benefits module first with the Control Alternative before making any other ITS Options so that we can be sure that the baseline output of this run matches reasonably well with the TDMs assignment runs. Any corrections necessary to the links, market sectors, or V/C curves need to be made now rather than after having deployed an ITS Option.

Validation is the comparison to the results of the TDM. It is not intended to relate in any way to the same term often used by the TDM community. **It is, in essence, validating to the TDM, and *not* validation of the TDM.**

Note: The assignment routine used in IDAS was developed by the same organization that developed the assignment algorithms for the TRANPLAN travel demand model. IDAS

provides a number of default parameters that are used in conducting the analysis. However, the likelihood of better replicating the results from a model is increased if the user is able to replace the default parameters within IDAS with the parameters directly from the TDM. This section describes those critical parameters.

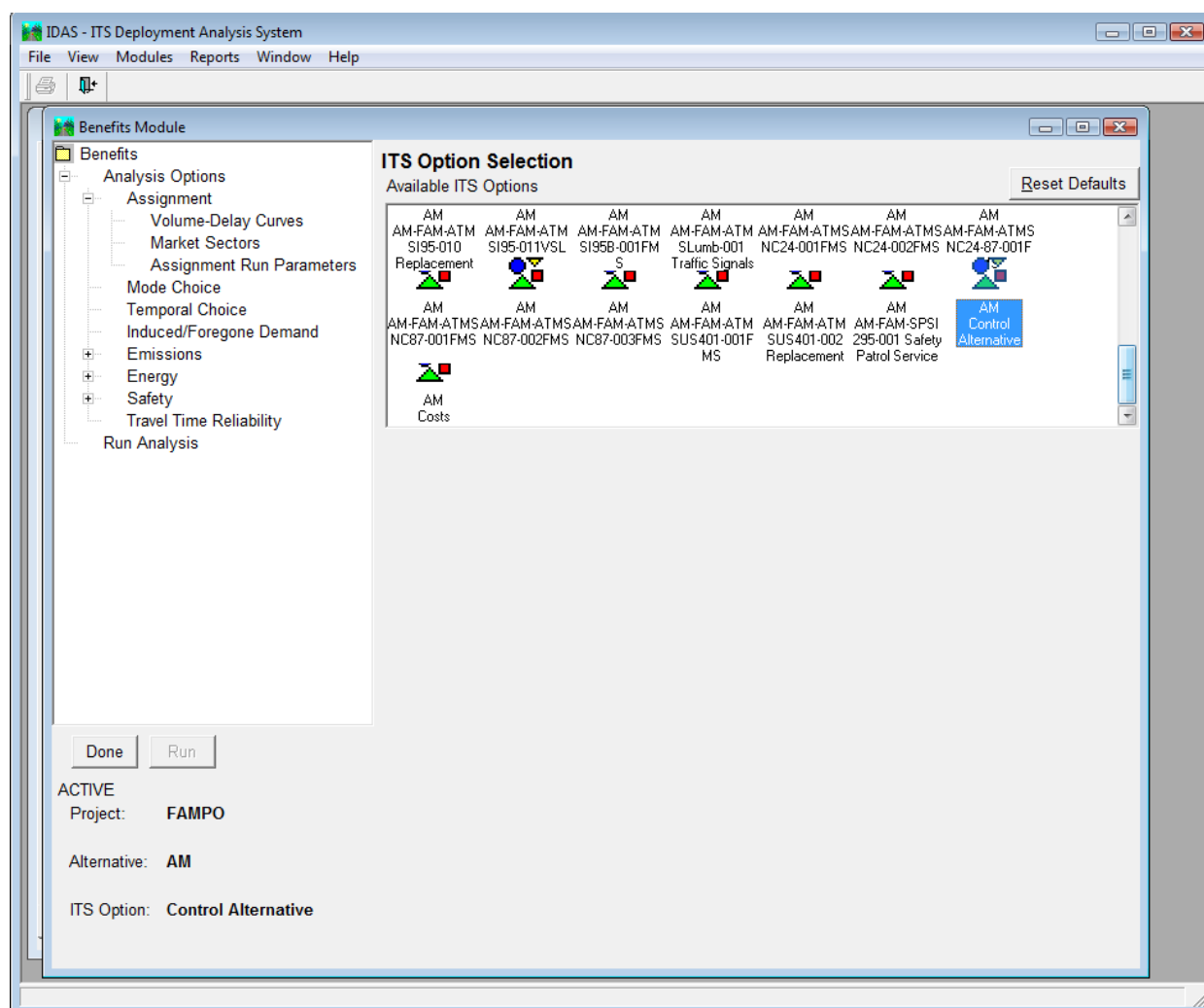
■ 8.2 Set Parameters in the IDAS Benefits Module

Selecting the Appropriate ITS Option

There are many parameters in this model that can be set. However, only a few affect the benefits run at the baseline level. Therefore, only those are discussed here.

The first selection to make is to choose the Control Alternative as the selected (active) ITS Option.

Figure 8.1 ITS Option Selection

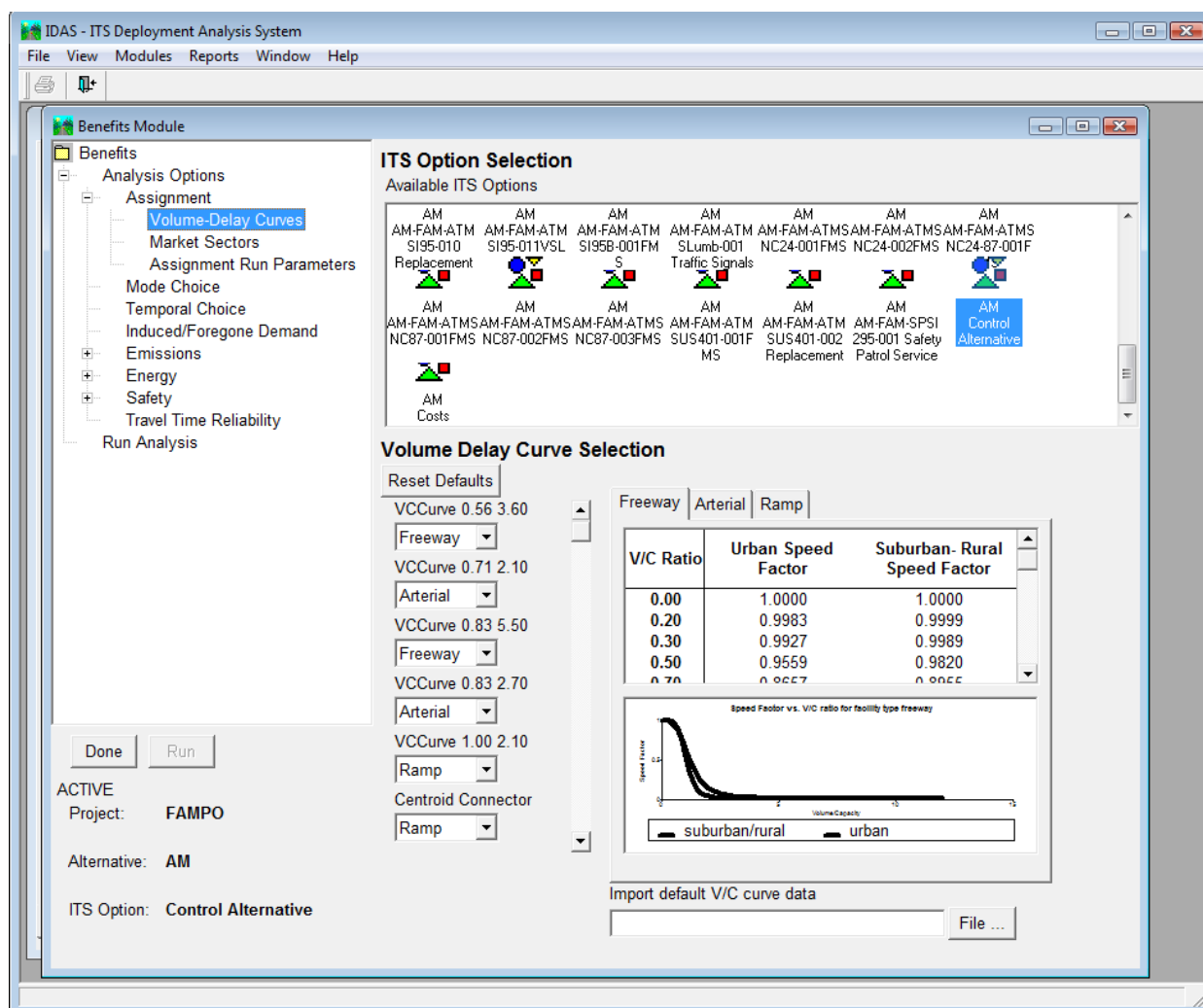


- **Step 1** Ensure the “Control Alternative” is selected as active.

Set the Volume Delay Curves Information

An extensive discussion of the construction and import of volume delay curves for IDAS was provided in Section 7.0.

Figure 8.2 IDAS Volume Delay Curves Input Window



- **Step 2.** It is here, during initial Control Alternatives benefits run, that we import these curves into IDAS for use not only in the baseline benefits run, but for all benefits runs that will occur in the future. As shown in **Figure 8.2**, press the “File ...” button in the lower right of the figure.
- **Step 3.** Navigate to the spreadsheet containing the V/C curves table described in Section 7.0 and select that spreadsheet.

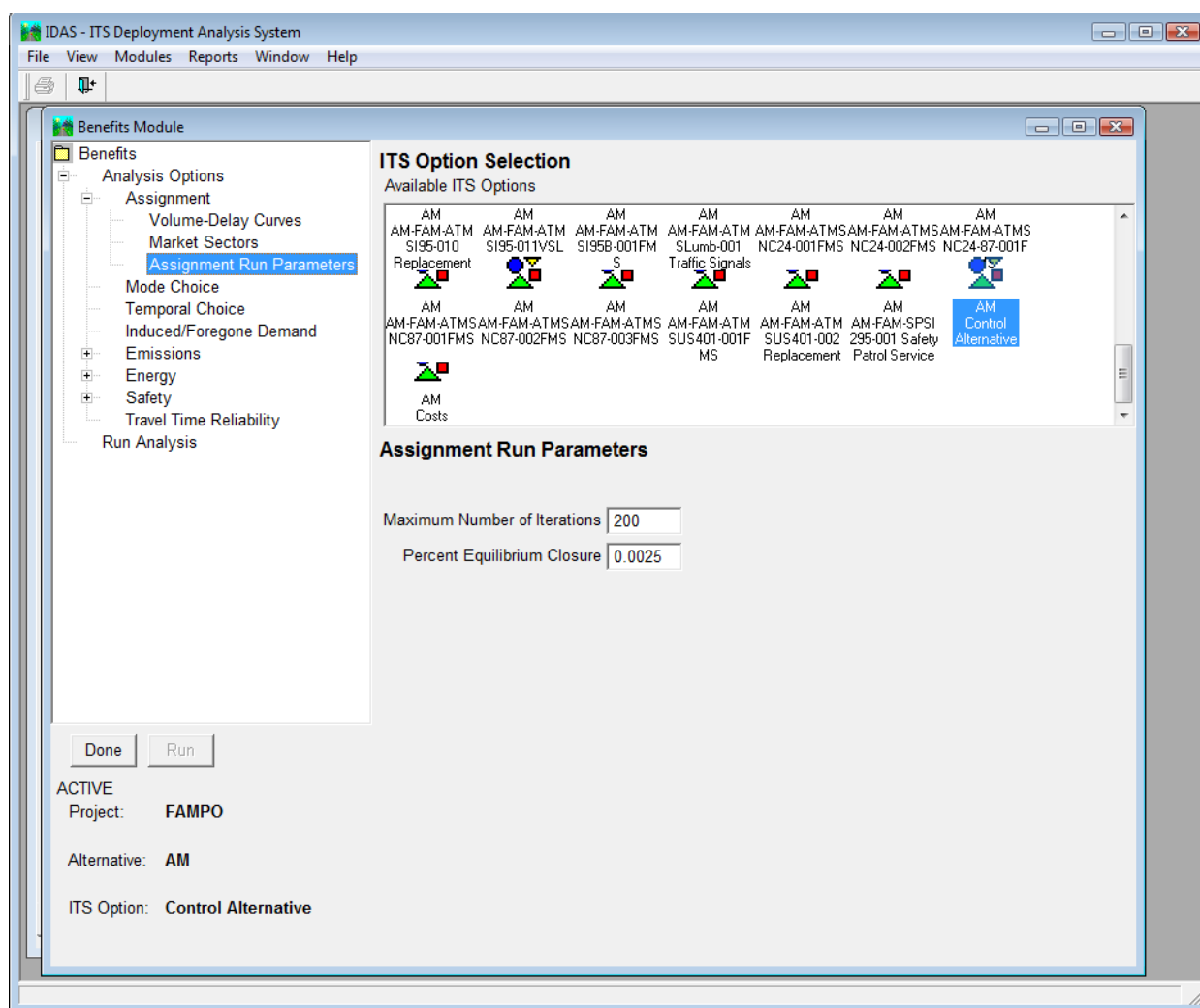
- **Step 4.** A message appears asking whether you want to set these curve values as the default for all runs; answer yes.

Specify the Assignment Closure Criteria

The assignment process is an iterative procedure that tries to determine the amount of traffic (volume) and speeds of every link in the network based on the demand represented by the matrices.

- **Step 5.** As an iterative process, it will continue analyzing the network until a certain calculated value either reaches a constant value or the allotted “number of” iterations has expired. These two settings are specified by clicking on “Assignment Run Parameters” in the window shown in the left side of **Figure 8.3**.

Figure 8.3 Assignment Run Parameters



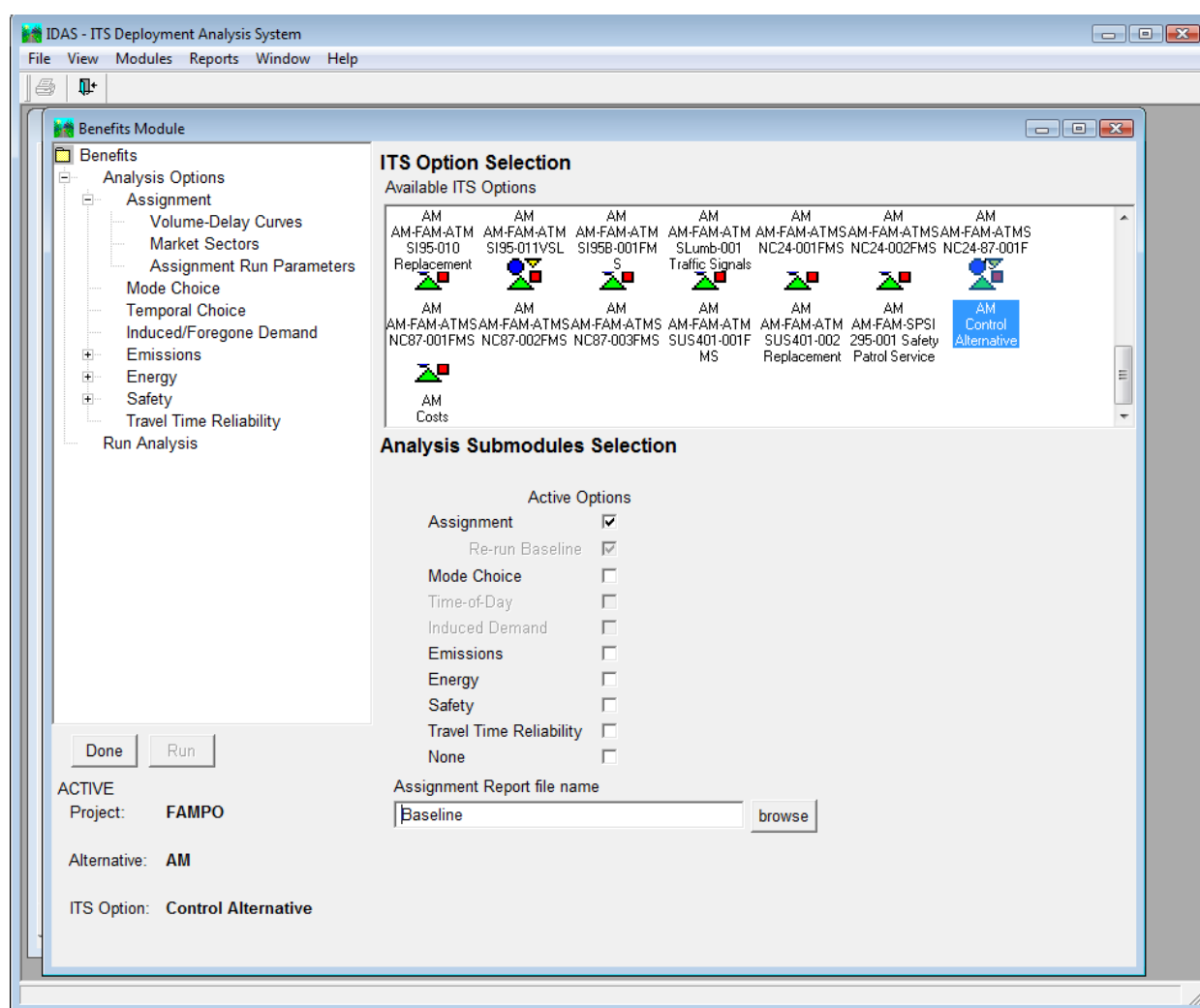
- **Step 6.** The default value of these is 0.0025 for the equilibrium closure gap and 200 as the maximum iteration count. Typically, an iteration count this high is never reached

unless there is a problem with the network links or capacities. The default value of 0.0025 for the closure gap has always worked well as the default value in IDAS.

Specify the Analysis Options

Figure 8.4 shows the analysis “submodules” available in the IDAS benefits module. During this initial run of the Control Alternative, only the actual assignment results (volumes and speeds on the network) are of interest. Usually, at least in terms of benefits, the other submodules do not need to run. Since no ITS strategies are deployed, there can be no difference in these measures for this particular (baseline) benefits run.

Figure 8.4 Benefits Modules Options



- **Step 7** (optional). If there is an interest in seeing the total accidents, emissions, or fuel usage that IDAS calculates, these submodules can be run to view these figures.

- **Step 8.** Deselect all options on this page except rerun baseline. The only required input value here is the benefits report file name. Enter any file name desired into this field shown on the bottom of **Figure 8.4**.

Note: The file produced, which you named, is of limited value to IDAS analysis. It is simply a run-time progress report of the assignment module as it proceeds through its steps. It is rarely used and then only in detailed-level debugging to determine what might have gone wrong in an assignment that produced incorrect results. **To reiterate, do not confuse this report file as someplace to find assignment results. Use the Alternatives Comparison Module (Section 12.0) to do that.**

■ 8.3 Run the Control Alternative Assignment

- **Step 1.** In **Figure 8.5**, an assignment run has just completed. This run was started by clicking on the “Run Analysis” text on the left side of the figure, and then clicking the “Run” button below that. The figure shows a completed run so the user can see what to expect when the analysis finishes.

IDAS - ITS Deployment Analysis System

File View Modules Reports Window Help

Benefits Module

Benefits

- Analysis Options
 - Assignment
 - Volume-Delay Curves
 - Market Sectors
 - Assignment Run Parameters
 - Mode Choice
 - Temporal Choice
 - Induced/Foregone Demand
 - Emissions
 - Energy
 - Safety
 - Travel Time Reliability
- Run Analysis

ITS Option Selection

Available ITS Options

AM	AM	AM	AM	AM	AM	AM	AM
AM-FAM-ATM SI95-010 Replacement	AM-FAM-ATM SI95-011VSL	AM-FAM-ATM SI95B-001FM	AM-FAM-ATM SLumb-001 Traffic Signals	AM-FAM-ATMS NC24-001FMS	AM-FAM-ATMS NC24-002FMS	AM-FAM-ATMS NC24-87-001F	AM-FAM-ATMS NC24-87-001F
AM	AM	AM	AM	AM	AM	AM	AM Control Alternative
AM-FAM-ATMS NC87-001FMS	AM-FAM-ATMS NC87-002FMS	AM-FAM-ATMS NC87-003FMS	AM-FAM-ATM SUS401-001F MS	AM-FAM-ATM SUS401-002 Replacement	AM-FAM-SPSI 295-001 Safety Patrol Service		
AM Costs							

Run Benefits

Note: Select Multiple ITS Options using [CTL-click]

Summary Report File:

Step	Task	Note	duration
31	Update Using Analysis Results	baseline	01s
32	Loading Results	network	02s
33	Loading Results	matrix	11s
34	Updating Matrix Information		00s
35	Summing VHT Out vehicle for Assigned market sector - All	matrix	00s
36	Summing Trips	matrix	00s
37	Applying the Control Alternative results - Matrix		10s
38	Applying the Control Alternative results - Network		03s
39	Finished		01m:52s

ACTIVE

Project: **FAMPO**

Alternative: **AM**

ITS Option: **Control Alternative**

[Benefits Run Settings Report](#)

Note: IDAS is not a multitasking, thread aware application. In particular, **while the benefits module is running, it is not possible to switch away and manipulate other parts of the IDAS system.** This means that IDAS may appear not to “paint” its user interface and may look like it has stalled. Windows may even tag the application as “not responding” during this period of time. Please be aware that IDAS is *not* stalled and will eventually refresh its screen to indicate it is running.

■ 8.4 Open and Save the Alternatives Comparison Module Performance by Facility Type Spreadsheet

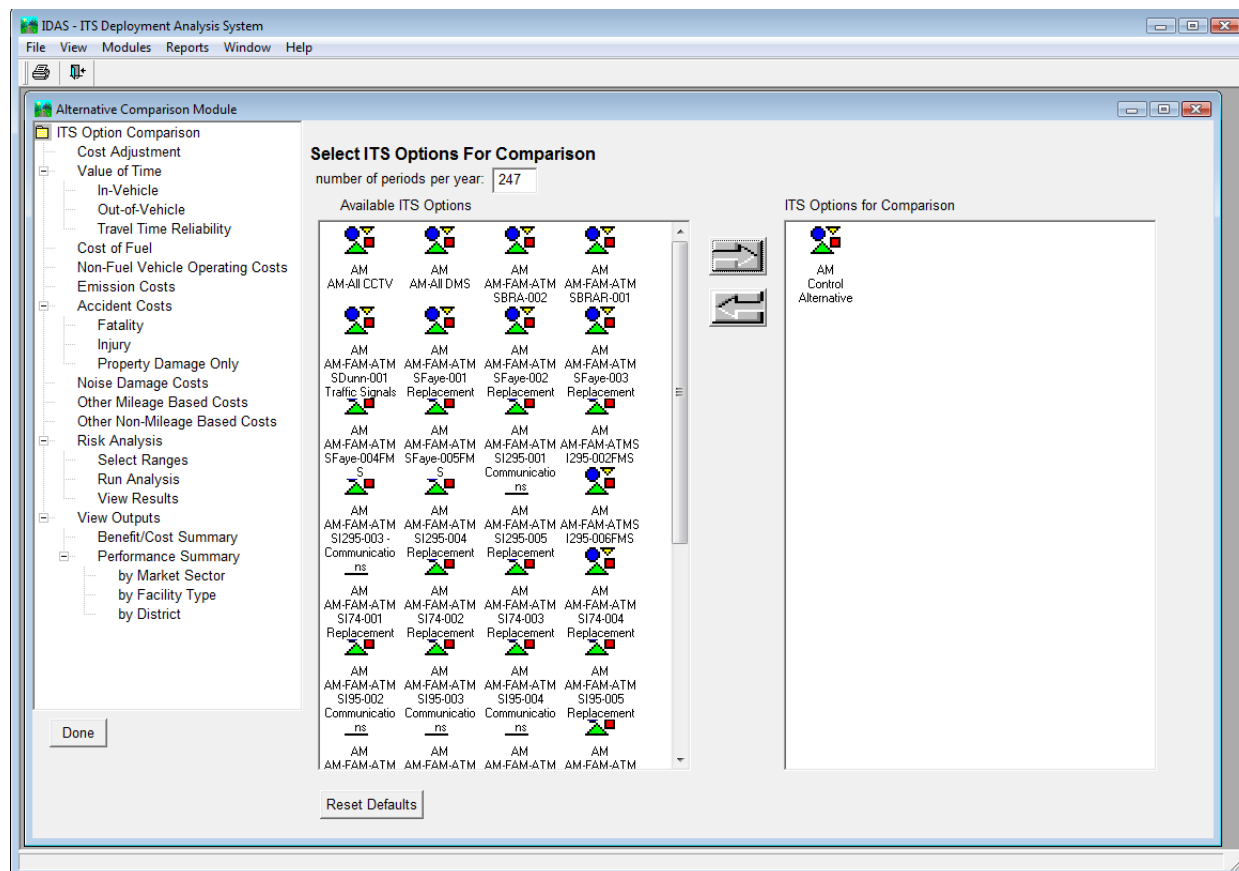
The Alternatives Comparison Module is used to view the results from the IDAS benefits (and costs) calculations by mixing and matching groups of ITS Options together and reporting on them all at once.

It is described in its own section (Section 12.0). Discussion of this module here only relates to obtaining the data we will use in the next section (validation).

Open the Alternatives Comparison Module

- **Step 1.** Select Modules → Alternatives Comparison from the IDAS main menu. This module features two vertical boxes containing ITS Options on its main page. The box on the right contains the ITS Options that are to be grouped together for benefits reporting. The box on the left contains the rest of the options.

Figure 8.6 The Alternatives Comparison Module

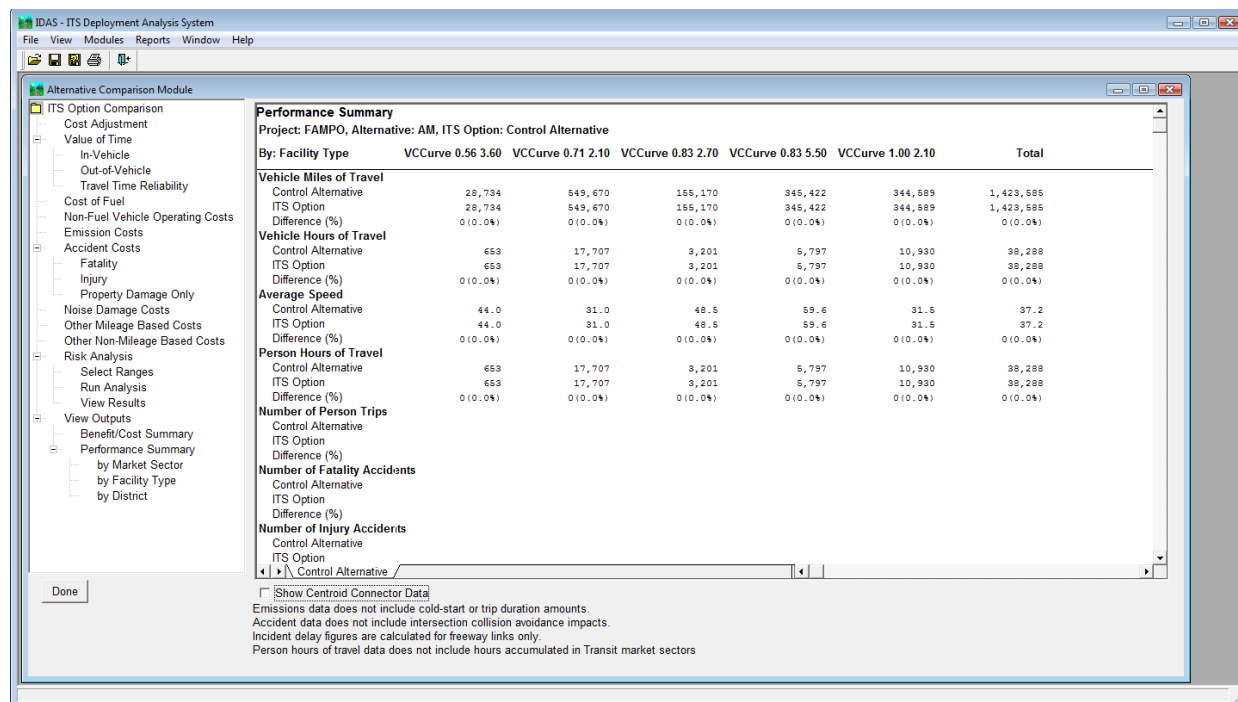


Select the Control Alternative

- **Step 2.** At this point, if the Control Alternative option is in the left window, click it once and then click the right arrow between the two boxes.

Produce the Performance by Facility Type Spreadsheet

- **Step 3.** Click on the Performance Summary by Facility Type near the bottom of the left side of **Figure 8.6**. This creates the Facility Type performance spreadsheet shown in **Figure 8.7**.

Figure 8.7 Performance Summary by Facility Type

- **Step 4.** Note carefully in **Figure 8.7** that the “Show Centroid Connector Data” check box has not been checked. This is optional but it is important to remember whether the total column on the right of **Figure 8.7** contains Centroid Connector volumes and speeds.

Save the Facility Type Spreadsheet

- **Step 5.** Click the Diskette icon with a question mark shown in the upper left of **Figure 8.9**. This provides an option to save this spreadsheet as a workbook. In the file dialog box, be certain to select .xls as the file type as the default file type has no real value.
- **Step 6.** Having run the Control Alternative through the benefits module, and saving this Performance by Facility type spreadsheet, you are ready to perform validation of the IDAS results with information from the TDM.

This topic is covered in Section 9.0.

9.0 Validating the IDAS Results

Validating IDAS results specifically refers to comparing the assignment results from IDAS with the TDM. IDAS assumes that the model itself has already been “validated,” in TDM parlance, and that the IDAS results can only be as good as those of the model.

Topics Covered in This Section

- When to Validate
- What is “Close?”
- Data Required for Validation
- Initial Validation in the Alternatives Network Generator
- Detailed Validation at the Link Level

When to Validate

Validation should occur after database loading, per Sections 4.0 through 6.0, V/C curves have been created and have been imported (Section 7.0), and the Control Alternative has been run through the benefits module (Section 8.0).

Do not deploy ITS Options on the network (Section 10.0), without at least some comfort level that the results of the IDAS benefits module match reasonably close.

What is Close

- The IDAS assignment subroutine operates similarly to a travel demand model assignment. Therefore, the baseline output from IDAS should be reasonably similar, but will not be identical to the output generated by the model. Differences in the capabilities of the models and the required modifications to the network data described in the previous sections guarantee that the results will not be identical.
- In some situations, the IDAS module is very close. The assignment routine within IDAS was built by Urban Analysis Group (now Citilabs) the creator of the TRANPLAN travel demand model platform. Therefore, it is often found that matching IDAS results with TRANPLAN produces results in the 2 to 5 percent difference range.
- However, it is noted that the way IDAS benefits are intended to be assessed effectively insulates the system from large discrepancies between it and the TDM’s performance output. When benefits are calculated in IDAS, it is always the *difference* in the network performance results that is taken into account. For example, the change in speed on a freeway link, between a traffic assignment done after an ITS deployment is in place

and the traffic assignment in the absence of that deployment, called the “Control Alternative.” Where some differences may exist between the model’s assessment of speed and that of IDAS, the underlying cause of that discrepancy will not impact on the change in speed. Said another way, if one used the model and ran it twice, the second time having applied the same network changes IDAS would apply, the model is very likely to come up with the same performance *delta* that IDAS did, and it is this delta that drives the benefits side of the analysis.

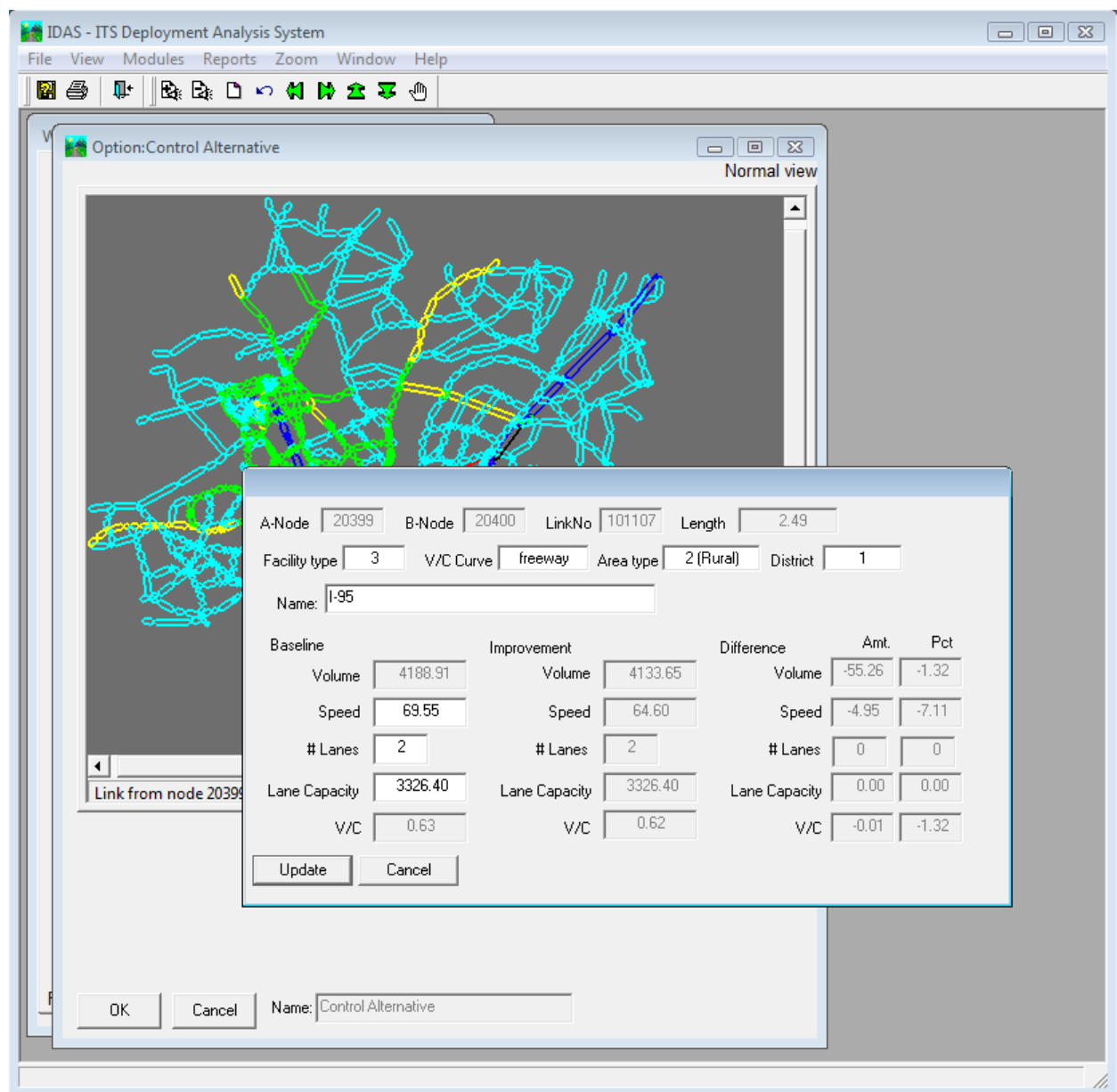
Data Required for Validation

In Section 8.0 (Figure 8.9), a Performance by Facility Type spreadsheet was produced by the Alternatives Comparison Module. Typically, using this spreadsheet is the first and highest level of validation. However, in the case of the FAMPO model, we actually have output of its results for every link in the network. Since this is available, we can compare the IDAS results on a link by link basis directly within our master Links workbook.

Initial Validation Using the Alternatives Network Generator

As discussed in Section 5 and shown in **Figure 5.3**, we actually have the link level model generated volumes in the FAMPO network. Therefore, the “visual” spot check described here is the first step in validation. If this shows a large discrepancy, there is no reason to perform the spreadsheet validation of the entire network described next. Instead, investigate the cause of the difference and re-run the benefits module until this step shows more reasonable values.

- **Step 1.** Open the Alternatives Network Generator for the Control Alternative (*after* baseline assignment run as detailed in Section 8.0) by double clicking on it in the IDAS Work prompter.
- **Step 2.** Right-click on a network link of interest, and choose Edit from the menu that appears.

Figure 9.1 Link-by-Link Validation Using the Alternatives Network Generator

- Step 3.** The data can be reviewed in the screen shown above. In the figure, a link on I-95 Northbound North of the I-95 Business interchange has been selected; it is black right above the inner detail window. All of the data about the analyzed (by IDAS) performance of this link is presented in the middle of the detail window (Improvement), and the data for this link that was imported into IDAS is on the left.

It is important to remember that this validation should only be done by viewing the Control Alternative. In this special ITS Option, the “Improvement” column of data is

what IDAS calculated as the baseline (i.e., no ITS Deployments) performance measures.

In other ITS Options, the baseline performance measures are the results of running assignment against the network without ITS Deployments. Therefore, again, in other ITS Options, the columns on the left are not the model input volumes, as they are in the Control Alternative. Here we have a volume on this link of 4188.91 from the TDM and, 4133.65 as calculated by IDAS. So IDAS is 1.32 percent low on this link.

- **Step 4.** Using this technique, one can go to any link on the map and see the comparison. It is a good idea to select several facility types, and also to focus on links where ITS strategies are expected to be deployed.

Detailed Validation at the Link Level

The FAMPO TDM writes out link volumes for every time period and direction for each link. For example, in the 2006 network, TransCAD produces the following file:

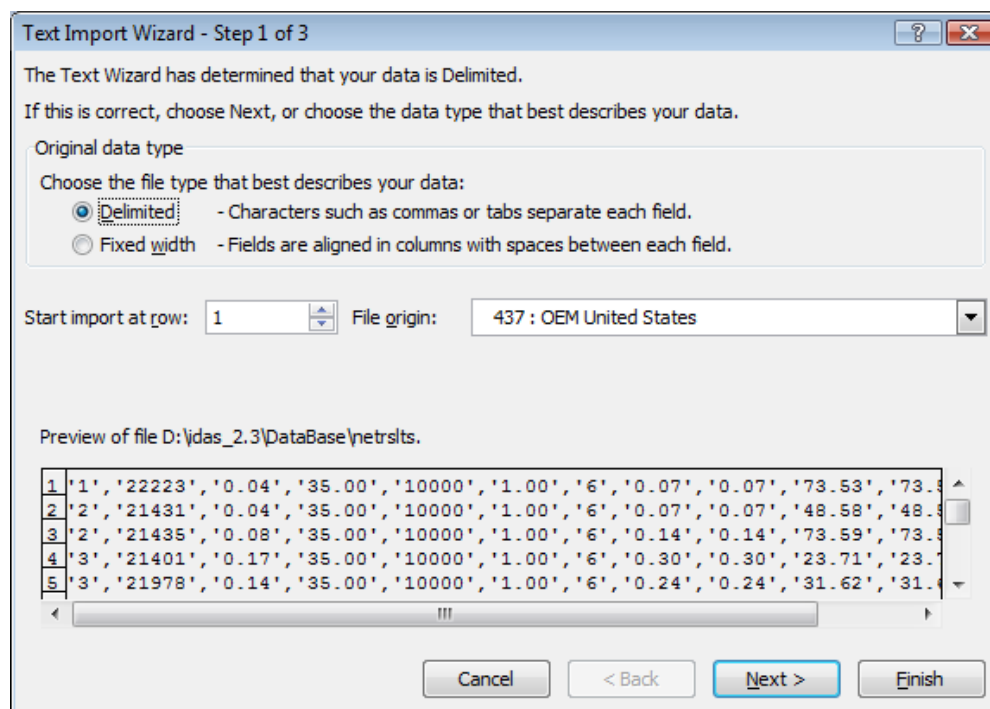
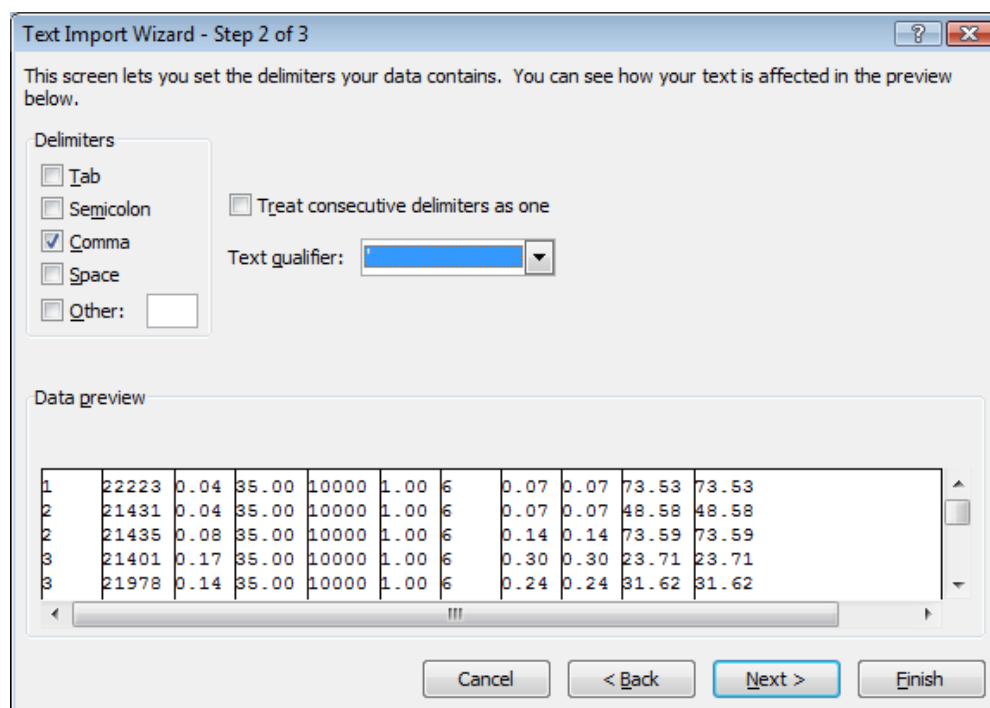
```
.\Model_Interface_V7\Output\2006\Highway_agn.bin
```

In section 5.2.1.3 – we discuss at length how this file was read using the readDCB tool, and subsequently imported into our master Links workbook into the “Model Results” worksheet. From here, appropriate modeled volumes are populated into the “volume” column for the network links import into IDAS. Thus facilitating our ability to utilize the alternatives network generator results view just discussed.

When the IDAS assignment run completes, it will have produced a file in the IDAS database directory called “netrslts”. This is a flat file that can be opened with Excel, and which contains the volumes (and speeds) for each link for each market sector.

Importing *this* file into our master links workbook allows us to compare the aforementioned Highway_agn.bin directly with the IDAS results in an automated way.

The following two figures step us through the process of importing the results file:

Figure 9.2 Upon Excel File Open - Delimited is checked. Click Next**Figure 9.3 Switch Delimiter to Comma, and Text qualifier to single quote, Click Finish**

Now, in the just opened worksheet – select all rows and columns, navigate to your master Links workbook, and paste into a blank worksheet.

Since IDAS identifies links by A and B node numbers, we use these two values to relate the IDAS results imported with the FAMPO model values in the volume column of the base Links spreadsheet (the one that will provide the links import file for IDAS).

Investigating the following figure:

Figure 9.4 IDAS Results in link comparison worksheet

	A	B	C	D	E	F	G	H	I	J	K	L
	ID	A-Node	B-Node	Distance				FT			IDAS Volume	
2	000001-022223	1	22223	0.04	35	10000	1	6	0.07	0.07	73.53	73.53
3	000002-021431	2	21431	0.04	35	10000	1	6	0.07	0.07	48.58	48.58
4	000002-021435	2	21435	0.08	35	10000	1	6	0.14	0.14	73.59	73.59
5	000003-021401	3	21401	0.17	35	10000	1	6	0.3	0.3	23.71	23.71
6	000003-021978	3	21978	0.14	35	10000	1	6	0.24	0.24	31.62	31.62
7	000004-021339	4	21339	0.04	35	10000	1	6	0.07	0.07	56.85	56.85
8	000004-021341	4	21341	0.3	35	10000	1	6	0.52	0.52	16.92	16.92
9	000004-021429	4	21429	0.23	35	10000	1	6	0.39	0.39	11.19	11.19
10	000005-021343	5	21343	0.05	35	10000	1	6	0.09	0.09	129.06	129.06
11	000006-021302	6	21302	0.25	35	10000	1	6	0.43	0.43	57.16	57.16
12	000006-021304	6	21304	0.14	35	10000	1	6	0.24	0.24	105.72	105.72
13	000006-021965	6	21965	0.15	35	10000	1	6	0.26	0.26	4.01	4.01
14	000007-021348	7	21348	0.18	35	10000	1	6	0.31	0.31	74.9	74.9
15	000007-021692	7	21692	0.13	35	10000	1	6	0.22	0.22	73.76	73.76
16	000007-021838	7	21838	0.14	35	10000	1	6	0.25	0.25	2.33	2.33
17	000008-021400	8	21400	0.07	35	10000	1	6	0.12	0.12	13.79	13.79
18	000008-021402	8	21402	0.11	35	10000	1	6	0.2	0.2	20.56	20.56
19	000009-021411	9	21411	0.03	35	10000	1	6	0.06	0.06	61.57	61.57
20	000009-021670	9	21670	0.1	35	10000	1	6	0.17	0.17	0.42	0.42
21	000010-021438	10	21438	0.11	35	10000	1	6	0.2	0.2	9.07	9.07
22	000010-021439	10	21439	0.06	35	10000	1	6	0.1	0.1	9.11	9.11
23	000010-021979	10	21979	0.05	35	10000	1	6	0.09	0.09	3.82	3.82
24	000011-021434	11	21434	0.08	35	10000	1	6	0.14	0.14	28.22	28.22
25	000011-021460	11	21460	0.07	35	10000	1	6	0.12	0.12	40.05	40.05
26	000012-021364	12	21364	0.06	35	10000	1	6	0.1	0.1	24.69	24.69
27	000012-021391	12	21391	0.05	35	10000	1	6	0.08	0.08	4.11	4.11

We see the sheet generated from the netrslts file, with the following changes:

- Row 1 has been inserted to provide labels for the columns, which are not present in the netrsIts file.

For reference, the columns in the netrsIts file are:

- A Node
- B Node
- Distance
- Input Speed
- Lane Capacity
- Number of Lanes
- Facility Type
- Travel *time* (minutes) for each market sector
 - If more than 1 market sector, a column exists for each
- Average travel time for all market sectors
- Volume for each market sector
 - Total volume for all market sectors

- Column A has been inserted, and an “ID” field generated by combining the A and B node numbers (columns B and C) using the Text Function padding the values to six characters left zero filled. It is important to follow this pattern in order to be sure that the ID field is 100% unique.

Tip: Once this worksheet has been setup, re-importing netrsIts (after fixing any issues, for example), should be done by first deleting the data in⁸ columns B thru L, in rows 2 thru the end, and then pasting the new values into there. In such a case, you select the values from the import sheet by highlighting cell A1 thru the bottom right cells, *not* by using the select entire sheet icon at the upper left of the sheet. Simply ensure that the number of rows is the correct after pasting the values in. Also ensure that the row counts are correct in the aggregation formulas in the upper right.

Scrolling **Figure 9.4** to the right we can see the Excel formulas used to make the comparison:

⁸ As opposed to deleting the columns. Select the *cells* to delete, not the columns in the column header, and press the delete key. If you get the “shift cells” dialog, stop and do it another way.

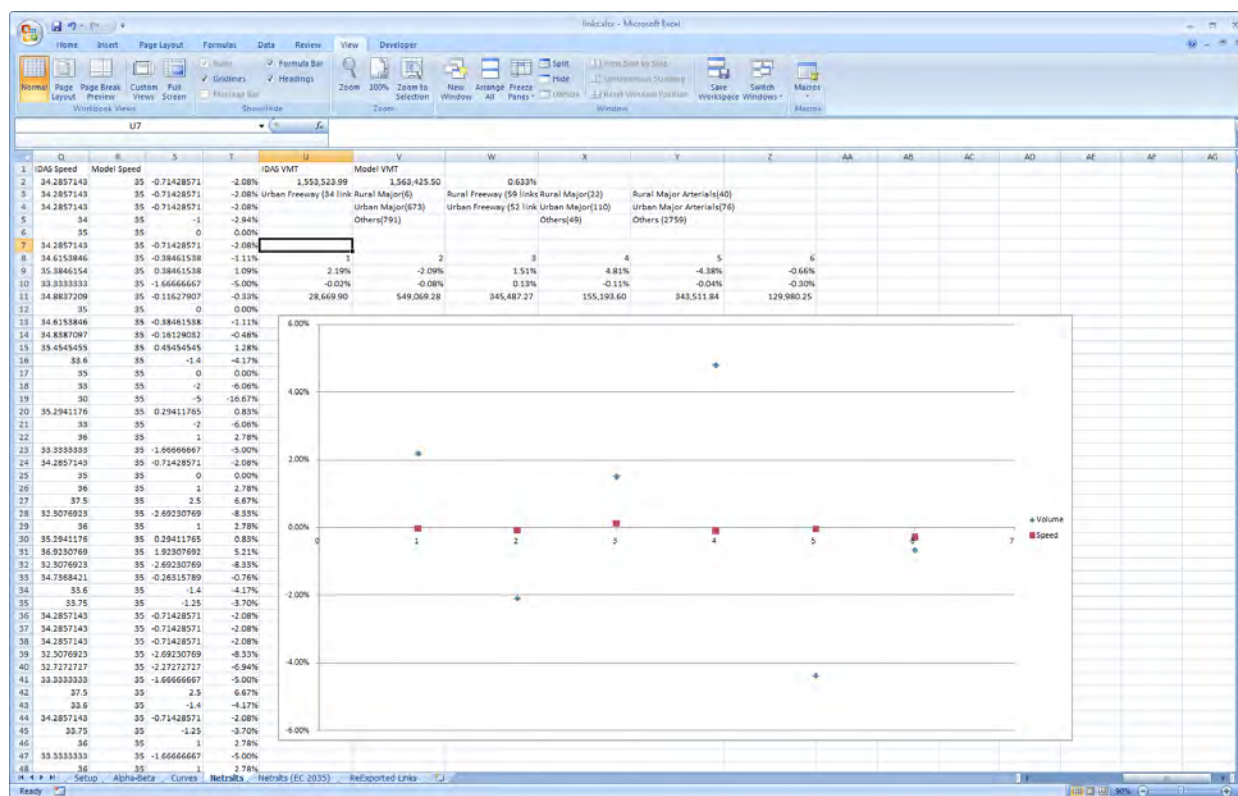
Figure 9.5 Excel formulas for link comparison

	A	I	J	K	L	M	N	O	P	Q	R	S	T
1	ID			IDAS Volume		Input Volume	Difference	Pct Difference	VMT	IDAS Speed	Model Speed		
2	000001-022223	0.07	0.07	73.53	73.53	73.718	-0.188	-0.26%	2.9412	34.28571429	35	-0.714285714	-2.08%
3	000002-021431	0.07	0.07	48.58	48.58	48.556	0.024	0.05%	1.9432	34.28571429	35	-0.714285714	-2.08%
4	000002-021435	0.14	0.14	73.59	73.59	74.069	-0.479	-0.65%	5.8872	34.28571429	35	-0.714285714	-2.08%
5	000003-021401	0.3	0.3	23.71	23.71	23.04	0.67	2.83%	4.0307	34	35	-1	-2.94%
6	000003-021978	0.24	0.24	31.62	31.62	32.619	-0.999	-3.16%	4.4268	35	35	0	0.00%
7	000004-021339	0.07	0.07	56.85	56.85	57.083	-0.233	-0.41%	2.274	34.28571429	35	-0.714285714	-2.08%
8	000004-021341	0.52	0.52	16.92	16.92	16.709	0.211	1.25%	5.076	34.61538462	35	-0.384615385	-1.11%
9	000004-021429	0.39	0.39	11.19	11.19	11.494	-0.304	-2.72%	2.5737	35.38461538	35	0.384615385	1.09%
10	000005-021343	0.09	0.09	129.06	129.06	129.325	-0.265	-0.21%	6.453	33.33333333	35	-1.666666667	-5.00%
11	000006-021302	0.43	0.43	57.16	57.16	53.138	4.022	7.04%	14.29	34.88372093	35	-0.11627907	-0.33%
12	000006-021304	0.24	0.24	105.72	105.72	110.071	-4.351	-4.12%	14.8008	35	35	0	0.00%
13	000006-021965	0.26	0.26	4.01	4.01	4.014	-0.004	-0.10%	0.6015	34.61538462	35	-0.384615385	-1.11%
14	000007-021348	0.31	0.31	74.9	74.9	68.036	6.864	9.16%	13.482	34.83870968	35	-0.161290323	-0.46%
15	000007-021692	0.22	0.22	73.76	73.76	81.302	-7.542	-10.23%	9.5888	35.45454545	35	0.454545455	1.28%
16	000007-021838	0.25	0.25	2.33	2.33	2.332	-0.002	-0.09%	0.3262	33.6	35	-1.4	-4.17%
17	000008-021400	0.12	0.12	13.79	13.79	14.218	-0.428	-3.10%	0.9653	35	35	0	0.00%
18	000008-021402	0.2	0.2	20.56	20.56	20.488	0.072	0.35%	2.2616	33	35	-2	-6.06%
19	000009-021411	0.06	0.06	61.57	61.57	61.903	-0.333	-0.54%	1.8471	30	35	-5	-16.67%
20	000009-021670	0.17	0.17	0.42	0.42	0.451	-0.031	-7.38%	0.042	35.29411765	35	0.294117647	0.83%
21	000010-021438	0.2	0.2	9.07	9.07	9.206	-0.136	-1.50%	0.9977	33	35	-2	-6.06%

In the figure, “Input volume” is directly from the FAMPO TDM, and it is “found” using VLOOKUP against the “2006 Links” sheet (which is the master links sheet for the 2006 network), which has the *same* ID generated in column A.

Similarly, speed is found from the model (Column R), and speed is *calculated* from the travel time column in the IDAS results (Column Q). Columns S and T show the difference and percent difference in speed.

Finally, **Figure 9.6** shows the summary error analysis of the comparison of all rows.

Figure 9.6 Summary validation chart

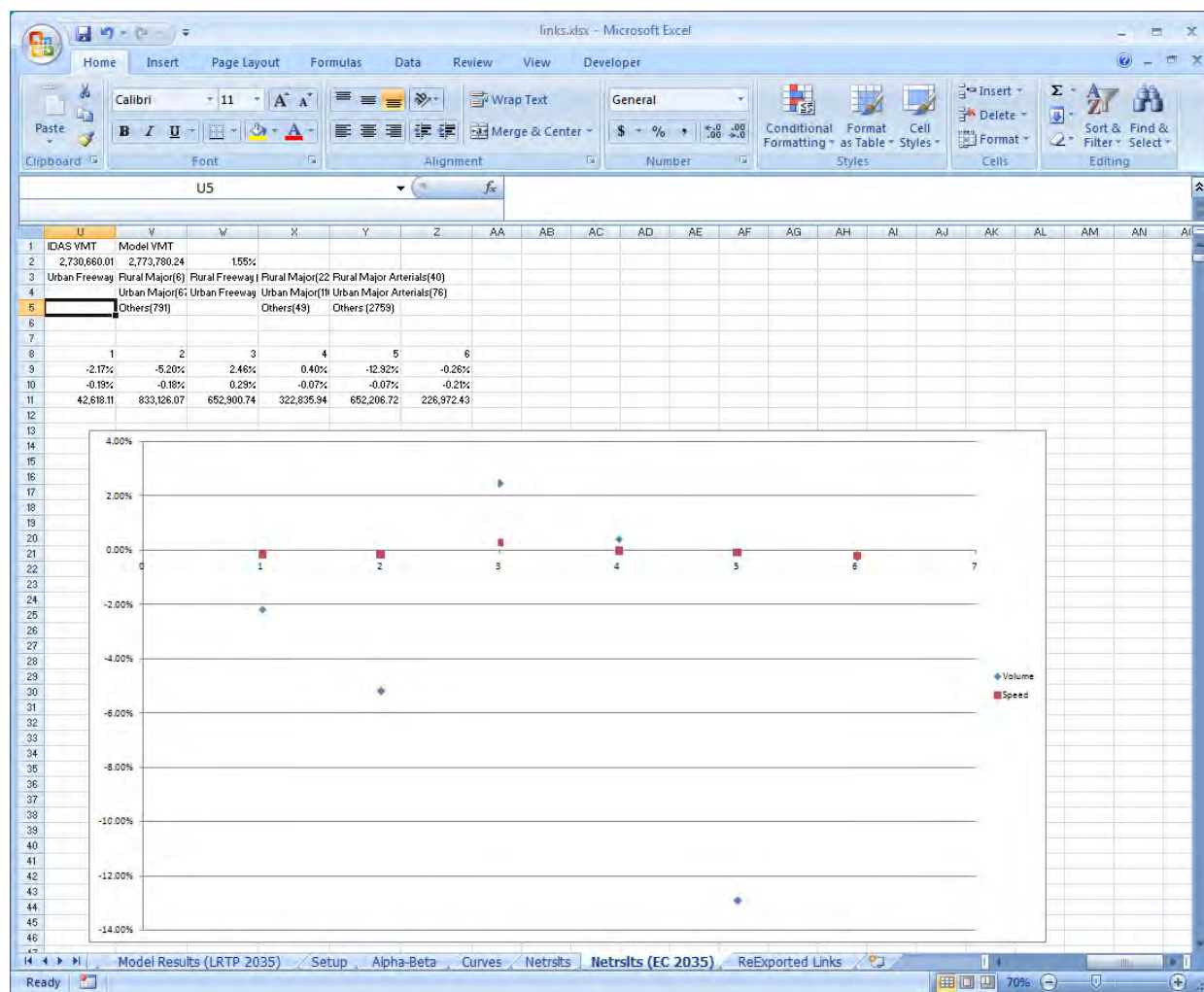
Note that the total (summed) VMT between IDAS and the FAMPO model are close. If these VMT values seem high, it is important to remember that they also include Centroid Connector links. The aggregate VMT for each facility type is shown in row 11, columns U through Z.

We also compared IDAS speed to the model speed in this exercise to better pinpoint what the input speed should be. The validation was in fact further off (higher errors) until we discovered that the model must be using a “factored” speed that is adjusted at model startup time to a value somewhere around 95 % of the speed limit. Once this was discovered, IDAS and the model came very close in their results.

It can be seen that facility types⁹ 1, 2, and 3 are with %2.1 percent. In the figure, facility types 1 and 3 are freeway, and 2 and 4 are arterials.

For completeness, we show the same as above for the 2035 Network, in this case the EC network.

⁹ Recalling that these are facility type codes we defined and should not be confused with the FAMPO codes.

Figure 9.7 Summary validation for 2035 EC

In the 2035 network, there is a facility type where IDAS is %12 low. However, this is for facility type 5 where there will be no deployments made. As networks get more congested, IDAS and a model are likely to drift apart on secondary roads but we always want to make sure that facility types where deployments will be made are as close as possible, and for these, the comparison is good.

10.0 Creating ITS Options

Topics Covered in This Section

- Using the IDAS Alternative Network Generator (ANG)
- Selecting ITS Strategies and placing them on ITS Options
- Specifying the location of the deployment
- Specifying the effectiveness of the deployment
- Creating a transit deployment
- A special note regarding equipment population and costs

■ 10.1 Introduction to the IDAS Alternative Network Generator

The Alternative Network Generator is the graphical “map” tool in IDAS which is used to deploy ITS Strategies in deployment groups called “ITS Options.”

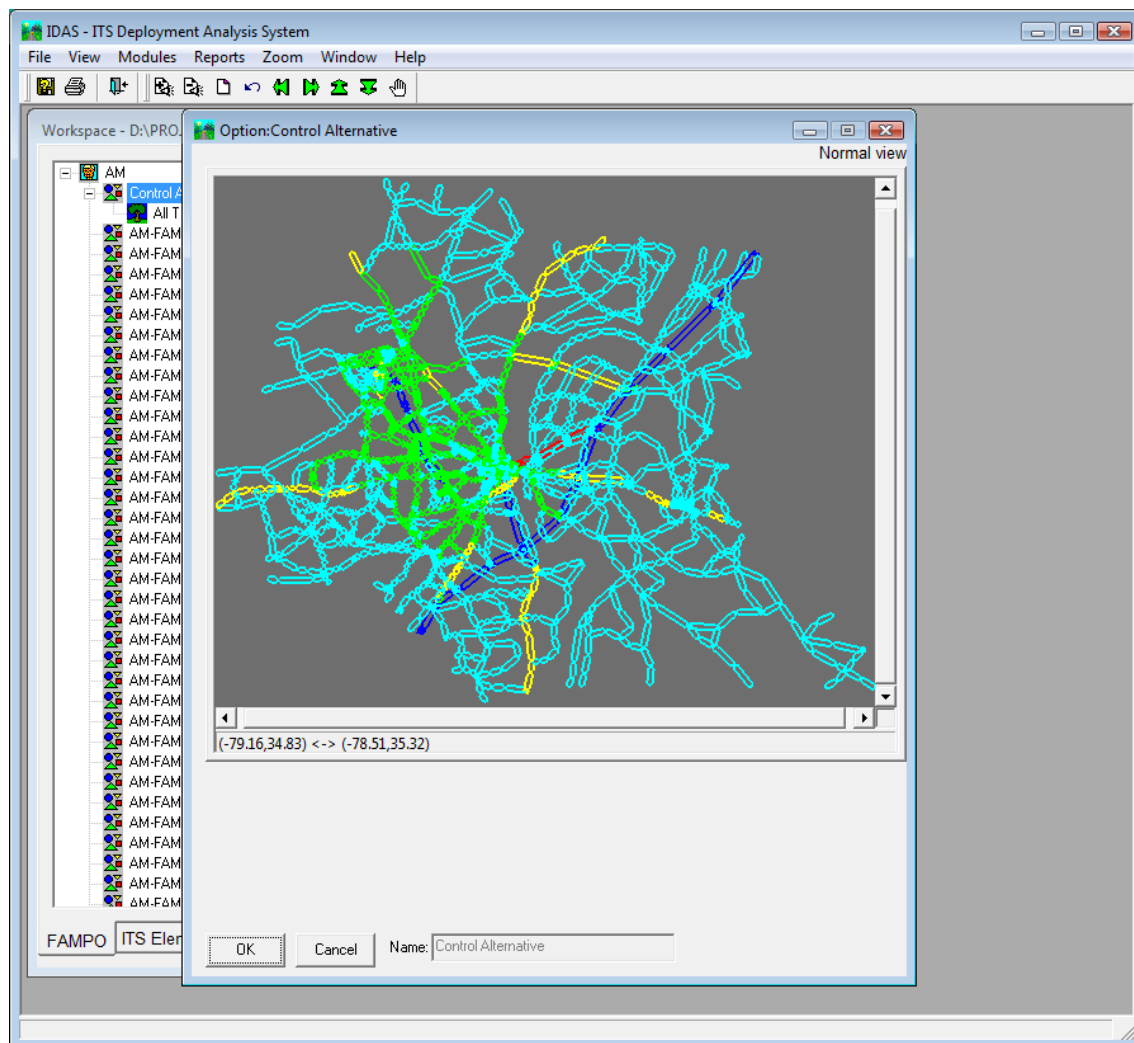
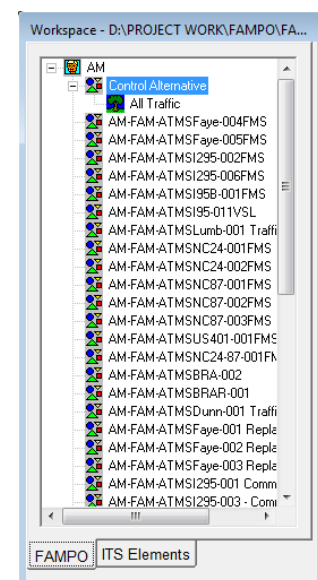
Figure 10.1 FAMPO Model

Figure 10.1 depicts the Alternatives Network Generator showing the entire FAMPO. Note that this is a view of the “Control Alternative,” the baseline conditions for the network upon which no ITS deployments can be made.

- **Step 1.** To view the Control Alternative, or any existing ITS Option, simply double-click the name shown in the IDAS Work prompter, which is shown to the right.

In this figure, the “Alternative” is the AM Alternative, the “Control Alternative” is the baseline network conditions. It can be seen that the Control Alternative “owns” the All Traffic market sector. However, the market sectors is used by every

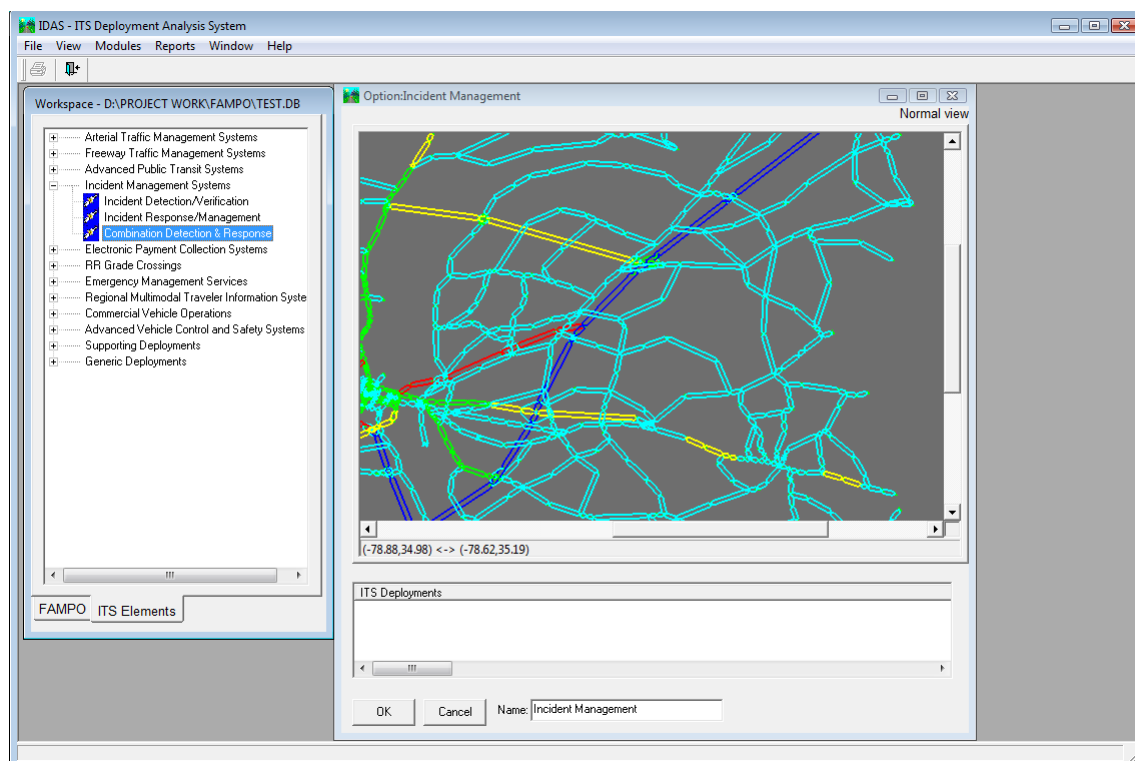


ITS Option, which are listed in the work prompter, the first one being “AM-FAM-ATMSFaye-004FMS.”

- **Step 2.** To create an ITS Option (any series of specific ITS deployments desired in one grouping), select File → New → ITS Option from the main menu. When the map loads, the first step is to give the option a descriptive name, in the Name field at the bottom of the map.
- **Step 3.** Having provided this name, we can now deploy on the network any ITS Strategy by highlighting and selecting the strategy from the ITS Elements tab of the workspace view. **Figure 10.2** shows a new ITS Option under construction which has been given the name “Incident Management,” and upon which a “Combination Detection and Response” deployment is about to be created. The network is zoomed into an area of interest, in this case, I-95 and Business I-95.

■ 10.2 Deploying ITS Strategies Into ITS Options

Figure 10.2 Preparing a New ITS Option for ITS Deployments



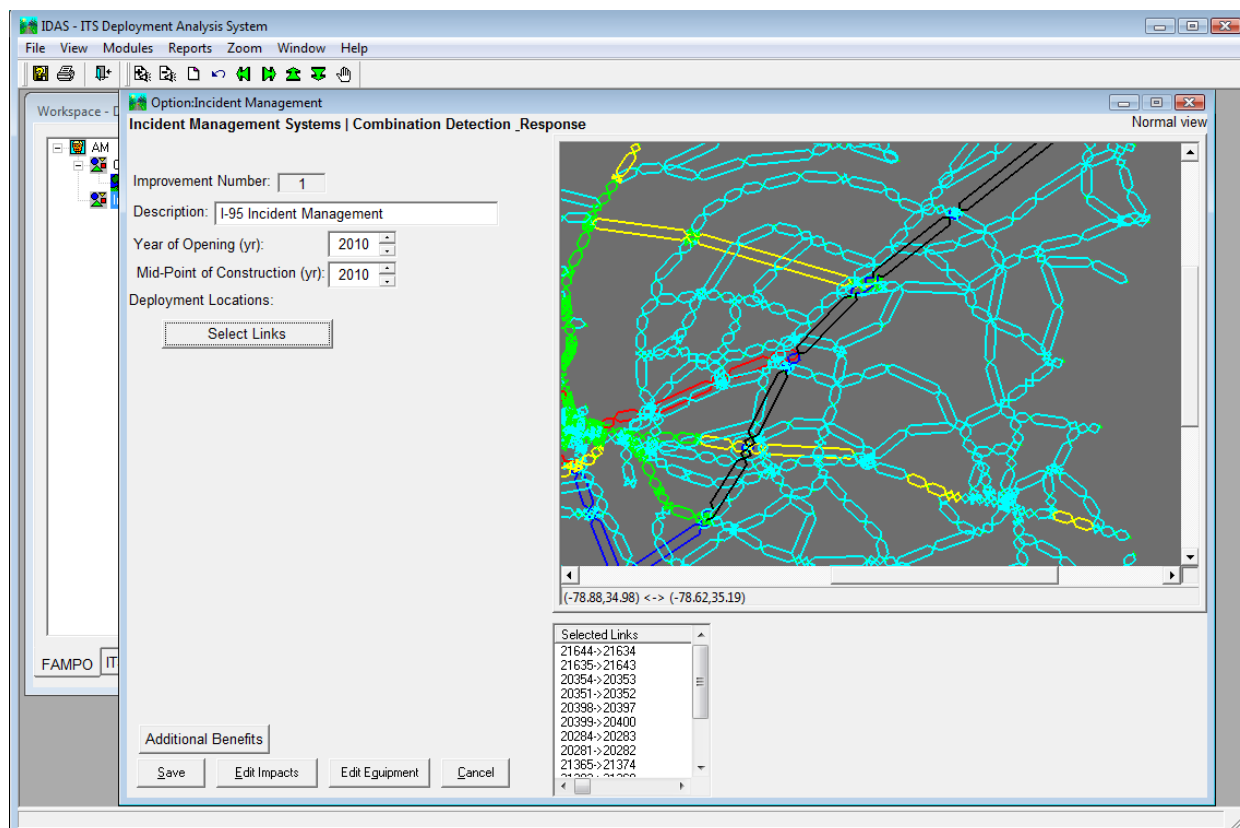
Choose an ITS Strategy

- **Step 1.** In **Figure 10.2**, the appropriate ITS Element is highlighted in the ITS Elements list, and the user will then “click and drag” that ITS Element onto the map, at which

point the deployment mode of the Alternatives Network Generator will activate, preloaded with the input parameters specific to the type of deployment selected.

- **Step 2.** In **Figure 10.3**, the user has provided a description for the deployment, the year of opening, and midpoint of construction, and has zoomed in and selected several links on I-95 (selected links are in black).

Figure 10.3 Selecting Links for Deployment



■ 10.3 Guidance in Selecting the Deployed Links

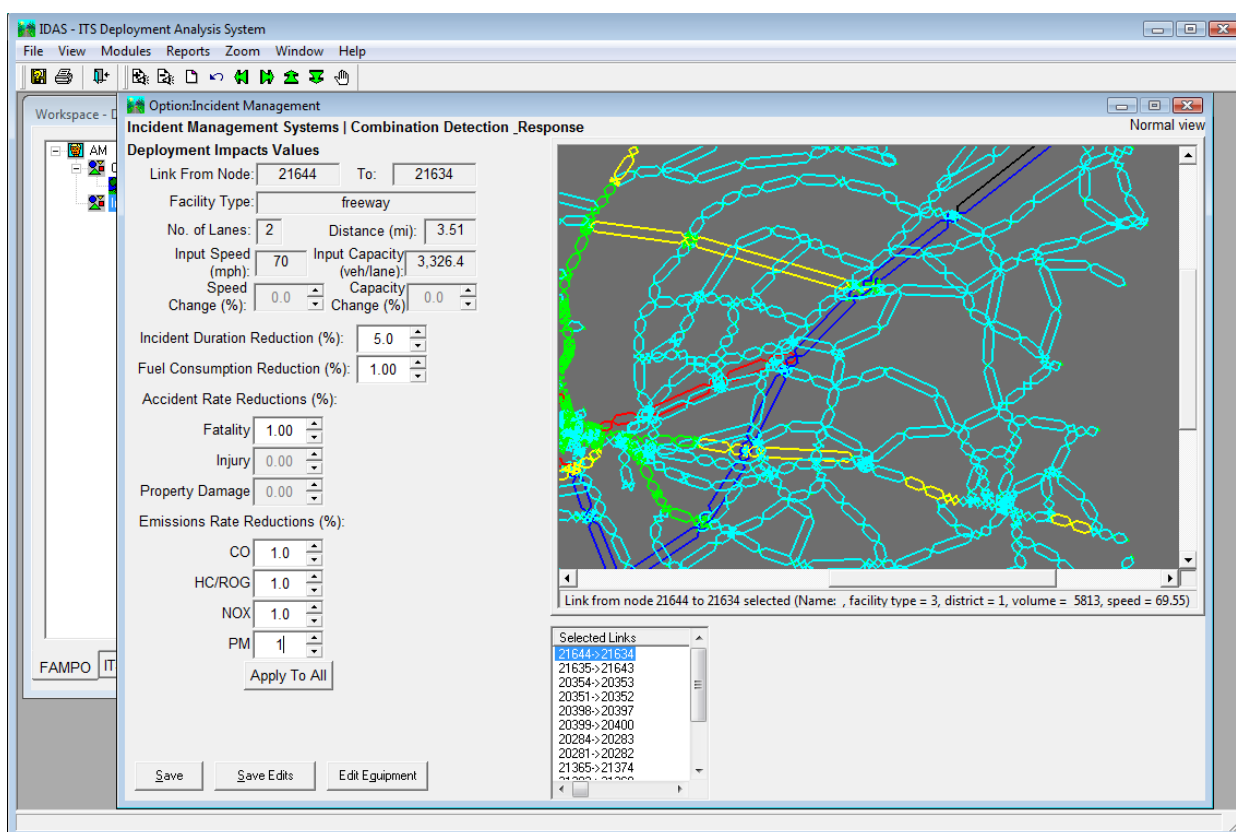
- On most ITS Deployment windows, a “Select Links” button appears, which indicates to the user that they should isolate those links that are expected to be affected by the ITS deployment.
- In some cases, there may be multiple types of links, for example, Traffic Signaling deployments have “progression,” and “cross flow” links. These indicate the corridor which will be positively affected, and those that may experience additional stops (cross flow).

- Other ITS Strategies might involve selecting centroids in the network. Typical of these are any transit deployments where the impact due to deployment is on trips made by transit riders, and not on links on the network.
- If links are involved in the deployment, as they are selected by the user they appear highlighted (in this case, in black), and their node numbers appear in the list at the bottom of the map, as shown in **Figure 10.3**.

■ 10.4 Setting the Impacts Parameters for the Affected Links

- **Step 1.** To set the impacts parameters for these links (or for centroids, depending on the ITS Strategy chosen), the user presses “Edit Impacts” on the bottom left and will then be able to input the impact parameters specific to this deployment.

Figure 10.4 Specifying Link-Level Impact Parameters



- **Step 2.** In this case, only one link at a time is selected in the map (and in the selected links list), and the impacts of the specific ITS Deployment on that link is specified by the user.

- **Step 3.** From the figure, the user is stating that the presence of the Incident Management system will produce a 5 percent incident duration reduction on this link, a 1 percent reduction in fuel consumption, fatality accidents, and emissions production. To help in choosing the impact values applied here, there are several sources of information concerning other agencies' experience with various ITS strategies and the anecdotal narratives outlining those experiences are included with IDAS in what is called the Direct Benefits spreadsheet. The numbers shown in the sample figure are typical of those used by Cambridge Systematics and represent a relatively conservative but realistic estimate of impact values.
- **Step 4.** Note that more ITS Elements can be applied to this ITS Option. For example, if the user wants to analyze the correlated impacts of a signal system along with a nearby ramp metering deployment (which might congest an arterial), they would deploy both ITS Elements in the same ITS Option. When this happens, the impacts on the entire network can be seen as they physically would occur on the network. For example, a higher throughput arterial (signal timing deployment) might push more traffic toward a metered ramp and cause more congestion on the arterial at that ramp.

Once your ITS Option has been defined, the Benefits Module can be run to compute the Benefits of the strategy. From the main IDAS Menu, choose Modules → Benefits, highlight the Incident Management ITS Option, select "Run Analysis" in the menu on the left, and click Run.

To see the benefits spreadsheet, after the Benefits module is finished, choose Modules → Alternative Comparison from the main menu. In the list of ITS Options on the left, highlight the Incident Management ITS Option, click the "Right" arrow to move that option to the right, and then choose "Benefit/Cost Summary" the list of choices on the left.

A Note Concerning Equipment Costs

While a user is creating deployments in an ITS Option, the IDAS system is, behind the scenes, populating the list of equipment that is expected to be necessary to build the deployment. The logic behind selecting which equipment is required, including which supporting equipment, such as communications facilities, etc., works well, while generic, is also very difficult to customize for a specific region or location.

Because of this, it is usually best to ignore the equipment populated on the ITS deployments by IDAS and to instead utilize a series of powerful costing spreadsheets that can be used to specify customized equipment costs which most agencies have readily available. These techniques take advantage of the IDAS cost module capabilities, which in correctly assess the capital and O&M costs for future years, by importing costs into a special "Costs" ITS Option into what are termed the "User-defined" costs.

Doing this in a systematic way (described in Section 11.0) will make the comparison of benefits versus costs much simpler while managing large volumes of data in a way that prevents the wrong costs from being applied to the wrong ITS Option and vice versa.

11.0 Managing Equipment and Deployment Costs

Topics Covered in This Section

- Using a new method to manage ITS costs
- Manage equipment lists in external spreadsheet(s)
- Use a specific naming convention to assist in results management
- Import equipment lists into IDAS
- Generate and save the IDAS costs spreadsheets

■ 11.1 A New Approach to Managing ITS Costs

Over many years of experience with the IDAS system in the analysis of ITS strategies in a wide range of regions throughout the country, it has consistently held that stakeholder agencies always have a clear idea of the costs of equipment, and of the components necessary to build the systems they are analyzing.

IDAS was built from the beginning to include ancillary costs (either over and above deployed equipment, or, in place of deployed equipment) that agencies might want to include should they need to. These are called “user-defined costs.”

However, since agencies already have knowledge of equipment lists and cost figures, the user-defined costs have become the de facto method of providing costs data for the analysis.

When IDAS uses equipment costs, it considers not only the initial capital and O&M costs for construction, but propagates those costs over the future period being analyzed in order to assess the true economic costs of the system over time. Travel demand models and long-range planning efforts often go out as far as 30 years and IDAS is capable of economic analysis for this length of time. However, most ITS equipment has a significantly shorter lifespan and changes in technology occur far more rapidly as well.

Two considerations – that agencies have a good handle on specific costs and that IDAS has the correct model to exercise the costs over time – have driven a convenient and powerful use of the IDAS cost module through the use of user-defined costs.

To leverage this technique effectively, a few steps need to be taken throughout the analysis process.

- **Step 1.** Name the ITS Options appropriately.

When certain tools are used to manage the large volume of ITS benefits and costs data after IDAS benefits calculation(s) are done, the naming convention of ITS Options is used to match up costs data with deployments.

For example, we often have lists of equipment that are associated with agency “projects” which themselves constitute, if not a full ITS Option, a deployment within an ITS Option. (An ITS Option is a grouping of multiple ITS Elements.)

In **Figure 11.1**, an ITS Option called FAM-ATMSFaye-004FMS is highlighted in the spreadsheet. Here, the costs are well known at the deployment level, e.g., 3 cameras will be deployed.

When the ITS Option is created, it is given the name “AM-” + the entry from the Project Name column in the spreadsheet.

We precede the project name from the spreadsheet with “AM-” for a very specific reason: When we want to apply costs to the specific ITS Option *and* when there are multiple TDM model periods (per day) available, we only want to apply those costs to *one* of those periods. Thus, when the benefits for the multiple periods are combined later, we don’t have to divide the costs among them.

Figure 11.1 Costs for an ITS Option

Turbo ID	Project Name	Project Description	Geographical Scope	Cost	Service Package
44	FAM-ATMSFaye-003 Replacement	Life Cycle Replacement. Fayetteville Signal System Upgrade	Fayetteville	\$13,800,000	ATMS03-2
42	FAM-ATMSFaye-004FMS	Deploy ITS on Santa Fe and Yarkin (3) Fayetteville CCTVs	Fayetteville		ATMS01-2
42	FAM-ATMSFaye-005FMS	Deploy ITS on US 401 Ramsey Street (4) Fayetteville CCTVs	Fayetteville		ATMS01-2
6	FAM-ATMSI295-001 Communications	Add Communications Infrastructure. Add optical fiber infrastructure. (16 miles)	I-295 NC/24/N87 (Bragg Boulevard) to I-95.	\$2,534,400	
7	FAM-ATMSI295-002FMS	Add ITS Devices. Add (8) CCTV cameras and (8) DMS.	I-295 from North I-95 to NC/24/N87 (Bragg)	\$2,000,000	ATMS01-1; ATMS06-1

- **Step 2.** Manage the costs data consistently and within the framework offered by the ITS Option naming convention.

An Excel workbook is used to automate the loading of costs data into IDAS in order to take out as many manual steps as possible, and avoid confusion about the proper dataset. **Figure 11.2** shows rows from the list of equipment that will be imported into IDAS as user-defined costs. Note that this spreadsheet is automated, so it is not necessary to actually populate the values here; if the strategy is adhered to throughout, this automation will all but eliminate potential cross-ups in the analysis.

Figure 11.2 ITS Equipment Cost Spreadsheet

Project Name	Project Description	Geographical Scope	Cost	Service Package	Comments	Questions	Camera Count
FAM-ATMSFaye-003 Replacement	Life Cycle Replacement. Fayetteville Signal System Upgrade	Fayetteville	\$13,800,000	ATMS03-2	not in IDAS?	Which arterials and intersections are included?	0
FAM-ATMSFaye-004FMS	Deploy ITS on Santa Fe and Yarkin (3) Fayetteville CCTVs	Fayetteville		ATMS01-2	CityFay-01	See shapefile and camera list for locations.	3
FAM-ATMSFaye-005FMS	Deploy ITS on US 401 Ramsey Street (4) Fayetteville CCTVs	Fayetteville		ATMS01-2	CityFay-02	See shapefile and camera list for locations.	4

Figure 11.2 shows our Costs spreadsheet. Again, it is keyed by the project name in Column C. We also have the complete listing of all cameras, Dynamic Message Signs, and Fiber runs called out for the FAMPO study. By keying that equipment to the project name, we then automatically calculate the number of each required for each ITS Option. These values for # of DMS and Fiber miles would appear in columns L and M in the above.

Finally, we have a “menu of costs” for each type of equipment. This was provided in spreadsheet form, a portion of which is shown in **Figure 11.3**.

Figure 11.3 ITS Equipment Costs Per Item

Item	Unit	Capital Cost (2009 \$)	Annual O&M Cost (2009 \$)	Lifecycle (yrs)	Total Lifecycle Cost (2009 \$)	Description and Assumptions	Items
CCTV Camera, PTZ	Per Each	\$18,500	\$1,250	12	\$33,500	Closed circuit television (CCTV) camera with pan, tilt, zoom (PTZ) functionality in a dome enclosure.	Camera, enclosure, post metal pole and foundation cabling
CCTV Camera, Fixed	Per Each	\$14,000	\$1,250	12	\$29,000	Fixed position closed circuit television (CCTV) camera in a dome enclosure.	Camera, enclosure, pole foundation, control cabling
DMS Overhead Mount	Per Each	\$200,000	\$1,000	15	\$245,000	Dynamic message sign (DMS) of a large size suitable for	Sign, structure and foundation

Figure 11.3 shows the standard cost for a camera. In the specification, we need the year of the costs data (2009), the initial capital cost to purchase *and* install the system, the annual Operations and Maintenance (O&M) cost, and how many years typically elapse before the system needs replaced (life cycle costs).

- **Step 3.** Import the costs data into IDAS.

As previously mentioned, the capabilities of the IDAS cost module are leveraged to use the future value of equipment purchases in an economically correct way in the B/C analysis.

- **Step 3a.** Create an ITS Option in IDAS called Costs. No deployments need be made for the ITS Option; simply create a new option, name it Costs, and exit the Alternative Network Generator.

This *only* needs to be done for one of the time periods the model provides. In the FAMPO analysis, we create a separate database for each time period, so we chose the AM database to maintain the Costs ITS Option. Thus the use of “AM-” in the name of our ITS Options within this database. Note that it is not strictly necessary to prepend “MD-”, for example, in the ITS Options within the Mid-Day IDAS database.

The process of loading the Costs into the IDAS database is automated. The implementation is within VBA (Visual Basic for Applications) code that is embedded in the costs workbook. The code for this is relatively simple and can be easily inspected and changed for future needs by an individual familiar with Excel automation.

For purposes of completeness, however, the manual method of importing these costs is briefly explained in the box below for use in smaller projects.

Alternative – Manual Method of Cost Entry

- When running IDAS, choose Modules → Cost module from the main menu.
- Select the Costs ITS Option.
- Click on “User Defined Costs” on the left side.

This will show the table of existing user-defined costs in IDAS

- Anywhere on this table, double right-click with the mouse. This will activate the internal spreadsheet tool that allows you to manipulate this table as a spreadsheet.

Figure 11.4 Table of Existing User-Defined Costs

User Defined Item	Year of Opening	Mid Point of Construction	Useful Life	Public Capital	Private Capital	Public O & M	Private O & M
AM-FAM-ATMSNC24-87-001FMS:CCTV Camera, PTZ	2010	2010	12	\$74,000.00	\$0.00	\$5,000.00	\$0.00
AM-FAM-ATMSNC24-87-001FMS:DMS, Overhead Mount	2010	2010	15	\$400,000.00	\$0.00	\$6,000.00	\$0.00
AM-FAM-ATMSDunn-001 Traffic Signals:Lump Sum Provided	2010	2010	10	\$1,350,000.00	\$0.00	\$135,000.00	\$0.00
AM-FAM-ATMSFaye-001 Replacement:CCTV Camera, PTZ	2010	2010	12	\$203,500.00	\$0.00	\$13,750.00	\$0.00
AM-FAM-ATMSFaye-002 Replacement:CCTV Camera, PTZ	2010	2010	12	\$203,500.00	\$0.00	\$13,750.00	\$0.00
AM-FAM-ATMSFaye-003 Replacement:Lump Sum Provided	2010	2010	10	\$13,800,000.00	\$0.00	\$1,380,000.00	\$0.00
AM-FAM-ATMSFaye-004FMS:CCTV Camera, PTZ	2010	2010	12	\$55,500.00	\$0.00	\$3,750.00	\$0.00
AM-FAM-ATMSFaye-005FMS:CCTV Camera, PTZ	2010	2010	12	\$74,000.00	\$0.00	\$5,000.00	\$0.00
AM-FAM-ATMSI295-001 Communications:Fiber Optic Cable	2010	2010	30	\$1,408,000.00	\$0.00	\$36,000.00	\$0.00
AM-FAM-ATMSI295-002FMS:CCTV Camera, PTZ	2010	2010	12	\$148,000.00	\$0.00	\$10,000.00	\$0.00
AM-FAM-ATMSI295-002FMS:DMS, Overhead Mount	2010	2010	15	\$1,600,000.00	\$0.00	\$24,000.00	\$0.00
AM-FAM-ATMSI295-006FMS:CCTV Camera, PTZ	2010	2010	12	\$148,000.00	\$0.00	\$10,000.00	\$0.00
AM-FAM-ATMSI295-006FMS:DMS, Overhead Mount	2010	2010	15	\$800,000.00	\$0.00	\$12,000.00	\$0.00
AM-FAM-ATMSI295-003 - Communications:Fiber Optic Cable	2010	2010	30	\$2,024,000.00	\$0.00	\$51,750.00	\$0.00
AM-FAM-ATMSI295-004 Replacement:CCTV Camera, PTZ	2010	2010	12	\$148,000.00	\$0.00	\$10,000.00	\$0.00

- Note, **Figure 11.4** is arrived at after a few steps. First, select Format-Sheet and check off “Protection.” Then select all visible columns and select Format-Unhide from the menu. It can be tricky, but all columns should eventually be shown as above. One might have to resize the cost columns that are on the right until they come into view.
- In your main (source) costs spreadsheet – organize your data as shown in the above figure, For the first column, prepend “AM-” to your project name, then fill out that row with the pertinent values, keeping in mind you want totals for all of your equipment for the options *except* that you should split rows out when equipment has different useful life values. Note the above figure has 2 rows for the first ITS Options, cameras and DMS are split because they have different useful life values.
- First delete all existing data (clicking and dragging across the header row selects all; press the delete key), then copy and paste the data from the main costs spreadsheet, one column of data at a time.

Note the blank column to the right of “Useful Life”. Your copy source should include this column

Step 4. Export two costs results sheets out of IDAS.

- **Step 4a.** While in the IDAS cost module, having selected Costs as the active ITS Option, select “Costs per Year” on the left side. This creates the “Stream of costs” spreadsheet.

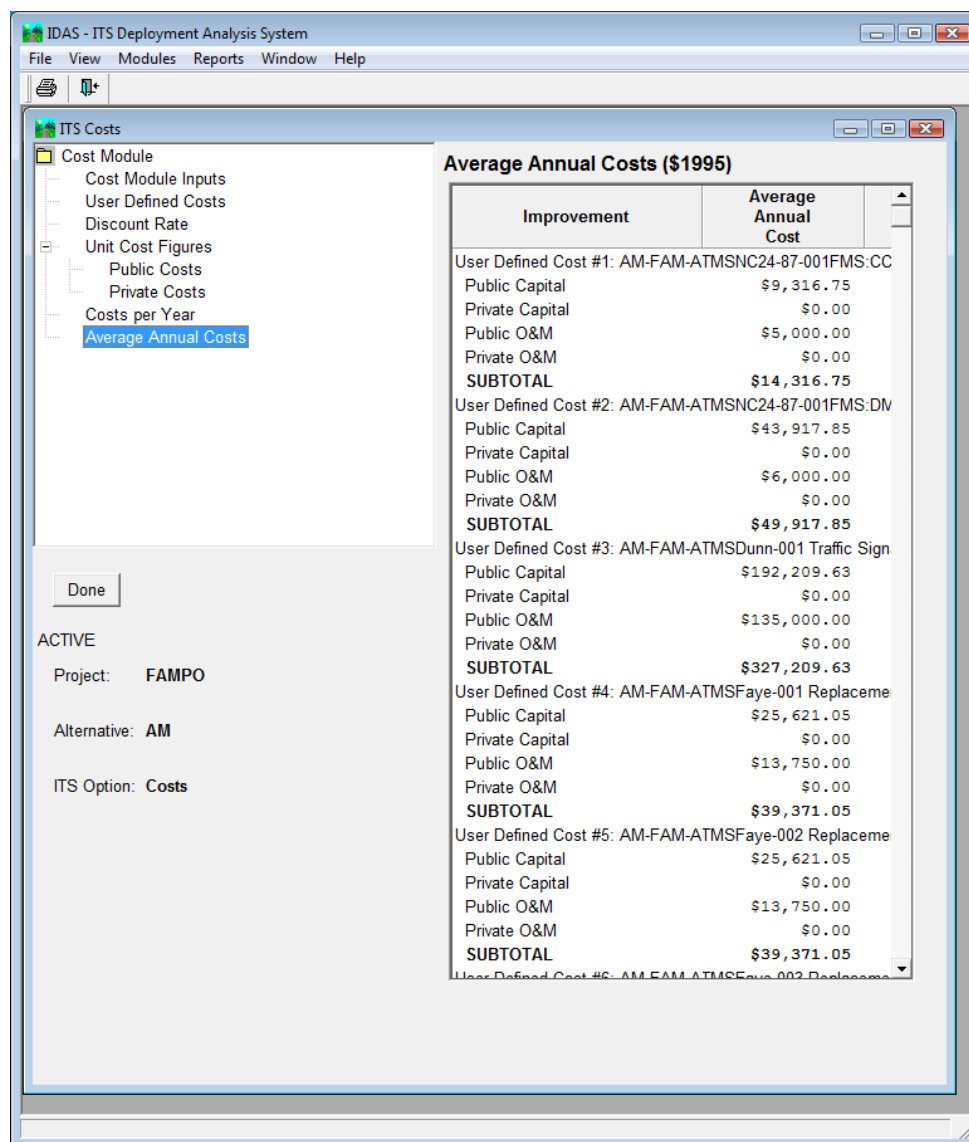
Figure 11.5 Costs per Year

Improvement	2010	2011	2012	2013	2014
User Defined Cost #1: AM-FAM-ATMSNC24-87-001FMS: CCTV Camera, PTZ					
Public Capital	\$74,000.00	\$0.00	\$0.00	\$0.00	\$0.00
Private Capital	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Public O&M	\$5,000.00	\$5,000.00	\$5,000.00	\$5,000.00	\$5,000.00
Private O&M	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
User Defined Cost #2: AM-FAM-ATMSNC24-87-001FMS: DMS, Overhead Mount					
Public Capital	\$400,000.00	\$0.00	\$0.00	\$0.00	\$0.00
Private Capital	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Public O&M	\$6,000.00	\$6,000.00	\$6,000.00	\$6,000.00	\$6,000.00
Private O&M	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
User Defined Cost #3: AM-FAM-ATMSDunn-001 Traffic Signals: Lump Sum Provided					
Public Capital	\$1,350,000.00	\$0.00	\$0.00	\$0.00	\$0.00
Private Capital	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Public O&M	\$135,000.00	\$135,000.00	\$135,000.00	\$135,000.00	\$135,000.00
Private O&M	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
User Defined Cost #4: AM-FAM-ATMSFaye-001 Replacement: CCTV Camera, PTZ					
Public Capital	\$203,500.00	\$0.00	\$0.00	\$0.00	\$0.00
Private Capital	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Public O&M	\$13,750.00	\$13,750.00	\$13,750.00	\$13,750.00	\$13,750.00
Private O&M	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
User Defined Cost #5: AM-FAM-ATMSFaye-002 Replacement: CCTV Camera, PTZ					
Public Capital	\$203,500.00	\$0.00	\$0.00	\$0.00	\$0.00
Private Capital	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Public O&M	\$13,750.00	\$13,750.00	\$13,750.00	\$13,750.00	\$13,750.00
Private O&M	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
User Defined Cost #6: AM-FAM-ATMSFave-003 Reolacement: Lump Sum Provided					

- **Step 4b.** Double right-click this spreadsheet to bring up the VCI formula one internal spreadsheet for the user-defined costs as shown in **Figure 11.5**.
- **Step 4c.** Save the file either by choosing File-Write from the main menu, or clicking on the diskette on the toolbar. Any name can be used, but “stream of costs” is recommended.

Carefully note the extension when saving the file. It defaults to a proprietary .vts format, but you want to be sure and save it to an .xls (Excel) format.

- **Step 4d.** Repeat steps a through c for the Average Annual Costs. The selection is on the left side of the cost module window, as shown in **Figure 11.6**. Save the spreadsheet to the “Average Annual Costs” spreadsheet and remember to use an .xls extension.

Figure 11.6 Average Annual Costs

Once these two costs spreadsheets have been created, and when costs or deployments change (specifically, new ITS Options added), the necessary steps from the perspective of preparing costs data are done.

We will use these costs spreadsheets to apply the costs data to the analysis in the discussion on organizing results in terms of benefits and costs in Section 13.0.

12.0 Using the Alternatives Comparison Module

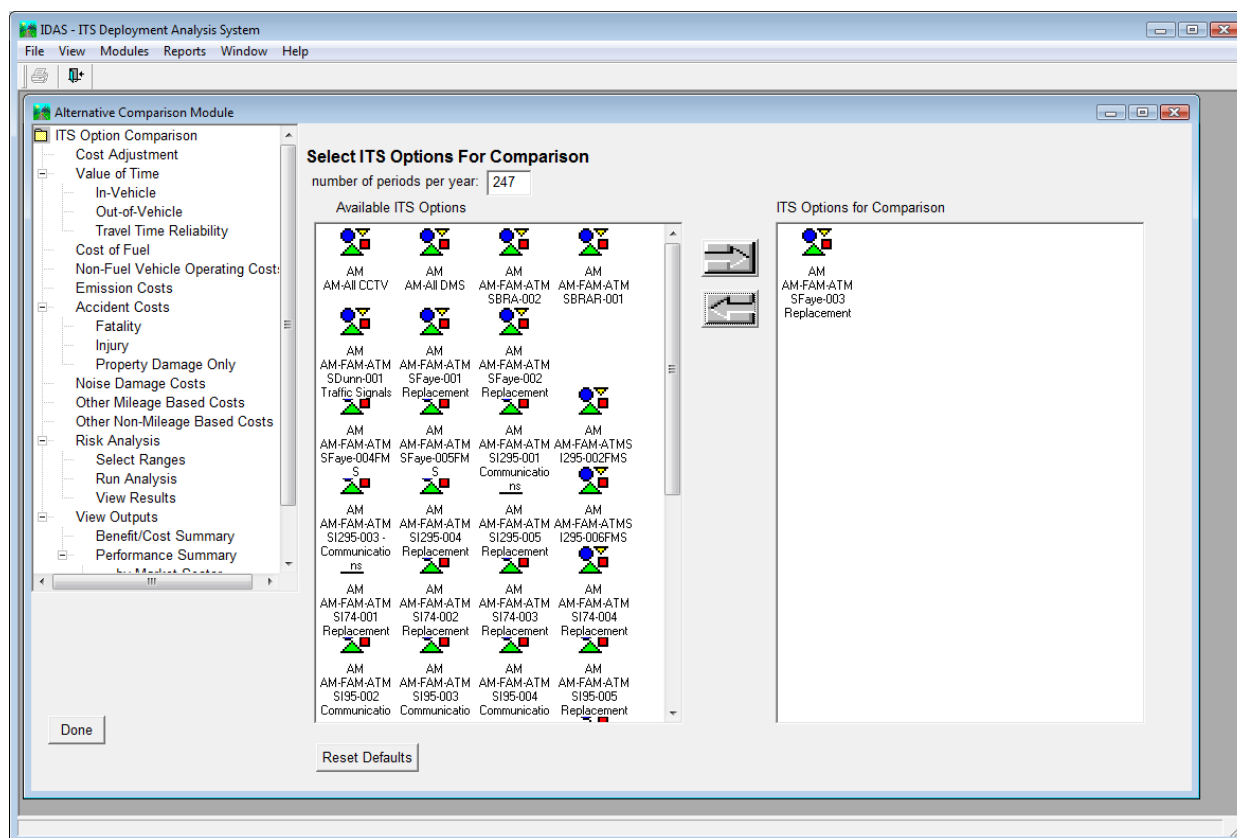
Topics Covered in This Section

- Selecting a group of ITS Options to compare
- Setting the dollar valuations that drive the benefits
- Viewing the Benefits/Costs spreadsheet
- Viewing the Performance Summary spreadsheets

■ 12.1 Selecting a Group of ITS Options

In the ACM, any combination of ITS Options within the current database can be viewed, or “compared” to each other.

Note that when multiple databases are used, there is no facility type view results between them. However, by exporting spreadsheets from the ACM of each database, they can be easily merged to compare results.

Figure 12.1 Creating a Group of ITS Options

In **Figure 12.1**, all ITS Options in the database are shown. When the ACM is first run, all of these would be in the left pane of the two windows.

To place ITS Options into a group of interest, click on them in the left pane and then click the right arrow button in the middle. To select multiple options to move, press the Ctrl key while selecting them.

Similarly, to take ITS Options out of a group, select them in the right pane and click the left arrow button in the middle.

■ 12.2 Specifying the Dollar Valuations

Figure 12.1 shows the entire menu of options in the ACM. Most of these deal with the dollar values that should be applied to the changes in the performance measures calculated by IDAS to arrive at the “benefit” side of the benefits costs calculation.

There are some items for which the meaning is not intuitive. A few of those are clarified below.

- Number of periods per year, shown at the top of the ITS Option selection window (**Figure 12.1**). This factor indicates how many of the time periods (that the original TDM data represents) will exist in any given year.

Because the IDAS Benefits/Costs spreadsheet is an annual picture of the benefits, this number is needed to convert the single time period network performance measures into an annual period.

The default value of 247 is 52 weeks of 5 weekdays, minus 13 holidays.

Note: It is not valid to specify a value of 1 here to consider the benefits/costs on a per-day basis. All costs, including the IDAS calculated equipment costs, and the newer costs technique used and described in Section 11.0, are always annualized. Given that the lifetime of equipment is given in years, and that this is a critical factor in the calculation of future costs, it would be problematic to convert costs to anything other than annual.

- Most of the cost factors down the left side of **Figure 12.1** are self-explanatory, the exceptions are:
 - Emergency vehicle value of time multiplier. This is tied to the value of time as a multiplier. The default of 30 accounts for the fact that an injured traveler seeking medical treatment values time very highly.
 - Internal and external accident costs. “Internal costs” refers to the affected travelers’ costs such as vehicle repair, lost wages, etc. “External costs” refers to public agencies’ costs such as facility repair costs, lost taxes, emergency personnel deployment, etc.

12.2.3 Viewing the Benefits Costs Spreadsheet

Clicking on View Outputs – Benefits/Costs Summary in **Figure 12.1** produces the Benefits/Costs (B/C) spreadsheet.

Figure 12.2 The Benefits/Costs Spreadsheet

Benefit/Cost Summary
Project: FAMPO
Benefits are reported in 1995 dollars

Measure	Weight	AM-FAM-ATMSFaye-003 Replacement
Annual Benefits		
Change in User Mobility	1.00	\$ 418,548
Change in User Travel Time		
In-Vehicle Travel Time	1.00	\$ 0
Out-of-Vehicle Travel Time	1.00	\$ 0
Travel Time Reliability	1.00	\$ 5,679
Change in Costs Paid by Users		
Fuel Costs	1.00	\$ 21,484
Non-fuel Operating Costs	1.00	\$ (4,821)
Accident Costs (Internal Only)	1.00	\$ (19,152)
Change in External Costs		
Accident Costs (External Only)	1.00	\$ (3,380)
Emissions		
HC/ROG	1.00	\$ 1,737
NOx	1.00	\$ (532)
CO	1.00	\$ 45,631
PM10	1.00	\$ 0
CO2	1.00	\$ 0
SO2	1.00	\$ 0
Global Warming	0.00	\$ 0
Noise	1.00	\$ (55)
Other Mileage-Based External Costs	1.00	\$ 0
Other Trip-Based External Costs	1.00	\$ 0
Change in Public Agencies Costs (Efficiency Induced)	1.00	\$ 0
Other Calculated Benefits	1.00	\$ 0
User Defined Additional Benefits	1.00	\$ 0
Total Annual Benefits		\$ 465,137
Annual Costs		
Average Annual Private Sector Cost		\$ 0
Average Annual Public Sector Cost		\$ 606,728
Total Annual Cost		\$ 606,728
Benefit/Cost Comparison		
Net Benefit (Annual Benefit - Annual Cost)		\$ (141,591)
B/C Ratio (Annual Benefit/Annual Cost)		0.77

Figure 12.2 shows the bottom line output result that IDAS produces.

To calculate this spreadsheet, IDAS has, for each measure in the Annual Benefits column in the figure, calculated the difference in the measure that occurs between the “improved” network performance (after ITS has been deployed), and the “baseline” network performance (before ITS is deployed).

IDAS takes that difference in the performance measure, multiplies it by the dollar valuation that applies to that measure, and then multiplies that by the number of model days per year.

The IDAS cost module¹⁰ calculates the average annual cost of the equipment that is deployed for each ITS Option and that value is used to calculate the actual B/C ratio and the net benefit of each ITS Option.

The B/C ratio is the benefit from the deployment divided by the cost.

Net Benefit is the dollar amount of the benefit minus the cost.

Note: The low B/C ratio in the figure should not be of concern. Remember that this particular calculation is being performed against the default IDAS equipment specifications that were populated when the deployment was being made. In the FAMPO analysis, we are **not** using that equipment, so the Costs values, and therefore anything derived from it, is not relevant – from the above figure, we should focus solely on the benefits.

12.2.4 The Performance Summary Spreadsheets

IDAS displays the calculated change(s) on the network in three related, but subtly different ways. These are the Performance Summary spreadsheets which show the performance difference by Market Sector, Facility Type, and District.

Note: The values in these spreadsheets are for a single “model” run. In other words, they are *not* annualized but represent the demand on the network specified by the time period inherent with the number of trips present in the market sector matrices.

The difference between before and after ITS Deployment performance measures can be seen in **Figure 12.3**.

¹⁰The IDAS cost module does not have to be “run”; the necessary calculations are automated at the point in time that the B/C spreadsheet is produced.

Figure 12.3 Difference Between Baseline and Improvement Measures

The screenshot shows the IDAS - ITS Deployment Analysis System interface. The left sidebar lists various modules like In-Vehicle, Out-of-Vehicle, Travel Time Reliability, etc. The main window displays the 'Performance Summary' for the project 'FAMPO, Alternative: AM, ITS Option: AM-FAM-ATMSFaye-003 Replacement'. The table compares the 'Control Alternative' and 'ITS Option' across five facility types: VC Curve 0.56 3.60, VC Curve 0.74 2.10, VC Curve 0.83 2.70, VC Curve 0.83 5.50, and VC Curve 1.00 2.10. The table includes metrics such as Vehicle Miles of Travel, Vehicle Hours of Travel, Average Speed, Person Hours of Travel, Number of Person Trips, Number of Fatality Accidents, Number of Injury Accidents, Number of PDO Accidents, and Travel Time Reliability. Each metric is shown for both the Control Alternative and the ITS Option, along with the difference and percentage difference. The total column shows the overall impact of the ITS option compared to the control alternative.

By: Facility Type	VC Curve 0.56 3.60	VC Curve 0.74 2.10	VC Curve 0.83 2.70	VC Curve 0.83 5.50	VC Curve 1.00 2.10	Total
Vehicle Miles of Travel						
Control Alternative	29,734	549,670	155,170	345,422	344,189	1,423,605
ITS Option	29,590	550,574	155,172	345,185	344,426	1,423,948
Difference (%)	-144 (-0.5%)	904 (0.2%)	0 (0.0%)	-237 (-0.1%)	-162 (-0.0%)	343 (0.0%)
Vehicle Hours of Travel						
Control Alternative	653	17,707	3,205	5,797	10,930	38,288
ITS Option	649	17,866	3,209	5,792	10,904	38,119
Difference (%)	-4 (-0.6%)	159 (0.9%)	4 (0.1%)	-5 (-0.1%)	-26 (-0.2%)	-169 (-0.4%)
Average Speed						
Control Alternative	44.0	31.0	49.3	59.6	31.3	37.2
ITS Option	44.0	31.2	49.4	59.6	31.6	37.2
Difference (%)	0 (0.1%)	0 (1.0%)	0 (0.1%)	0 (0.0%)	0 (0.2%)	0 (0.0%)
Person Hours of Travel						
Control Alternative	653	17,707	3,205	5,797	10,930	38,288
ITS Option	649	17,866	3,205	5,792	10,904	38,119
Difference (%)	-4 (-0.6%)	159 (0.9%)	0 (0.0%)	-5 (-0.1%)	-26 (-0.2%)	-169 (-0.4%)
Number of Person Trips						
Control Alternative						
ITS Option						
Difference (%)						
Number of Fatality Accidents						
Control Alternative	1.894E-04	9.729E-03	2.746E-03	2.279E-03	6.099E-03	2.104E-02
ITS Option	1.899E-04	9.745E-03	2.746E-03	2.279E-03	6.099E-03	2.105E-02
Difference (%)	-5.52E-07 (-0.5%)	1.6E-05 (0.2%)	2.747E-06 (0.0%)	-1.664E-06 (-0.1%)	-2.87E-06 (-0.0%)	1.064E-05 (0.1%)
Number of Injury Accidents						
Control Alternative	1.378E-02	5.339E-01	2.456E-01	1.499E-01	5.864E-01	1.966E+00
ITS Option	1.371E-02	5.354E-01	2.456E-01	1.499E-01	5.851E-01	1.967E+00
Difference (%)	-6.867E-06 (-0.5%)	1.55E-05 (0.2%)	2.423E-06 (0.0%)	-1.279E-06 (-0.1%)	-2.761E-06 (-0.0%)	1.048E-05 (0.1%)
Number of PDO Accidents						
Control Alternative	1.788E-02	1.359E+00	3.833E-01	2.225E-01	8.523E-01	2.836E+00
ITS Option	1.779E-02	1.361E+00	3.833E-01	2.224E-01	8.519E-01	2.837E+00
Difference (%)	-9.02E-05 (-0.5%)	2.23E-05 (0.2%)	3.813E-06 (0.0%)	-1.761E-06 (-0.1%)	-4.019E-06 (-0.0%)	1.572E-05 (0.1%)
Travel Time Reliability (hours of unexpected delay)						
Control Alternative	2.52			508.89		511.41
ITS Option						
Difference (%)						

In **Figure 12.3**, each measure has three rows of information: the Control Alternative, the ITS Option, and the calculated and percentage difference.

The “benefit” is the difference value. For example, the reduction in travel time benefit reported in the Benefits/Costs spreadsheet is the total change in Vehicle Hours of Travel across the entire network (total column not shown), multiplied by the user supplied “Value of In-Vehicle Time,” and finally, that value multiplied by the number of model periods per year.

The different types of usage for these is explained in the following.

By Market Sector

This spreadsheet shows the changes in performance value based on the travelers using it. The FAMPO analysis has only one market sector, therefore, if we were to view the performance spreadsheet by Market Sector, there would be only one column of data. If we had more than one MS, there would be a column for each.

In the vast majority of ITS Strategies, one should see no difference in impact across market sectors, because few strategies are targeted at market sectors. Specifically, if you improve capacity on a freeway link, and all vehicles can use that link, all market sectors will experience the benefit.

An exception to this would be, for example, when commercial vehicle operations deployments are done, in which case, the Market Sector performance summary will contain valid information about the split of benefits across market sectors.

Note: This performance summary sheet is the only place to see the number of trips made, or the change in those counts. It is not possible to calculate the effective number of trips on links network-wide.

By Facility Type

This performance summary sheet (shown in **Figure 12.3**) is usually the most useful, particularly in the absence of specific districts having been defined.

Here one can see the direct benefit upon each facility type. Typically, a specific ITS Strategy affects a single facility type, such as only freeways and only arterials. To the extent that ITS Strategies affecting multiple types of facilities are not combined into one ITS Option, those performance benefits will stand out on this performance summary sheet.

By District

This performance summary sheet is ideal for inspecting any particular area of interest. As mentioned in Section 4.0, districts can be defined for the links in the network that can separate them into any grouping of links that may be of interest in the final analysis. This is that final analysis where the affect on these groupings can be seen.

In the FAMPO analysis, however, there was no interest expressed in splitting out the information in any particular way.

13.0 Managing IDAS Results

Topics Covered in This Section

- Defining the IDAS results
- Why results management is important
- The IDAS results workbook
 - Importing costs
 - Importing facility type performance spreadsheets
 - Create the performance spreadsheet in IDAS
 - Import these into IDAS results
 - Operating the IDAS results workbook
 - Monetary and valuation parameters
 - The stream of costs
 - The report table and physical performance measures

■ 13.1 What Are the IDAS Results

The primary outputs of IDAS are found in the Benefit/Costs spreadsheet created by using the Alternatives Comparison Module (ACM), which is discussed in Section 12.0. The information in this spreadsheet is created when the user selects the option to display it, and it uses a variety of economic assumptions (such as value of time) and other assumptions that are set in various places within the ACM.

IDAS calculates the Benefits values in the B/C spreadsheet directly from the network performance changes that have occurred due to the deployment of ITS. These performance results also can be viewed by the user in one of three spreadsheets called the Performance Spreadsheets. These categorize the performance of the network before implementation (Control Alternative) and after deployment (ITS Option) measures of several important factors regarding the traveling experience of the public.

These measures include VMT, VHT, speed, delay due to congestion (termed Travel Time Reliability, or TTR), and safety, emissions, and fuel results. As mentioned previously, it is the change in these measures that drive the benefits realized by deploying ITS.

The three spreadsheets are:

1. **By Market Sector.** This spreadsheet details network performance for each segment of the traveling public that is represented by a market sector. It is used primarily to view how each market sector might be affected by ITS deployments. Since most market sectors are allowed to comingle on every type of facility, the performance of the network should not be gleaned from this spreadsheet; rather, one of the other two should be used. The exception to this is that the market sector performance spreadsheet is the only place to view the number of trips that were made by each market sector. Number of trips cannot be calculated for the other two sheets.
2. **By Facility Type.** This sheet details the performance characteristics for each facility type. It is most useful in consideration of the network as a whole since here you can see how traffic shifts across facility types, as well as how a particular facility type is affected. For example, it is possible to see a deployment on arterials increase volume on the arterials, but you also may see a decrease in volume on freeways.
3. **By District.** Defining districts to categorize links allows this spreadsheet to show the results of deployment on a corridor, or any set of facilities grouped together in an interesting way by the user. This is a powerful tool used to isolate the effects of the deployment(s) on just an area of interest.

IDAS calculates the Costs results for the B/C spreadsheet by using the output of the Cost module, which has managed all of the equipment and other costs associated with deployments while deployments were being made in IDAS.

■ 13.2 Why Is Results Management Important

- In a complex regional analysis project, it is often the case that a large number of ITS Options are analyzed. Usually, many stakeholder groups are asked what types of ITS strategies they feel may be of importance to them and a list of potential deployments is created from which the analyst will start deploying the options.
- In addition to this, IDAS has a complex and rich set of ITS Impacts parameters. These are the values an IDAS user will provide to indicate the effectiveness of a deployment. For example, what is the estimated increase in capacity that might occur if signals were timed along a corridor? IDAS has defaults for these, but stakeholders often have an idea of their own about what these should be, sometimes even a range of such values.
- Finally, the results of IDAS are “locked” into the system. A user has to run IDAS to look at the results. This is not difficult in and of itself. What becomes difficult is keeping the log of what was changed and for what purpose. IDAS remembers all of its settings and parameters between runs of the system to extract an output. However,

that output itself does not contain enough information to infer or find out what the values of these many parameters and settings were when it was produced.

All of these issues become an order of magnitude more complex when users want to compare arbitrary sets of deployments. For each combination of deployments one wants to look at in IDAS itself, the user has to select those ITS Options in the ACM and produce the results. That combination is an entity as a group and cannot later be changed or used in comparison to other groups or ITS Options.

Said another way, it became clear that it would be advantageous to have a bucket into which all ITS Options could be placed. A user could then reach into that bucket and pull out any combination of ITS Options desired and look at them as a group, without having to run IDAS to do it.

Another major issue involves the complexity of managing costs and ensuring they are matched correctly to the right ITS Option. There also is a need for a configuration management system to cover the impacts of users changing important inputs to the system, such as the costs of certain equipment, the dollar valuations, etc. When these inputs change, and they always do, all prior IDAS results sets become invalid or at least suspect and probably should be recreated altogether.

■ 13.3 The IDAS Results Workbook

Section 11.0 introduced a set of spreadsheet tools used to manage costs of equipment and the relationship between equipment and specific ITS Options. **The result of the equipment/costs management effort is two spreadsheets that become the “Costs” side of the analysis.**

The “Benefits” side of the analysis is handled by the previously mentioned Facility Type performance spreadsheets that are produced by IDAS. **The two costs sheets and one or many performance sheets come together into one management system, the IDAS Results Workbook.**

The ability of this workbook to correctly manage IDAS results is based on the fact that the monetary considerations (e.g., dollar values of time) and the performance results of the network are decoupled and then brought together later from one source of dollar values, and multiple sources of performance values.

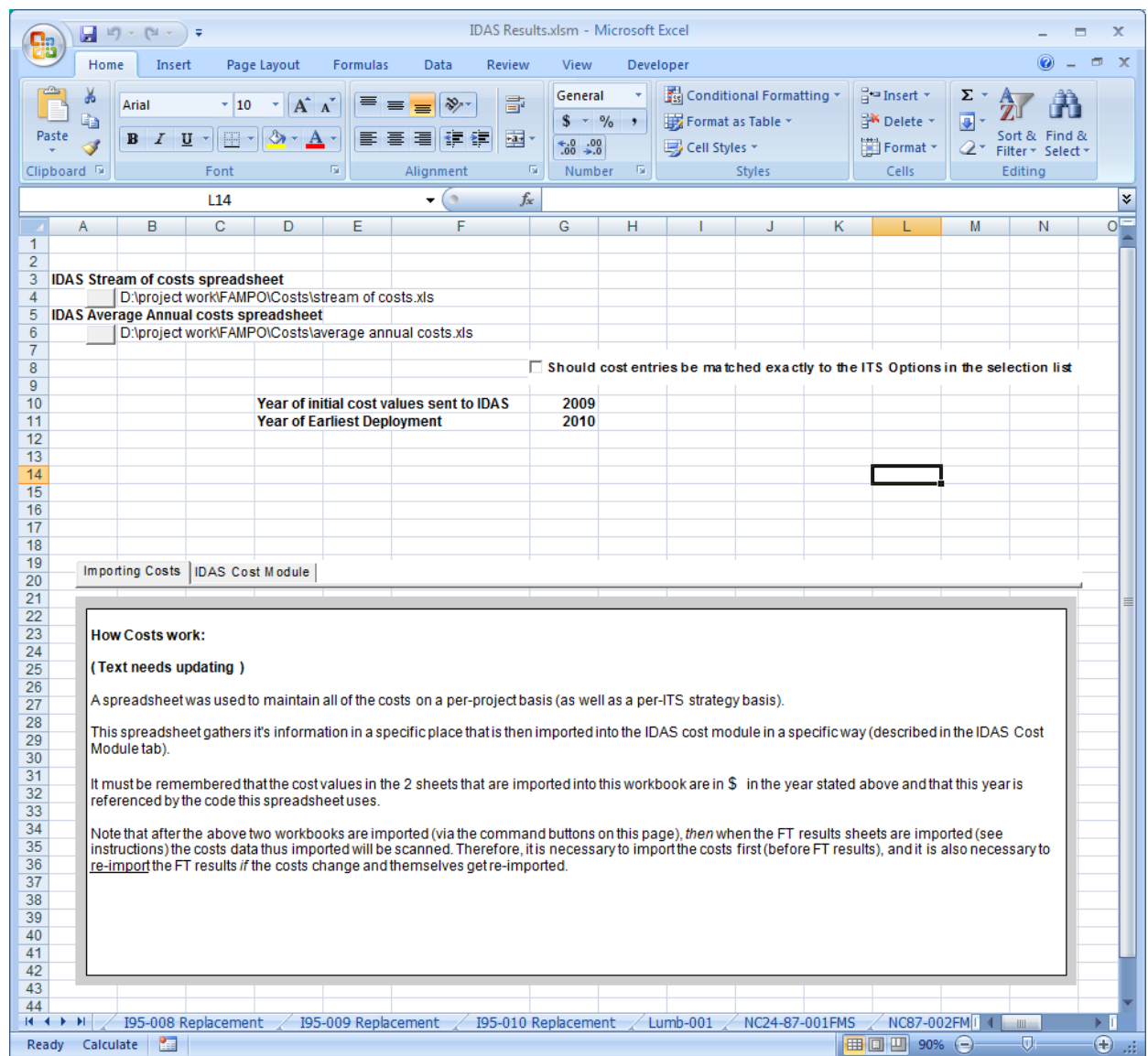
Note: The IDAS Results workbook is a single Excel file that contains many different *worksheets*. To clarify, when we refer to worksheets (or “sheets”) in this section, remember that these are *within* the workbook, except when we explicitly refer to another file, as in importing a spreadsheet.

13.3.1 Importing the Costs Spreadsheet

Prerequisite: The two costs spreadsheets described in Section 11.0 have been exported out of IDAS into an Excel compatible version. These are the Average Annual Cost and the Stream of Costs spreadsheets.

- **Step 1.** First, open the IDAS Results workbook, navigate to the “Costs” sheet, and import these two spreadsheets by clicking on the appropriate button in the upper left.

Figure 13.1 Importing IDAS Costs Spreadsheets



Some important points to note are:

- **Step 2.** Year of initial cost values sent to IDAS

When the equipment costs spreadsheet (Section 11.0) was created, it was populated with a menu of equipment with each specific equipment type given a cost. The year of those costs is not a consideration for that spreadsheet. Instead, costs are inflated (or deflated) to the specific year of analysis¹¹ set in the IDAS Results workbook and by the globally specified inflation rate¹², also in the IDAS Results workbook.

- **Step 3.** Should cost entries be matched exactly to the

The answer to this is “Yes” in the FAMPO analysis. The ITS Options were given names while being created in IDAS that explicitly define the relationship of each particular ITS Option to its equipment.

This option could be used to associate equipment across multiple ITS Options that share a similar name. For example, all deployments with a name that starts with “ramp metering” could be associated with a common set of equipment. However, we provide ALL the costs for Each deployment in this analysis, so this option should be set to “Yes” so that costs don’t intermingle between ITS Options that may have similar names.

- **Step 4.** Any time costs change—for example, additional equipment is deemed important, additional deployments are made, or the cost of certain equipment is adjusted—the user should perform the steps in Section 11.0. This involves importing the one global equipment costs spreadsheet into IDAS and running IDAS to export the two costs sheets. Once those two sheets are available, reimport them here.
- **Step 5.** After the system imports the costs sheets, it prompts the user whether the existing B/C sheets should be rescanned to update the costs throughout the system. The answer to this is yes if performance results are not about to be imported. (This is described in the next section.)

13.3.2 Importing the Performance Results Spreadsheets

13.3.2.1 Export from IDAS

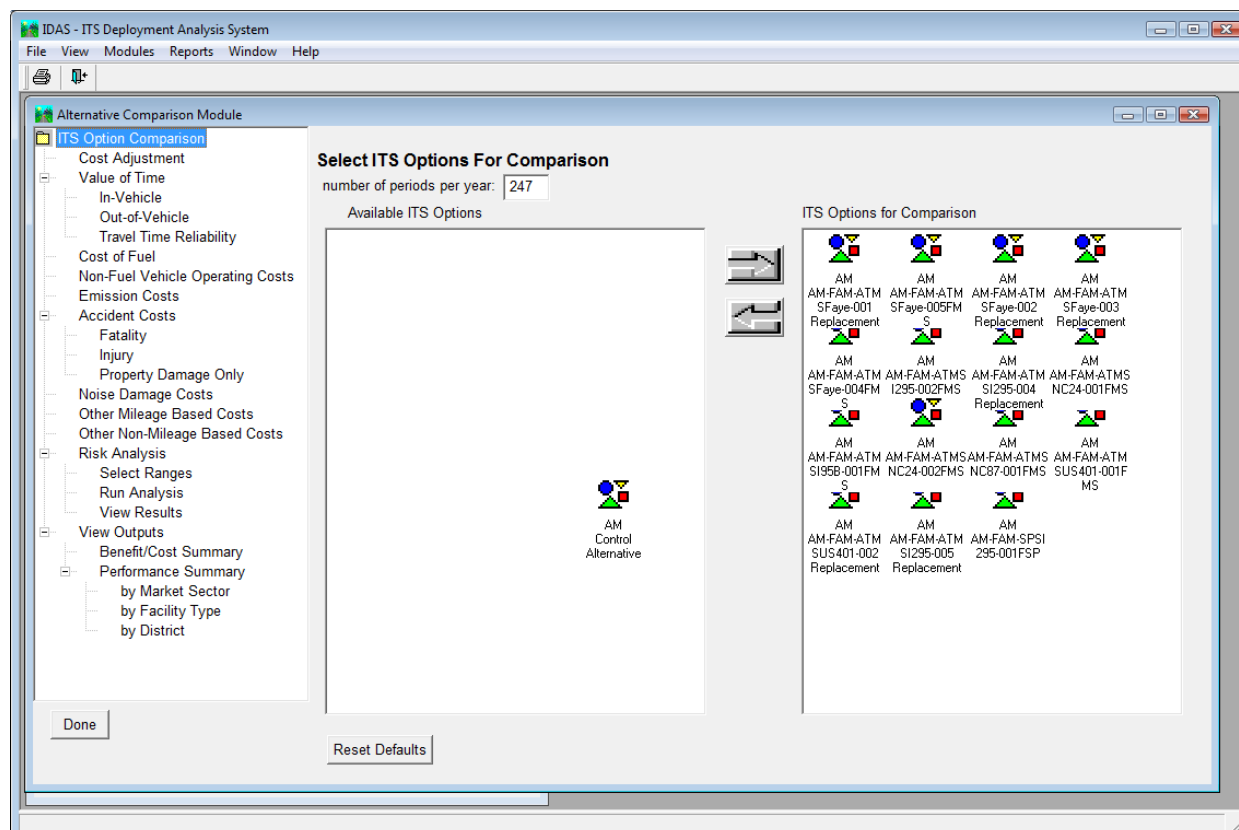
Figure 8.7 shows the performance by facility type spreadsheet in IDAS. Note that this is really a workbook with several sheets; the sheets that are in the workbook are dictated by which ITS Options were chosen in the Alternative Comparison Module (ACM) prior to showing the spreadsheet.

¹¹A single (global) value, which represents the specific year in which benefits and costs are reported.

¹²Another single value that is specified in only one place, to prohibit any chance of these variables from getting mixed into the analysis from different sources.

Figure 13.2 shows the ACM ITS Option selection window with several ITS Options selected and ready to be moved to the right side to have them included in the resulting workbook. **Note that multiple ITS Options can be chosen by pressing the CTRL key while clicking the icon.** Upon pressing the right arrow in the middle, the specified combination of ITS options will then be produced when the Performance Summary by Facility Type option is selected on the left.

Figure 13.2 Selecting ITS Options to Combine



Note that there is no restriction on the combination chosen, whatever is convenient for the user in organizing the analysis. How this organization ultimately takes form is described in the discussion that follows, where the resulting performance spreadsheet will be imported to the IDAS Results system.

- **Step 1.** At this point, the user selects the Performance Summary by Facility Type option and the workbook as shown in **Figure 13.3** is created. This spreadsheet is exported by selecting File\Save from the main menu, or clicking on the diskette with the question mark that appears on the toolbar.

Figure 13.3 The Performance by Facility Type Spreadsheet

Performance Summary
Project: FAMPO, Alternative: AM, ITS Option: AM-FAM-ATMSFaye-003 Replacement

By: Facility Type	VCCurve 0.56 3.60	VCCurve 0.71 2.10	VCCurve 0.83 2.70	VCCurve 1.00 2.10	Total
Vehicle Miles of Travel					
Control Alternative	28,734	949,670	159,170	349,422	344,989
ITS Option	28,590	950,574	159,172	349,188	344,426
Difference (%)	-144 (-0.5%)	904 (0.2%)	2 (0.0%)	-237 (-0.1%)	-562 (-0.2%)
Vehicle Hours of Travel					
Control Alternative	652	17,707	3,201	9,797	10,930
ITS Option	642	17,346	3,208	9,792	10,904
Difference (%)	-8 (-0.6%)	-359 (-0.8%)	4 (0.1%)	-5 (-0.1%)	-26 (-0.4%)
Average Speed					
Control Alternative	44.0	31.0	48.9	59.6	31.9
ITS Option	44.0	31.3	48.9	59.6	31.2
Difference (%)	0 (0.1%)	0 (1.0%)	0 (-0.1%)	0 (0.0%)	0 (0.2%)
Person Hours of Travel					
Control Alternative	652	17,707	3,201	9,797	10,930
ITS Option	642	17,346	3,208	9,792	10,904
Difference (%)	-8 (-0.6%)	-359 (-0.8%)	4 (0.1%)	-5 (-0.1%)	-26 (-0.4%)
Number of Person Trips					
Control Alternative					
ITS Option					
Difference (%)					
Number of Fatality Accidents					
Control Alternative	1.8963E-04	9.7292E-03	2.7465E-03	2.2799E-03	6.0932E-03
ITS Option	1.8863E-04	9.7462E-03	2.7465E-03	2.2782E-03	6.0963E-03
Difference (%)	-9.922E-07 (-0.5%)	1.6E-05 (0.2%)	2.747E-08 (0.0%)	-1.564E-06 (-0.1%)	-2.876E-06 (0.0%)
Number of Injury Accidents					
Control Alternative	1.3782E-02	9.3959E-01	2.6963E-01	1.6999E-01	9.8946E-01
ITS Option	1.3713E-02	9.3942E-01	2.6964E-01	1.6987E-01	9.8918E-01
Difference (%)	-6.347E-05 (-0.5%)	1.926E-03 (0.2%)	2.623E-06 (0.0%)	-1.273E-04 (-0.1%)	-2.761E-04 (0.0%)
Number of PDO Accidents					
Control Alternative	1.7858E-02	1.3597E+00	3.8283E-01	2.2259E-01	8.5237E-01
ITS Option	1.7765E-02	1.3619E+00	3.8283E-01	2.2241E-01	8.5197E-01
Difference (%)	-9.028E-05 (-0.5%)	2.236E-03 (0.2%)	3.823E-06 (0.0%)	-1.761E-04 (-0.1%)	-4.019E-04 (0.0%)
Travel Time Reliability (hours of unexpected delay)					
Control Alternative					
ITS Option					
Difference (%)					

AM-FAM-ATMSFaye-003 Replacement

Show Centroid Connector Data
Emissions data does not include cold-start or trip duration amounts.
Accident data does not include intersection collision avoidance impacts.
Incident delay figures are calculated for freeway links only.
Person hours of travel data does not include hours accumulated in Transit market sectors.

- **Step 2.** Saving these in a consistent location with a name that describes the grouping of the ITS Options is recommended. The default name is “ftPerformance,” which should be changed.
- **Step 3.** Also, it is important to remember to change the extension of the saved file to .xls (Excel) as the default file format (.vts) is of no value in this process.
- **Step 4.** Additionally, sometimes these workbooks must be combined with others and this should be reflected in the naming convention. For example, in the FAMPO analysis, we are combining results from four IDAS databases: AM, MD, PM, and off-peak periods. Therefore, the exported files names will contain these identifiers to keep them from overwriting each other.

13.3.2.2 Import Into IDAS Results

Figure 13.4 shows the “Control” sheet in the IDAS Results workbook.

Figure 13.4 Importing Performance Spreadsheets Into IDAS Results

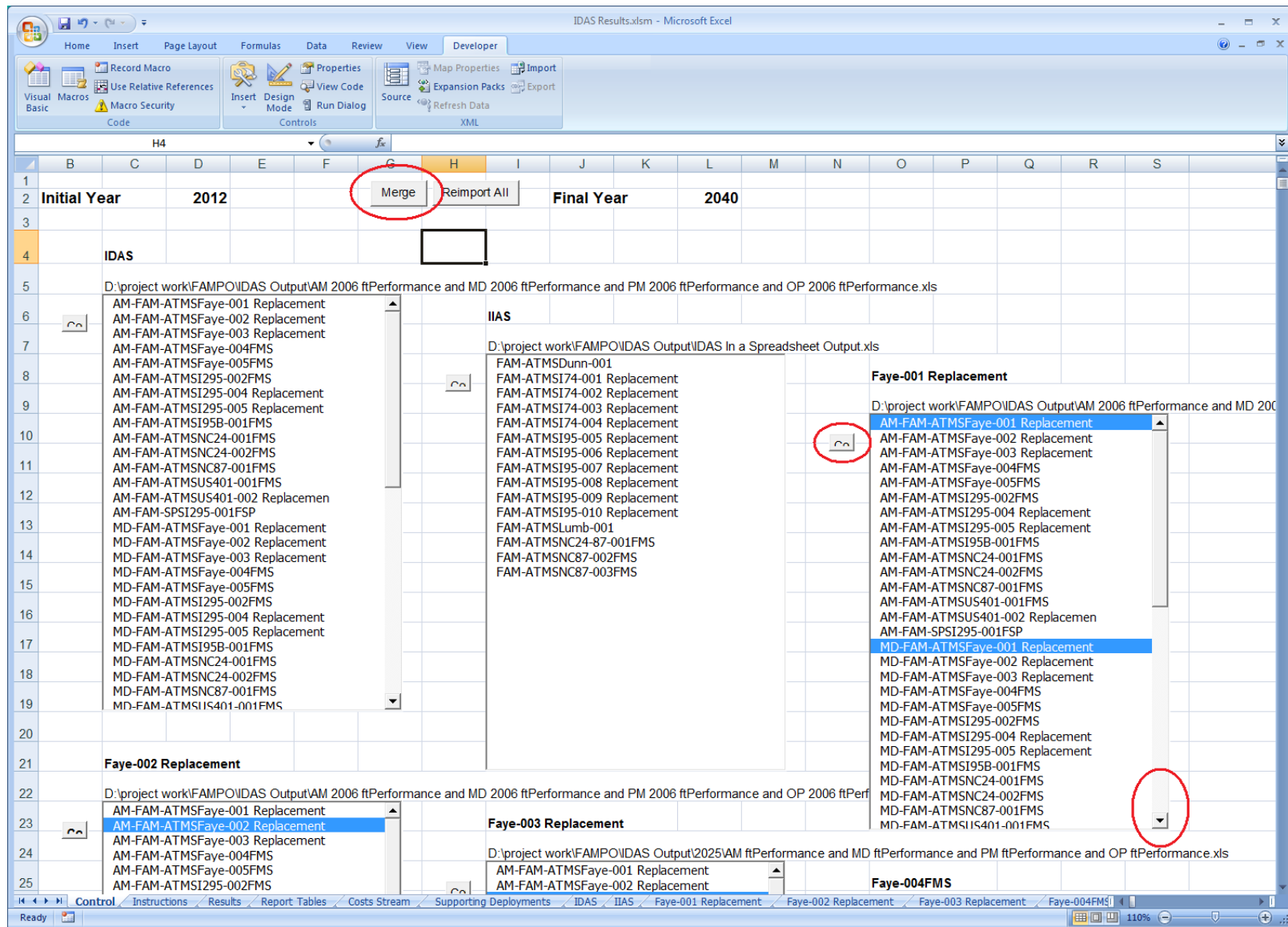


Figure 13.4 shows how ITS Options are combined into groupings that define whatever form of project desired by stakeholders. This will become clearer when looking at the actual Results (B/C) spreadsheet, but this particular figure shows what will be one of the columns in that main results sheet (the “Faye-001 Replacement” column) and that this column will utilize the results of 4 ITS Options, the AM, MD, OP, and PM results of the “...-FAM-ATMSFaye-001 Replacement” ITS Options. The OP and PM selections are not visible. To see them, we would use the scrollbar (highlighted) for the list. Any number of options can be “combined” for any one column in the results.

In the FAMPO analysis, there are four time periods: the AM, MD, PM periods and an off-peak (OP) period. This means that the total picture of any one deployment is actually the combination of the results from all four databases.

- **Step 1.** To create this combination, we use the Merge button in the control spreadsheet. In the figure, this button is circled under column G. IDAS can make any combination of ITS Options *within* a given database, but cannot create a combination *across* databases¹³.
- **Step 2.** When Merge is pressed, the user navigates to two files; any two files that have been exported out of IDAS can be merged together this way as long as the file name and the ITS Option names within them are distinct. This is the reason why, when multiple databases are used, it is convenient to name the ITS Options such that they can later be recognized as to which database they came from. In our example, we have merged the AM and MD performance sheet with each other, then merged that with the PM performance sheet, and finally, merged that with the OP sheet, arriving at one single combined performance spreadsheet that contains every ITS Option for every time period for the 2006 FAMPO model.
- **Step 3.** The Merge process creates a file in the same directory as the first selected file, with a file name containing the word “and” between the two original file names.

Having combined all results, AM, MD, PM, and off-peak, the desired column in the IDAS Results spreadsheet can be populated.

- **Step 4.** First, the cell in the Control sheet (O8) is given the name of the sheet that will be used to manage the B/C for this particular grouping. It must be distinct from all other names, which are in the 2nd cell above each of the list boxes. This will become the “descriptive” name for the ITS Grouping assembled out of the associated list contents.
- **Step 5.** Pressing the button (highlighted) at the top left of the list imports the previously combined ITS Options into the system into the B/C sheet for that list. At

¹³It is possible to have all 4 time periods in one database, however, the size of databases in a network this large makes it easier to keep them separate.

the same time, the previously imported costs information is parsed to associate the correct costs with the correct ITS Option.

While there are many steps necessary to accomplish this, **it is important to remember that once an analysis region has been setup, all of it is automated.** For example, if IDAS has to be rerun (and this is rarely necessary, unless impacts values are changed in deployments), or if Costs information is updated (and this is not only likely, but frequent), one simply presses Reimport All, shown at the top of **Figure 13.4**.

13.3.2.3 Managing and Reviewing the Combined Results

The “Results” sheet in the IDAS Results workbook contains all of the summary B/C columns for any of the ITS Option lists that are populated in the Control sheet **AND** which have their entry selected in the list of ITS Option groups on the left. Please see **Figure 13.5** on the next page.

Note that each column takes into account only those ITS Options selected in one list on the Control worksheet.

Figure 13.5 Initial View of the B/C Results

IDAS Results.xlsm - Microsoft Excel

Home Insert Page Layout Formulas Data Review View Developer

Clipboard Font Alignment Number Styles Cells Editing

General Conditional Formatting Check Cell Explanatory ... Input Linked Cell Note

AutoSum Fill Clear Sort & Filter Find & Select

Factors affecting Analysis:

	Desired	IDAS Defaults
Number of travel days in a year	247	247
Year of \$ values	2010	1995
Inflation Rate	3.0%	3%
Value of In-vehicle time	\$24.00	\$9.63
Value of In-vehicle time (commercial)	\$28.87	\$16.96
Value of Out-vehicle time (commercial)	\$28.95	\$17.00
Value of time multiplier for Emergency Veh	30.0	30.0
Value of Out-vehicle time	\$28.95	\$17.00
Value of reduced delay time	\$16.39	\$28.90
Fuel Costs (gallon)	\$2.50	\$1.21
Emissions Costs (\$/ton)		
HC/ROG	\$3,020.00	\$1,774.00
NOx	\$6,351.00	\$3,731.00
CO	\$6,620.00	\$3,889.00
PM10	\$18,839.00	\$11,066.00
CO2	\$6.06	\$3.56
SO2	\$6.06	\$3.56
GW	\$0.00	\$0.00
Accident Costs		
Internal		
Fatality	\$4,490,000.00	\$2,317,398.00
Injury	\$86,415.00	\$50,760.00
Property damage	\$7,760.00	\$2,824.00
External		
Fatality	\$696,213.00	\$408,952.00
Injury	\$15,250.00	\$8,958.00
Property damage	\$847.00	\$498.00
Non-Fuel operating costs (\$/mile)	\$0.11	\$0.06
Noise Damage Costs (\$/mile)	\$0.0011	\$0.0007
Other mileage based (\$/mile)	\$0.00	\$0.00
Other non-mileage based (\$/mile)	\$0.00	\$0.00
Vehicle Occupancy	1.25	
Year of reporting \$ values	2012	
Discount Rate	5.0%	

Benefit/Cost Summary
Project: FAMPO

Annual Benefits	Weight	Faye-001 Replacement	Faye-002 Replacement	Faye-003 Replacement	Total
Change in User Mobility	1.00	\$ 0	0	0	0
Change in User Travel Time					
In-Vehicle Travel Time	1.00	\$ 0	0	12,729,261	12,729,261
Out-of-Vehicle Travel Time	1.00	\$ 0	0	0	0
Travel Time Reliability	1.00	\$ 105,956	0	210,720	316,677
Change in Costs Paid by Users					
Fuel Costs	1.00	\$ 213,309	134,472	516,246	864,026
Non-fuel Operating Costs	1.00	\$ 0	0	2,448	2,448
Accident Costs (Internal Only)	1.00	\$ 136,310	90,247	(112,165)	114,392
Change in External Costs					
Accident Costs (External Only)	1.00	\$ 22,423	14,846	(19,579)	17,690
Emissions					
HC/ROG	1.00	\$ 6,577	3,955	29,505	40,036
NOx	1.00	\$ 17,681	10,249	547	28,477
CO	1.00	\$ 95,790	58,087	708,231	862,109
PM10	0.00	\$ 0	0	0	0
CO2	0.00	\$ 0	0	0	0
SO2	0.00	\$ 0	0	0	0
Global Warming	0.00	\$ 0	0	0	0
Noise	0.00	\$ 0	0	0	0
Other Mileage-Based External Costs	1.00	\$ 0	0	0	0
Other Trip-Based External Costs	1.00	\$ 0	0	0	0
Change in Public Agencies Costs	1.00	\$ 0	0	0	0
Other Calculated Benefits	1.00	\$ 0	0	0	0
User Defined Additional Benefits	1.00	\$ 0	0	0	0
Total Annual Benefits		\$ 598,047	311,856	14,065,213	14,975,116
Annual Costs					
Average Annual Cost in 2012 Dollars		43,022	43,022	3,654,963	3,741,007
Actual 2012 O&M Cost in 2012 Dollars		15,025	15,025	0	30,050
Benefit/Cost Comparison					
Net Benefit (Annual Benefit - Annual Cost)		555,025	268,834	10,410,250	11,234,109
B/C Ratio (Annual Benefit/Annual Cost)		13.90	7.25	3.85	4.00
Initial Capital in year 2012		222,370	222,370	0	444,740
Year Built		2012	2012	2017	
Capital in year Built		222,370	222,370	15,079,633	
O&M in year Built		15,025	15,025	1,507,963	

Control Instructions Results Report Tables Costs Stream Supporting Deployments IDAS IAS Faye-001 Replacement Faye-002 Replacement Faye-003 Replacement Faye-004FMS Faye-005FMS I295-002FMS I295-005FMS

Figure 13.5 shows the bottom-line results of the grouping of ITS Options that have been imported and selected as active in the third list of options on the Control sheet.

- On this worksheet, all of the ITS Options can be compared side by side, and each column (R through BE) represents one of the groupings that can again be created in any way a user may desire. In our case, we *combined* the 4 periods of three ITS Options.
- On the left side of **Figure 13.5**, we choose which groupings to include by clicking them in the list. Any grouping not selected will have its corresponding column hidden in the B/C table.

The Use of Monetary and Valuation Factors in a Single Location

In **Figure 13.5**, the most compelling reason to use the IDAS Results system can now be seen. All of the monetary values used to drive the level of benefits are in one and only one place; down the middle left are the IDAS default values for these factors¹⁴, and to the left of that are the particular regional factors settled on for use by stakeholders familiar with local conditions.

The benefits of using the physical performance measures from IDAS in the form of facility type performance spreadsheets, splitting out the equipment costs and allocations into the user-defined costs (Section 11.0), and placing the dollar valuations and tools to mix, match, and combine ITS Options into this one place are significant.

If one feels that the value of time, for example, is too low, simply changing that value in Cell G10 applies the new figure everywhere. No need to run the IDAS benefits module or to go to IDAS to export another B/C workbook.

Some pertinent information regarding these valuation factors are:

- Travel days per year. This is the number of days per year with conditions similar to that of the model IDAS is using. For example, if the model input to IDAS is an AM Peak period, and if a PM period is **not** available, typically this value is twice the number of weekday travel days per year. This is to capture the benefit of the missing PM period for which no analysis was done.

In the case of the FAMPO work, AM, MD, PM, and off-peak were available, run, and combined, so this value would be the number of weekdays per year. The value 247 is 52 weeks of 5 days minus 13 holidays.

- Year of dollar values. This is the year for which all dollar values in the column are valid for. These dollar values do not have to be in the “current year” or the “year of

¹⁴For reference purposes only, these values are not used in any calculation.

reporting”; they can be in any year and the workbook will correctly use them, along with the inflation rate below it.

- Inflation rate. Used in conjunction with the year above it. This value has nothing to do with equipment costs or economic analysis on equipment. It is only used to change the dollar values in this column from the year of dollar values to whatever year the benefits are being referenced, which is the “year of reporting.” As an example, the user may decide to use a value of time from 2005 but want to conduct a benefit/cost analysis for year 2010. The inflation rate would be used to adjust the 2005 value of time to 2010.
- Actual values. Most of these are self explanatory, with a few additional notes:
 - Value of time for emergency vehicle multiplier. This is not a dollar figure, but a multiplier on the in-vehicle time value.
 - Internal/external accident costs. Internal refers to costs experienced by the traveling public involved in accidents such as lost income, repair costs, etc. External refers to the cost to supporting agencies such as accident investigation, lost taxes, facility damage, etc.
- Vehicle occupancy. The benefits calculated by IDAS are intended to include all of the traveling public. For example, when travel time decreases due to the deployment of ITS, it is less for the driver and all passengers in the vehicle.

This value is a multiplier to bring the passengers into the mix as having received benefit from ITS deployment.

Because this value is available for use here, whenever we define Market Sectors within IDAS, we set the vehicle occupancy count at 1.

- Year of reporting dollar values. This value indicates in what year the benefits and costs will be reported. Specifically, IDAS produces results that should be considered in one year only. It does not, for example, tell you what the benefit will be in 2015 in 2015 dollars; it tells you what the benefit will be in any **one** year in whichever dollar year the user desires. To clarify this, note that if this year value is changed, the bottom-line B/C ratio does not change; the benefit dollar values may rise (in the future year’s dollars), but so do the costs.
- Discount rate. This value is used by the cost module in IDAS to calculate the present value of a future equipment purchase when equipment needs to be replaced.

The IDAS cost module will tabulate all future year purchases of equipment based on the useful life of the equipment (see Section 11.0) over a period of a few decades into the future. This is illustrated in the next section by the Costs Stream.

While this tabulation is occurring, the system uses this value in the present value calculation for future expenditures.

It is important to remember that this is not an inflation rate, nor is it related to the change in the cost of equipment in the future. Equipment costs are expected to be the same in the future as they are now, albeit in relative year dollars.

The Costs Stream

To see the way that IDAS has calculated the future stream of costs, visit the “Costs Stream” sheet in the IDAS Results workbook.

When activated, this worksheet will pull together all the equipment that is allocated to the chosen ITS Options (these are the groupings that are selected on the left side of the Results sheet).

Figure 13.6 Stream of Costs

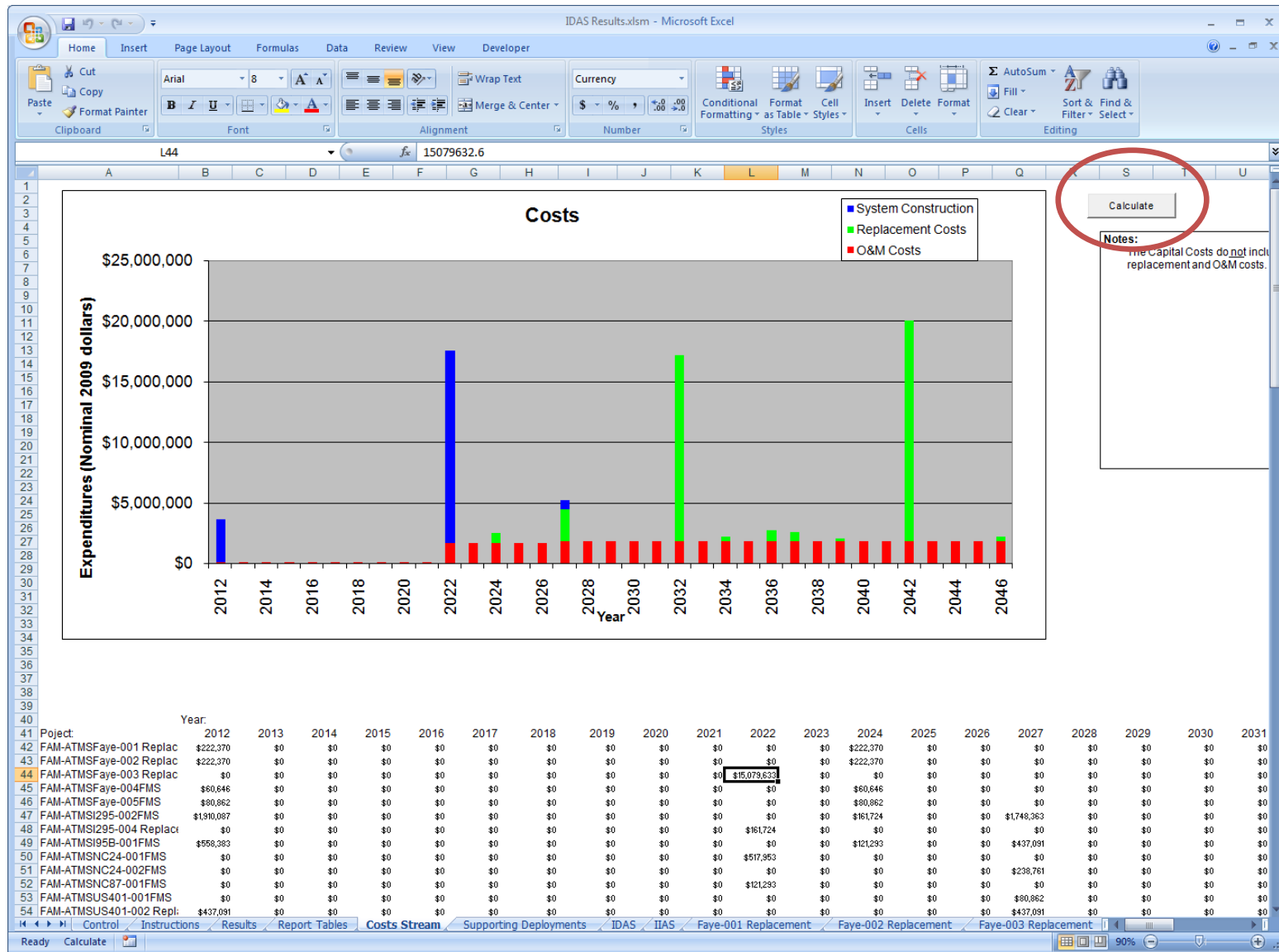


Figure 13.6 shows the deployed ITS Options under consideration and how much capital will be spent and when. It also shows the constant amount of O&M expenditures for each year and identifies the proposed years of various capital expenditures including replacement and new deployments.

The stream of costs only shows those ITS Groupings that are also selected on the left side of the Results worksheet. However, every time that combination changes, a user needs to click the “Calculate” as shown in the above figure.

Recalculation of this worksheet is not automatic because it is slow. Therefore, a “Calculate” button is provided (circled in **Figure 13.6**) to regenerate this graph when desired.

Reviewing the Report Table and the Physical Performance Measures

The IDAS Results workbook contains the “Report Tables” spreadsheet, shown in **Figure 13.7**, which arranges the information shown on the “Results” (Main B/C spreadsheet) in row form while grouping them in higher-level groups, such as all time savings dollar values into one travel time benefits cell.

There will be as many rows in the main (dollar values) report table as there are selected ITS Option groups on the Results worksheet. In other words, the current “active mix” is reported in the dollar values table.

Below the dollar values, the user can see the actual performance measures IDAS calculated for the ITS Options, e.g. total VMT, total fuel, emissions, etc.

Figure 13.9 shows most of these parameters; there are some emissions values to the right that are not shown to keep the figure at a minimum zoom level.

Figure 13.7 Report Tables

Microsoft Excel - IDAS Results.xlsxm

Home Insert Page Layout Formulas Data Review View Developer

Clipboard Font Alignment Number Styles Cells Editing

Normal Bad Good Neutral Calculation Check Cell

AutoSum Fill Clear Sort & Filter Find & Select

A95 2006

Save block: 2006

Go Clear All

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
		Travel Time	Travel Time Reliability	Accident Reduction	Operating Cost	Environmental	Agency Savings	Total	Annualized Cost	O&M Costs	Initial Capital in 2012	Net Benefits	B/C Ratio	Year Built	Capital in Year Built	O&M in Year Built
3	Deployments															
6	Faye-001 Replacement	\$0	\$105,957	\$158,734	\$213,309	\$120,049	\$0	\$598,049	\$43,022	\$15,025	\$222,370	\$555,027	13.9	2012	\$222,370	\$15,025
7	Faye-002 Replacement	\$0	\$0	\$105,094	\$134,472	\$72,291	\$0	\$311,857	\$43,022	\$15,025	\$222,370	\$268,835	7.2	2012	\$222,370	\$15,025
8	Faye-003 Replacement	\$12,729,261	\$210,721	-\$131,745	\$518,695	\$738,283	\$0	\$14,065,215	\$3,654,964	\$0	\$0	\$10,410,251	3.8	2017	\$15,079,633	\$15,079,633
9	Faye-004FMS	\$0	\$0	\$10,687	\$12,556	\$5,910	\$0	\$29,153	\$11,733	\$4,098	\$60,646	\$17,420	2.5	2012	\$60,647	\$4,098
10	Faye-005FMS	\$0	\$0	\$35,106	\$41,984	\$20,560	\$0	\$97,650	\$15,644	\$5,464	\$80,862	\$82,006	6.2	2012	\$80,862	\$5,464
11	I295-002FMS	\$163,743	\$0	\$28,607	\$31,532	\$18,412	\$0	\$242,294	\$249,474	\$37,153	\$1,910,087	-\$7,180	1.0	2012	\$1,910,087	\$37,153
12	I295-004 Replacement	\$163,743	\$0	\$28,607	\$31,532	\$18,412	\$0	\$242,294	\$31,289	\$0	\$0	\$211,005	7.7	2017	\$161,724	\$10,927
13	I95B-001FMS	\$97,172	\$2,298	\$53,243	\$68,183	\$31,985	\$0	\$252,881	\$78,012	\$14,752	\$558,383	\$174,869	3.2	2012	\$558,384	\$14,752
14	NC24-001FMS	\$159,448	\$0	\$42,200	\$48,423	\$21,735	\$0	\$271,806	\$70,191	\$0	\$0	\$201,615	3.9	2017	\$517,953	\$12,020
15	NC24-002FMS	\$45,634	\$0	\$19,103	\$21,544	\$8,766	\$0	\$95,047	\$31,185	\$0	\$0	\$63,862	3.0	2022	\$238,761	\$4,644
16	NC87-001FMS	\$0	\$9,465	\$11,794	\$23,327	\$14,023	\$0	\$58,609	\$23,467	\$0	\$0	\$35,142	2.5	2017	\$121,293	\$8,195
17	US401-001FMS	\$0	\$0	\$39,528	\$48,283	\$24,756	\$0	\$112,567	\$15,644	\$0	\$0	\$96,923	7.2	2022	\$80,862	\$5,464
18	US401-002 Replacement	\$266,283	\$0	\$0	\$0	\$0	\$0	\$266,283	\$54,546	\$6,556	\$437,091	\$211,737	4.9	2012	\$437,091	\$6,556
19	Dunn-001	\$356,197	\$0	\$0	\$0	\$0	\$0	\$356,197	\$357,551	\$0	\$0	-\$1,354	1.0	2017	\$1,475,182	\$147,518
20	I74-001 Replacement	\$0	\$902	\$53,495	\$60,139	\$0	\$0	\$114,536	\$19,555	\$0	\$0	\$94,981	5.9	2024	\$101,078	\$6,830
21	I74-002 Replacement	\$279,704	\$0	\$0	\$0	\$0	\$0	\$279,704	\$136,366	\$0	\$0	\$143,338	2.1	2027	\$1,092,727	\$16,391
22	I74-003 Replacement	\$0	\$868	\$73,109	\$82,190	\$0	\$0	\$156,167	\$23,467	\$0	\$0	\$132,700	6.7	2024	\$121,293	\$8,195
23	I74-004 Replacement	\$760,730	\$0	\$0	\$0	\$0	\$0	\$760,730	\$327,280	\$0	\$0	\$433,450	2.3	2027	\$2,622,545	\$39,338
24	I95-005 Replacement	\$0	\$237,668	\$168,507	\$189,437	\$0	\$0	\$595,612	\$35,199	\$0	\$0	\$560,413	16.9	2022	\$181,940	\$12,293
25	I95-006 Replacement	\$1,974,032	\$0	\$0	\$0	\$0	\$0	\$1,974,032	\$245,460	\$0	\$0	\$1,728,572	8.0	2025	\$1,966,909	\$29,504
26	I95-007 Replacement	\$0	\$153,371	\$146,813	\$165,048	\$0	\$0	\$465,232	\$23,467	\$0	\$0	\$441,765	19.8	2022	\$121,293	\$8,195
27	I95-008 Replacement	\$1,879,008	\$0	\$0	\$0	\$0	\$0	\$1,879,008	\$218,186	\$0	\$0	\$1,660,822	8.6	2025	\$1,748,364	\$26,225
28	I95-009 Replacement	\$0	\$320,073	\$87,374	\$98,227	\$0	\$0	\$505,674	\$11,733	\$0	\$0	\$493,941	43.1	2022	\$60,647	\$4,098
29	I95-010 Replacement	\$273,799	\$0	\$0	\$0	\$0	\$0	\$273,799	\$27,273	\$0	\$0	\$246,526	10.0	2025	\$218,546	\$3,278
30	Lumb-001	\$1,294,290	\$0	\$0	\$0	\$0	\$0	\$1,294,290	\$715,102	\$0	\$0	\$579,188	1.8	2017	\$2,950,363	\$295,036
31	NC24-87-001FMS	\$273,799	\$232,668	\$75,487	\$84,863	\$0	\$0	\$666,817	\$70,191	\$0	\$0	\$596,626	9.5	2017	\$517,953	\$12,020
32	NC87-002FMS	\$0	\$90	\$15,454	\$17,374	\$0	\$0	\$32,918	\$11,733	\$0	\$0	\$21,185	2.8	2022	\$60,647	\$4,098
33	NC87-003FMS	\$0	\$9	\$9,333	\$10,491	\$0	\$0	\$19,833	\$11,733	\$0	\$0	\$8,100	1.7	2022	\$60,647	\$4,098
35	SPS1295-001FSP	\$2,602,006	\$154,733	\$355,995	\$248,320	\$0	\$0	\$3,361,054	\$218,995	\$0	\$0	\$3,142,059	15.3	2022	\$284,110	\$149,704
36	I295-005 Replacement	\$163,743	\$0	\$0	\$0	\$0	\$0	\$163,743	\$31,289	\$0	\$0	\$132,454	5.2	2022	\$161,724	\$10,927
47	Total Benefits	\$23,482,592	\$1,274,090	\$1,185,263	\$2,257,604	\$1,343,502	\$0	\$29,543,051	\$6,806,773	\$98,072	\$3,491,809	\$22,736,278	4.3			

Control Instructions Results Report Tables Costs Stream Supporting Deployments IDAS IAS Faye-001 Replacement Faye-002 Replacement Faye-003 Replacement Faye-004FMS Faye-005FMS

Ready Calculate Average: 511144.6554 Count: 508 Sum: 220303346.5 100%

Figure 13.8 Performance Impacts

Figure 13.8 Performance Impacts is a screenshot of a Microsoft Excel spreadsheet titled "IDAS Results.xlsx". The spreadsheet displays a detailed table of performance impacts for various ITS deployments. The table is organized into columns for different metrics and rows for specific deployment items. The "Performance Impacts" section is highlighted in blue. The table includes columns for "Change in VMT", "Baseline VMT", "Improvement VMT", "ATIS Savings (hours)", "Baseline Delay (hours)", "Improved Delay (hours)", "Delay Reduction", "Baseline Fatalities", "Improved Fatalities", "Fatality Reduction", "Baseline Injuries", "Improved Injuries", "Injury Reduction", "Baseline Fuel", "Improved Fuel", "Fuel Reduction", and "Base HC/R (tons)". The table lists various deployment items, including replacements and FMS (Fleet Management System) implementations, and provides numerical values for each metric. The "Total Impacts" row at the bottom summarizes the overall performance impacts across all listed items.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	
		Change in VMT	Baseline VMT	Improvement VMT	ATIS Savings (hours)	Baseline Delay (hours)	Improved Delay (hours)	Delay Reduction	Baseline Fatalities	Improved Fatalities	Fatality Reduction	Baseline Injuries	Improved Injuries	Injury Reduction	Baseline Fuel	Improved Fuel	Fuel Reduction	Base HC/R (tons)
53	Faye-001 Replacement	0	8,986,791	8,986,791	0.00	5,371.24	5,351.50	-19.74	0.137485	0.137392	-9.2683E-05	12.973734	12.973734	0	465,978.06	465,652.45	-325.6094971	
54	Faye-002 Replacement	0	8,986,791	8,986,791	0.00	5,371.24	5,371.24	0.00	0.137485	0.137423	-6.1363E-05	12.973734	12.973734	0	465,978.06	465,772.79	-205.2675781	
55	Faye-003 Replacement	-7,581	12,891,354	12,883,773	0.00	10,923.24	10,659.97	-263.27	0.194248	0.194243	-5.13E-06	18.331702	18.329518	-0.00218328	710,333.30	709,230.04	-1103.250427	
56	Faye-004 FMS	0	12,891,354	12,891,354	0.00	10,923.24	10,923.24	0.00	0.194248	0.194242	-6.349E-06	18.331702	18.331702	0	710,333.30	710,312.86	-20.4375	
57	Faye-005 FMS	0	8,986,791	8,986,791	0.00	5,371.24	5,371.24	0.00	0.137485	0.137464	-2.0498E-05	12.973734	12.973734	0	465,978.06	465,913.97	-64.0859375	
58	I295-002 FMS	0	8,986,791	8,986,791	30.50	5,371.24	5,371.24	0.00	0.137485	0.137468	-1.6703E-05	12.973734	12.973734	0	465,978.06	465,929.92	-48.13183594	
59	I295-004 Replacement	0	8,986,791	8,986,791	30.50	5,371.24	5,371.24	0.00	0.137485	0.137468	-1.6703E-05	12.973734	12.973734	0	465,978.06	465,929.92	-48.13183594	
60	I95B-001 FMS	0	8,986,791	8,986,791	18.10	5,371.24	5,370.81	-0.43	0.137485	0.137453	-3.1088E-05	12.973734	12.973734	0	465,978.06	465,873.98	-104.0778809	
61	NC24-001 FMS	0	8,986,791	8,986,791	29.70	5,371.24	5,371.24	0.00	0.137485	0.137460	-2.464E-05	12.973734	12.973734	0	465,978.06	465,904.14	-73.91601563	
62	NC24-002 FMS	0	8,986,791	8,986,791	8.50	5,371.24	5,371.24	0.00	0.137485	0.137473	-1.1154E-05	12.973734	12.973734	0	465,978.06	465,945.17	-32.88525391	
63	NC87-001 FMS	0	8,986,791	8,986,791	0.00	5,371.24	5,369.48	-1.76	0.137485	0.137478	-6.886E-06	12.973734	12.973734	0	465,978.06	465,942.45	-35.60668945	
64	US401-001 FMS	0	8,986,791	8,986,791	0.00	5,371.24	5,371.24	0.00	0.137485	0.137461	-2.308E-05	12.973734	12.973734	0	465,978.06	465,904.35	-73.70117188	
65	US401-002 Replacement	0	8,986,791	8,986,791	49.60	5,371.24	5,371.24	0.00	0.137485	0.137485	0	12.973734	12.973734	0	465,978.06	465,978.06	0	
66	Dunn-001	0	26,431	26,431	0.00	0.05	0.05	0.00	0.000468	0.000468	0	0.044906	0.044906	0	1,400.84	1,400.84	0	
67	I74-001 Replacement	0	391,122	391,122	0.00	8.64	7.87	-0.77	0.006923	0.006880	-4.3268E-05	0.664516	0.664560	4.3268E-05	19,947.22	19,822.55	-124.6701445	
68	I74-002 Replacement	0	6,722,410	6,722,410	70.70	47.56	47.56	0.00	0.118987	0.118987	0	11,421,374	11,421,374	0	342,842.90	342,842.90	0	
69	I74-003 Replacement	0	407,419	407,419	0.00	17.17	15.50	-1.67	0.007211	0.007139	-7.2113E-05	0.692204	0.692277	7.2113E-05	20,778.36	20,570.57	-207.7835741	
70	I74-004 Replacement	0	22,298,725	22,298,725	234.60	751.18	751.18	0.00	0.394687	0.394687	0	37,885,534	37,885,534	0	1,137,234.98	1,137,234.98	0	
71	I95-005 Replacement	0	770,021	770,021	0.00	3,137.01	2,831.03	-305.98	0.013629	0.013493	-0.00013629	1,308,266	1,308,403	0.00013629	39,271.10	38,878.38	-392.710955	
72	I95-006 Replacement	0	47,460,213	47,460,213	499.40	258,953.73	258,953.73	0.00	0.840046	0.840046	0	80,634,902	80,634,902	0	2,420,470.85	2,420,470.85	0	
73	I95-007 Replacement	0	670,883	670,883	0.00	2,804.09	2,530.58	-273.51	0.011875	0.011756	-0.00011875	1,139,830	1,139,949	0.00011875	34,215.03	33,872.88	-342.1502853	
74	I95-008 Replacement	0	45,174,594	45,174,594	475.30	204,993.60	204,993.60	0.00	0.799590	0.799590	0	76,751,634	76,751,634	0	2,303,904.27	2,303,904.27	0	
75	I95-009 Replacement	0	399,270	399,270	0.00	2,972.51	2,682.57	-289.93	0.007067	0.006996	-7.0671E-05	0.678360	0.678431	7.0671E-05	20,362.79	20,159.16	-203.6279026	
76	I95-010 Replacement	0	6,587,962	6,587,962	69.30	49,046.35	49,046.35	0.00	0.116607	0.116607	0	11,192,947	11,192,947	0	335,986.04	335,986.04	0	
77	Lumb-001	0	135,300	135,300	0.00	3.97	3.97	0.00	0.002395	0.002395	0	0.229875	0.229875	0	6,945.90	6,945.90	0	
78	NC24-87-001 FMS	0	303,000	303,000	51.00	453.73	410.39	-43.34	0.005363	0.005318	-4.4958E-05	0.514797	0.514842	4.4958E-05	15,523.00	15,393.46	-129.54	
79	NC87-002 FMS	0	52,000	52,000	0.00	0.17	0.16	-0.02	0.000920	0.000911	-9.204E-06	0.088348	0.088357	9.204E-06	2,652.00	2,625.48	-26.52	
80	NC87-003 FMS	0	31,400	31,400	0.00	0.02	0.02	0.00	0.000556	0.000550	-5.558E-06	0.053349	0.053354	5.558E-06	1,601.40	1,585.39	-16.014	
82	SPS1295-001 FSP	0	15,736,050	15,736,050	0.00	21,573.21	20,244.03	-1,329.18	0.238327	0.238203	-0.00012374	22,700,316	22,700,316	0	932,338.83	931,601.61	-737.2246094	
83	I295-005 Replacement	0	15,736,050	15,736,050	156.80	21,573.21	21,573.21	0.00	0.238327	0.238327	0	22,700,316	22,700,316	0	932,338.83	932,338.83	0	
84	I295-006 FMS	0	12,891,354	12,891,354	61.80	10,923.24	10,778.19	-145.05	0.194248	0.194217	-3.1043E-05	18,331,702	18,331,702	0	710,333.30	710,155.59	-177.7050781	
85		0	0	0	0.00	0.00	0.00	0.00	0.000000	0.000000	0	0.000000	0.000000	0	0.00	0.00	0	
86		0	0	0	0.00	0.00	0.00	0.00	0.000000	0.000000	0	0.000000	0.000000	0	0.00	0.00	0	
87		0	0	0	0.00	0.00	0.00	0.00	0.000000	0.000000	0	0.000000	0.000000	0	0.00	0.00	0	
88		0	0	0	0.00	0.00	0.00	0.00	0.000000	0.000000	0	0.000000	0.000000	0	0.00	0.00	0	
89		0	0	0	0.00	0.00	0.00	0.00	0.000000	0.000000	0	0.000000	0.000000	0	0.00	0.00	0	
90		0	0	0	0.00	0.00	0.00	0.00	0.000000	0.000000	0	0.000000	0.000000	0	0.00	0.00	0	
91		0	0	0	0.00	0.00	0.00	0.00	0.000000	0.000000	0	0.000000	0.000000	0	0.00	0.00	0	
92		0	0	0	0.00	0.00	0.00	0.00	0.000000	0.000000	0	0.000000	0.000000	0	0.00	0.00	0	
93	Total Impacts	-7,581	300,431,614	300,424,033	1,785.80	658,189.55	655,514.92	-2,674.64	4.898052	4.897080	-0.00097188	466,406,759	466,405,976	-0.00168247	15,824,572.85	15,820,079.80	-4493.048173	

Notes on Viewing the Results

- It is important to note that these performance values are the combined values for all ITS Options that comprise a group. For example, our “Faye-001 Replacement” grouping really contains 4 ITS Options, 1 for each of four time periods. The VMT shown for this grouping is therefore 4 times any one of them.
- If you want to see the contribution of just one of the ITS Options to these numbers, simply go to the Control worksheet and click off all but that one ITS Option in the list of options comprising this group.
- Note that the Go button (circled) at the top of this page will create a copy of the two tables shown in **Figures 13.7 and 13.8** with a name that is in the text entry field to the left of the Go button, unless such a block already exists in the spreadsheet with that name, in which case, the contents of that block are replaced.
- The Clear All button erases all of the existing predefined groups. This is done to clear out any old data when some event happens that might make them invalid, such as re-importing costs.
- To recap, to create a snapshot of the specific set of ITS Option groups currently selected as the mix of interesting options (including a subset of the ITS Options themselves within each group), simply select the groups active in the list of options on the left side of the Results worksheet, and then for each group, select the ITS Options active (by selecting them in the lists on the Control spreadsheet).

There is no restriction to the combinations that can be created this way.

CAUTION! One must be somewhat careful regarding costs. When four time periods are combined as they are in the FAMPO study, only one of the time periods should have the costs associated with them. This is why “AM” was prepended to the ITS Option names as described in Section 11.0—to be sure the costs got applied for only one time period. This means that when time periods are combined, all time periods of any ITS Option that is selected should be selected.

IDAS Manual Appendices

The following Appendices were created as part of the Triangle Region ITS Strategic Deployment Plan Update, conducted in 2010.

APPENDIX A – QUICK REFERENCE GUIDE

Purpose of Checklist

The purpose of this document is to serve as a quick reference guide to IDAS for more experienced users. Additionally, it provides a non-user with exposure to the steps and procedures required to use IDAS in the analysis of ITS projects. Since IDAS is a complex software package with a wide range of capabilities, new users are encouraged to use the full procedures manual for guidance in applying IDAS.

Step-by Step-Procedures

Overview of IDAS

The ITS Deployment Analysis System (IDAS) software was developed by the Federal Highway Administration (FHWA) as a sketch-planning tool specifically designed to help planners better estimate the potential benefits and costs of proposed ITS deployments. The IDAS tool works by importing data from the Travel Demand Forecasting (TDF) model in order to recreate the validated regional network structure and travel demand within IDAS. The data exchanged between the model and IDAS includes network data regarding the characteristics of transportation facilities in the region and travel demand data, including the number of trips and mode share of travel between different zone pairs in the model. This baseline scenario is then analyzed in IDAS. It also is important for the IDAS results to be compared with the model results for validation purposes.

Once the network and travel demand data have been imported and validated, the IDAS user is then able to create analysis alternatives by selecting ITS components from a menu of over 60 ITS improvement types, and placing these on the desired location on the network. The user may then perform analysis within the software to estimate the incremental impacts of ITS deployments, including changes in link speeds and volumes, and travel mode shares. From these impacts, IDAS estimates the impacts in a number of performance measures, including travel time, accidents, emissions, noise, and other impacts. These benefits are summarized for the user and form the basis for comparison with other deployment alternatives created by the user. Benefits can be compared to costs, which include both annual operations and maintenance costs and annualized capital costs.

What You Need

In order for an agency to use IDAS as an analysis tool, it is important for the TDM to include specific data files. Those files are listed below.

Zone-to-district equivalence file (optional)

Node coordinate file

Network link characteristics file

Turn prohibitor file (optional)

Trip origin-destination (O-D) (trip table) data files

Trip in-vehicle travel time O-D tables (optional for nontransit market sectors)

Trip out-of-vehicle travel time O-D tables (optional for nontransit market sectors)

Checklist

The following sections outline key steps required to apply the IDAS model for a regional analysis. These steps are provided as a basic checklist of activities. Depending on the alternatives identified for evaluation, additional sub-items will be required. The body of the IDAS procedures manual provides additional specifics related to these sub-items. Additionally, the page number within the procedures manual that corresponds with each step is shown in parentheses.

Run TDM

Identify and obtain the TDM for the year(s) of analysis. (11)

Run the model and check results. (11)

Prepare trip tables, network files, and other files required for input to IDAS. (12)

Develop TransCAD node definitions. (13)

Modify TDM output formats as necessary to make sure they are compatible with IDAS. (21)

Identify characteristics of IDAS scenario(s) (general description page 7)

Identify facility types to be included in analysis. (24)

Identify geographic districts, projects, or facilities to be evaluated. Districts can be defined as corridors, municipalities, divisions, districts, or other level of segmentation desired. (26)

Identify ITS/operational alternatives to be evaluated. Data needed for this analysis is listed below. (29)

Devices

Operational strategies

Costs (capital and O&M)

Location of deployments

Package deployments at a level that reflects the goals of the analysis. (30)

Export TransCAD files to IDAS

- Export node and link files. (13)
- Export turn penalty files (if required). (14)
- Export trip tables (highway market segments, transit market segments). (15)
- Export other key files as needed (transit travel time skims, volume/delay curves). (16)

Prepare IDAS for analysis

- Provide required zone and area type information. (22)
 - Enter maximum zone ID in entry screen. (22)
 - Develop matrix matching IDAS facility and area type codes to equivalent TDM codes. (22)
 - Develop facility type table. (24)
 - Define and set up districts and district names. (26)

Copy database (31)

Import network data

- Set up fields for extract process (extract data selection window). (34)
 - Select fields from TDM and associate them with IDAS. (35)
 - Convert two-way TransCAD links to one-way IDAS links. (36)
 - Add required IDAS fields not in the TDM (time/speed indicator, conversion of link to lane capacity; area type, district or travel types not available in TDM data. (38)
- Run the Extract Data tool to export files to IDAS and check files. (39)
- Create node file. (41)
 - Convert location information to IDAS format. (42)
- Export link and node data to *.csv files. (43)
- Create project in IDAS. (44)
- Create alternative. (45)
- Import link and node files. (47)

Import market sector data

- Define maximum zone number. (51)
- Define, provide parameters, and import market sector data. (52)
- Process and convert transit matrices. (55)

Incorporate volume/delay curves

- Relate V/C curves to facility type. (57)
- Manage and calculate V/C curves in Excel. (59)
- Associate V/C curves to links. (61)
- Import V/C curves into IDAS. (62)

Run the baseline analysis

- Set parameters in IDAS benefits module. (65)
 - Set volume/delay curves information (66)
 - Specify the assignment closure criteria (67)
 - Specify the analysis options (68)
- Run the control alternative assignment. (70)
- Open and save the alternatives comparison module performance by facility type spreadsheet. (71)

Validate IDAS results

- Review and identify criteria for validation. (75)
- Conduct initial validation using the alternatives network generator. (76)
- Summarize validation results at the facility type level and review. (78)

Create IDAS Options

- Create ITS Options. (81)
- Deploy ITS Strategies. (83)
- Set parameters for impacted links. (85)
- Create transit deployment (if being evaluated). (86)

Manage equipment and deployment costs

- Name ITS Options. (98)
- Organize cost data in correct format for input to IDAS. (98)
- Import cost data into IDAS. (100)
- Export cost results from IDAS. (101)

Using the Alternatives Comparison Module

- Select ITS Options for comparison. (103)
- Specify dollar valuations. (104)
- Review benefit/cost and performance summary spreadsheets. (105)
- Review results by: (108)
 - Market sector
 - Facility type
 - District

Manage IDAS Results

- Import cost spreadsheet to IDAS results workbook. (113)
- Import performance results spreadsheet to IDAS results workbook. (115)
- Merge into IDAS results spreadsheet. (118)
- Incorporate monetary and valuation factors. (121)
- Review results. (123)

APPENDIX B – QUALIFICATIONS FOR IDAS ANALYST

Qualifications for IDAS Analyst

(May be revised based on agency requirements for position level) Education requirements should include Bachelor's Degree in Civil Engineering or Transportation Planning and three to five years of experience or equivalent experience.

Should have background in transportation modeling and analysis, travel demand forecasting, transit planning, data analyses, and transportation policy evaluation.

Experience should include travel demand forecasting (preferably with TransCAD) including calibration and validation of travel demand models; and providing analytical basis for evaluating the benefits of alternative transportation investments (benefit/cost analysis).

Experience should include statistical and quantitative analysis; modification and application of travel demand models using modeling and spatial analysis software (TransCAD, ArcGIS).

Should be able to process and manipulate large databases with tools such as Excel and Access.

Should have basic knowledge of statistical tools such as SAS.

Should be familiar with basic transportation economic concepts such as system performance measures and their conversion to monetary values.

Should be familiar with value of time calculations and have basic understanding of transportation project cost development.

APPENDIX C – REQUIREMENT TEXT FOR OUTSOURCING IDAS COMPATIBLE TDM DEVELOPMENT

Requirement Text for Outsourcing IDAS Compatible TDM Development

The following text is provided for use by agencies contracting consultants for the development of TDMs. It is intended to include requirements so the adopted model will have all of the necessary files for ITS deployment analysis using IDAS.

For use with the Intelligent Transportation Systems (ITS) Deployment Analysis System (IDAS) software, the travel demand forecasting (TDF) model should include the following files in the final deliverable.

- Zone-to-district equivalence file (optional)

- Node coordinate file

- Network link characteristics file

- Turn prohibitor file (optional)

- Trip origin-destination (O-D) (trip table) data files

- Trip in-vehicle travel time O-D tables (optional for nontransit market sectors)

- Trip out-of-vehicle travel time O-D tables (optional for nontransit market sectors)

- Volume/delay curves

FAMPO Regional ITS Strategic Deployment Plan Update

Mainstreaming/Integrating ITS into the MPO Planning Process Final Report



Prepared for:
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Prepared by:

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SYSTEMATICS

 FOURSQUARE INTEGRATED
TRANSPORTATION PLANNING

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Revision History

Filename	Version	Date	Authors	Comment
Process Integration Report Draft 12-3-12	0.1	12/3/12	B Eisenhart	Initial Draft
Final Process Integration Report 3-31-13	1.0	3-31-13	B Eisenhart	Final incorporating comments
FAMPO Process Integration Final Report 2013-04-11	1.01	4-11-13	B Eisenhart	Final incorporating comments
FAMPO Process Integration Final Report 2013-05-24	1.02	5-24-13	J Baker	Final version for Workbook and DVD

Note: This document is based on and incorporates relevant sections of the following document developed as part of the Triangle effort: Final Strategies for Improved Integration of ITS into the Transportation Planning Process, March 2010.

1. INTRODUCTION

The FAMPO Region Intelligent Transportation System (ITS) Strategic Deployment Plan (SDP) Update seeks to develop ITS projects, processes, and policies that can be efficiently implemented to realize the vision of the plan. As with any long range planning effort, whether it be capital, operation and maintenance, or project planning, it is imperative to collaborate with all relevant stakeholders. This collaboration helps to identify and consider future needs and obstacles, best appropriate resources, and identify where project efforts can be consolidated to develop a comprehensive ITS network. This approach will ensure that the local, regional, and statewide networks will properly work together and minimize future efforts to seamlessly integrate ITS projects into each respective system.

The intent of this document is to establish a process and methodology for the consistent evaluation and incorporation of ITS approaches and ITS projects into the existing transportation planning process in the FAMPO region. The approach in this document is based upon the model for improving the integration of ITS into the transportation planning process that was developed for the Triangle region. This document is based upon and borrows from the following document developed as part of the Triangle effort: Final Strategies for Improved Integration of ITS into the Transportation Planning Process, March 2010.

Ideally, the use of this approach will result in the mainstreaming of ITS project consideration to mitigate transportation system deficiencies and to help achieve transportation system goals. The improved integration of ITS approaches into the Transportation Planning processes also helps to highlight the importance of planning for operations and the consideration of not only recurring congestion mitigations techniques, but approaches for increasing travel time reliability, reduced exposure to incident based delay, better access to information about our transportation systems, and improved safety and security within our transportation networks. This proposed approach serves as a procedure to truly marry the vision, goals, and objectives identified during the Strategic Deployment Process with the strategies and tactics identified in the ITS Architecture which have been evaluated utilizing the ITS Deployment Analysis Systems (IDAS). By explicitly considering ITS projects on a quantitative basis, the ability of ITS strategies and approaches to contribute to the regional and statewide goals and objectives for transportation can be measured and their investment value compared to that of other approaches.

Traditionally, in many organizations, ITS planning has been conducted independent of other transportation planning processes, typically in separate departments, managed by different teams of staff with differing backgrounds that rarely overlap. The Federal Highway Administration (FHWA) has recognized this disparity and has offered federal guidance to bridge the gap between ITS planning and the traditional transportation

planning process. The approaches described in this document are consistent with FHWA Register 23 CFR parts 450 and 500 and Federal Transit Administration (FTA) 49 CFR part 613. Applicable sections state the following:

23 CFR 450.104 (Subpart A)

Intelligent transportation system (ITS) means electronics, photonics, communications, or information processing used singly or in combination to improve the efficiency or safety of a surface transportation system.

23 CFR 450.208-7(f) (Subpart B)

(f) The statewide transportation planning process shall (to the maximum extent practicable) be consistent with the development of applicable regional intelligent transportation systems (ITS) architectures, as defined in 23 CFR part 940.

23 CFR 450.306 – 8(f) (Subpart C)

(f) The metropolitan transportation planning process shall (to the maximum extent practicable) be consistent with the development of applicable regional intelligent transportation systems (ITS) architectures, as defined in 23 CFR part 940.

FTA 49 CFR 613.200

The regulations in 23 CFR 450, subpart B, shall be followed in complying with the requirements of this subpart. The definitions in 23 CFR 450, subpart A, shall apply.

In addition to the regulatory direction available on this issue, the following publications are a sample of the assistance offered at a national level to help guide the integration of planning and operations:

- Applying Analysis Tools in Planning for Operations (FHWA),
- Statewide Opportunities for Linking Planning and Operations A Primer, Getting More by Working Together (FHWA)
- Opportunities for Linking Planning and Operations (FHWA,)
- Incorporating ITS Into the Transportation Planning Process: An Integrated Planning Framework (ITS, M&O, Infrastructure) Executive Guidebook
Transportation Research Board, National Cooperative Highway Research Board.

Additional relevant publications can be found at
<http://ops.fhwa.dot.gov/travel/plan2op.htm>.

To ensure efficient implementation, the current State and FAMPO planning processes are being considered and recommendations are suggested to improve integration of ITS into the existing processes.

2. EXISTING PROCESSES

The State and FAMPO are currently working together on a regular basis to integrate and streamline each of their respective planning practices, whether they overlap or lead into one another.

This regional approach to planning allows for better, more comprehensive information to be gathered and potentially more opportunities for implementation. In addition, better coordination leads to implementation of a consistent transportation network.

Regarding ITS, all MPOs and NCDOT divisions currently consider ITS strategies in the their planning efforts. A formalized statewide process to integrate ITS strategies into the planning process has been developed as part of the Triangle Region ITS Strategic Deployment Plan Update, completed in 2010. This process seeks to establish a method of integrating ITS planning into current practices. Following is a brief discussion of the current planning process.

2.1. State Practices

The following represent the NCDOT statewide planning practices that will most likely offer opportunities to efficiently plan projects at a statewide and regional level through integration.

This is not an exhaustive list for every project. Each project planning phase should coordinate and collaborate with the most applicable stakeholders.

2.1.1. State Transportation Improvement Program (STIP)

The STIP is currently a seven year funding program that identifies capital transportation projects throughout the state. The STIP actually covers 10 years, but only the first 7 are funded. Years 8-10 are considered “unfunded”, but assist development of subsequent STIPs by providing out year projects that move into the funded category at each new update. The document normally is updated every two years, with it being finalized in odd years. However, due to a change in administration at NCDOT, the STIP currently under development is not expected to be finalized until 2014. Whether this is a one time schedule adjustment or will become the norm is unknown, so for the purposes of this document the original timing of the document is maintained in the figure presented later. The program identifies each project, capital costs, funding sources, and schedule. The project types include highways, aviation, enhancements, public transportation, rail, bicycle and pedestrians, and the Governor's Highway Safety Program. The STIP development is based on projects submitted through NCDOT's biennial prioritization process and is subject to available funding.

A newly developed document, related to the STIP is the 5 Year Work Program, which is a five year plan which provides a more detailed accounting of how dollars will be

allocated at a project and program level for the first 5 years of the STIP. Like the STIP this Plan is updated every two years, with a draft in year 1 and the final in year 2. For this one the current version is 2012 with the next update to be official in 2014.

2.1.2. Strategic Planning Office of Transportation (SPOT)

SPOT is the office responsible for the development of a project strategic prioritization process that is focused on achieving the Department's mission and goals. The prioritization process is based on quantitative and qualitative data that is weighted and ranked based on goal, tier, and MPO, RPO, and NCDOT Division rankings. The outcome of this process will be the primary source for the STIP. The Department's strategic prioritization process will occur every two year, with the first one having occurred in 2010 as part of the Triangle effort. Since this is a new effort, the prioritization process will be evaluated prior to the next implementation which may result in process improvements.

2.1.3. Regional Models

Regional travel demand models are used to forecast future regional traffic patterns. The model results are used as a tool to identify deficiencies and to test the effectiveness of projects and strategies in a region. Regional travel demand models are a widely accepted method of representing future traffic conditions. Their results are also used as inputs to develop regional emissions estimates to determine air quality conformity in National Ambient Air Quality Standards (NAAQS) maintenance and non-attainment areas.

2.1.4. North Carolina Transportation Plan (NCTP)

The NCTP is a statewide long-range multimodal transportation plan that considers a 25+- year investment horizon for transportation funds. It provides high level vision, goal, and objectives for the state's transportation system as well as it identifies long term funding priorities. This plan is the result of a multi-year intensive planning process including technical analysis, public engagement, and strategic planning. The plan is adopted by the Board of Transportation and serves as a "policy guideline to support future investment decision-making."

2.2. FAMPO Practices

The following represents portions of the FAMPO planning practices relevant to ITS project evaluation and selection that are currently required to obtain scheduled federal and state funding.

2.2.1. Metropolitan Transportation Improvement Program (MTIP)

The MTIP is currently a five-year funding program (that aligns with the first 5 years of the STIP) that identifies multi-modal transportation projects within FAMPO's planning boundary. As with the STIP, the MTIP identifies each project, capital costs, funding sources, and schedule. FAMPO has developed a prioritization process that identifies

those projects found to be most important to its area. With the development of the strategic prioritization process, FAMPO provides input and comments on the prioritization of their projects within the STIP. FAMPO is required to reconcile their MTIPs between the needs of the local area and NCDOT to produce a final STIP. The MTIP is updated every two years, with approval occurring in October of odd years. This current approach is likely to be adjusted because of the current plans to defer the next update of the STIP until 2014.

2.2.2. Long-Range Transportation Plan (LRTP)

The LRTP is a multi-modal, fiscally constrained transportation plan which guides project development and investment in roadways, public transportation, bicycle, pedestrian, aviation, and freight. This plan is a requirement of FHWA and is developed based on a 25- 30 year horizon. In addition to producing a fiscally constrained plan, regions that are in air quality non-attainment or maintenance status must demonstrate their LRTP conforms. For a project to be included in the STIP, it must be contained in the corresponding LRTP unless it is in an exempt project class.

2.2.3. Comprehensive Transportation Plan

Established under North Carolina law (GS 136-66.2) in 2001, the CTP is an unfunded, multi-modal, long range vision plan depicting the transportation infrastructure needed to handle the area's travel demand need to be made over the next 25 to 30 years. The plan includes elements for highways, public transportation and rail, and bicycles. The highway map designates the roadway network needed to handle existing and anticipated travel demand. The public transportation and rail map designates the public transportation network needed to handle existing and anticipated travel demand; and also designates active and inactive rail corridors. The bicycle map designates the bicycle networks that are of statewide significance; it also designates local facilities or portions of local facilities that are CTP is now developed instead of a thoroughfare plan.

2.2.4. Congestion Management Process (CMP)

The CMP is a plan that seeks to develop a process to effectively manage and reduce congestion by accurately assessing the areas of concern, recommending mitigation strategies, and establishing a methodology for addressing future congestion in a metropolitan area. This is a mandated process that requires TMA areas (MPOs with populations greater than 200,000, which includes FAMPO) to develop and implement a CMP as part of the MPO transportation planning process.

2.3. Transit Practices

2.3.1. Transit Urban Application

The Transit Urban Application process is conducted to obtain urban and regional transit system funding for the following two fiscal years. In addition, the transit planning process includes an effort to secure technology funds to integrate technology into public transportation.

2.4. Fort Bragg Practices

Fort Bragg has its own transportation planning activities that proceed in parallel with FAMPOs. Fort Bragg has a TIP that is updated annually; however the document is guidance for how monies are spent rather than a formal planning document. Because of the organizational setup of Fort Bragg, planning and funding of projects is not done by a single organization but occurs through multiple groups. Some projects go through Department of Public Works, including roadway improvements and any ITS devices included in these upgrades. Other projects relating to base public transportation go through the Department of Logistics, which manages the Fort Bragg Bus System.

3. EXISTING INTEGRATION PRACTICES

The importance of collaboration and coordination between agencies and even departmental planning staff has long been recognized. Long-range planning typically involves committees of various stakeholders who often represent different interests or jurisdictions involved in the process. Although there have been strides to effectively integrate planning processes, ITS planning is still conducted independently in many areas.

3.1. Current ITS Planning Integration Practices

FAMPO and NCDOT currently coordinate their planning activities through coordination of STIP and MTIP development processes. Each document is on a two year update cycle, with the STIP update occurring a few months before the MTIP. Relevant projects from the STIP (including ITS projects) are included in the MTIP. FAMPO does not currently have a separate evaluation or ranking of ITS projects.

3.2. Best Practices Integration

This section presents the findings from the Best Practices Scan conducted in the early phases of the development of the Strategic Deployment Plan, as they are relevant to the integration of ITS with current planning methodologies. This practice is summarized following to provide context for the process proposed under this project.

FDOT developed a Statewide ITS Strategic Plan as part of the compliance with the FHWA Final Rule on consideration of ITS in the transportation planning process. The Strategic Plan encompassed 10 elements, including the need for integration of ITS into the transportation planning process.

The FDOT ITS Planning Guidelines identifies key roles for how MPOs should incorporate ITS into their planning activities, including the CMP (and how ITS can generate the data needed to support the CMP performance monitoring), as well as how to evaluate potential ITS technologies as part of corridor studies. The guidelines also establish a link between ITS and sustainability as well as ITS and air quality monitoring requirements. By providing MPOs with information about how ITS can benefit a wide range of

transportation system planning requirements, ITS potentially can be leveraged with other project development efforts.

These planning guidelines were found to be successful, particularly in Polk County where the signal system was given priority because local transportation plans were coordinated and referenced the project. The lessons learned from this case study that can be applied to North Carolina and the FAMPO region include:

- Recognize that ITS deployment is important at the local level, just as it is on the statewide level.
- Create a process to incorporate ITS into the existing transportation planning processes (MPO or Statewide) that will accelerate project development and funding at the local/regional level while at the same time increasing interest on the statewide level.
- Create ITS Subcommittees at the MPO level and facilitate regularly scheduled meetings. In Florida, this approach has been shown to benefit the deployment of ITS, particularly at the local level.
- MPOs should consider developing a local set-aside of federal and state funds for projects identified in the congestion management process. Having available funding for ITS projects coupled with the inclusion of ITS in the transportation planning process almost certainly will increase and accelerate the deployment of ITS projects.

4. PROPOSED PROCESS

The proposed process described in this section is a customization of the statewide process to be applicable to FAMPO. The outcome of this task is a process for integrating and synchronizing ITS planning with the overall transportation planning process. In contrast to the Best Practices example presented in Section 3.2, it is the objective of this process to provide a means for the explicit consideration of ITS projects through the comparison of quantitative project evaluation measures that allow them to be ranked against non-ITS projects for their mode or project category.

As part of the Transportation Planning Process, the use of travel demand models is a key element in evaluating individual projects and overall scenarios to develop long-range transportation plans. Projects contained in the transportation plan are then considered for inclusion into the STIP and MTIP.

Because ITS projects are not typically measurable in a travel demand model, the evaluation of highway and transit oriented ITS projects has taken place outside of the travel demand model. Typically, this has meant that the ability to evaluate ITS project benefits and compare them to projects evaluated with output from travel demand models has been limited.

A key part of the proposed process is the use of the ITS Deployment Analysis System (IDAS). Through the incorporation of IDAS into the transportation planning process, the opportunity to evaluate ITS projects against highway and transit projects traditionally evaluated in the travel demand model is now available. It is expected that by having ITS projects explicitly compared against highway and transit projects in a travel demand model context, a more thorough and balanced application of ITS approaches will be undertaken.

Stakeholders in the FAMPO region have identified the following vision for ITS in the region:

A safe and efficient multi-modal transportation system that uses appropriate technology to provide reliable service in an environmentally sustainable manner, improving the quality of life in the region.

To realize the vision of *A safe and efficient multi-modal transportation system that uses appropriate technology* and to meet the FHWA and FTA's guidelines, ITS planning must be integrated with current, ongoing statewide and MPO planning processes. The proposed planning integration of ITS into the process was developed collaboratively through project meetings with the FAMPO ITS Steering Committee.

4.1. Relationship Building

The consistent commitment to the vision, goals, and objectives of the SDP will guide decision makers at the local, regional, and statewide level to realize the importance of ITS within their respective areas. However, without a strong focus on building professional relationships with appropriate staff within the City of Fayetteville, Cumberland County (and other adjoining counties), Fort Bragg, FAMPO, and NCDOT structure, the full potential of any ITS network will be lost. By building and maintaining these relationships, the agencies could share valuable information, infrastructure, and operations responsibilities. It is becoming increasingly important to recognize and consider operations and management during the planning stages of ITS networks at a local and statewide level. This collaboration could result in huge cost savings for each party that is somewhat unique to the field of ITS. Whereas in traditional transportation networks, you can build a road and forget about it, the successful implementation of an ITS project will have significant investment in the operations of the project. This is where the strong relationships built through the planning phases of the project should be sustained to efficiently manage and operate the system. The coordination and collaboration of municipal, county, Fort Bragg, FAMPO, and NCDOT professionals is vital to the successful planning, development, implementation, operation, and maintenance of ITS projects throughout the state. Incident Management groups are a prime example of how this interagency collaboration is working well in FAMPO.

4.2. MPO Planning Process

Since the formation of MPOs out of the Federal Aid Highway Act of 1962, the ‘continuous, comprehensive, cooperative’ (3-C) planning process has been the basis for long-range, multimodal planning. FHWA states that “[t]ransportation planning processes are required to be organized and directed...” This proposed ITS integration process seeks to establish an organized and directed process that is continuous, comprehensive, and cooperative in nature. The following summarize the overall ITS integration process, but what does that mean to a FAMPO planner specifically? This section speaks to the key elements and responsibilities of a FAMPO transportation planner that are proposed as part of this integration process.

During the initial development phases of the LRTP, the most critical aspect of the ITS integration process from a FAMPO perspective is the coordination and collaboration with local staff and NCDOT staff. Consistent communication should occur during all key elements of the planning process. The FAMPO planner should use the ITS project list from the current ITS SDP and consider those projects relevant to their respective areas. Through the LRTP planning process, the FAMPO planner should assess those ITS projects currently listed in the ITS SDP and any new ITS projects that have been developed. Those existing and new projects determined to address identified system deficiencies should be combined in a single IDAS run as described below. The results from this run should be used to evaluate the proposed projects and those deemed necessary should be included in the LRTP Recommended Plan. To truly integrate ITS planning, it is important that FAMPO personnel evaluate the proposed ITS projects alongside other LRTP projects as described below.

The FAMPO planner should be sure to coordinate with NCDOT to provide an updated ITS project list to be incorporated in the SDP update. The agency that oversees the regional travel demand model also should oversee the IDAS analysis to establish current results that can be used to evaluate projects during MTIP development. The FAMPO planner should coordinate with NCDOT during STIP development as necessary. Upon completion of this portion of the cycle, the FAMPO planner should coordinate and collaborate with NCDOT to provide input into the development of the NCTP which will establish the statewide vision and goals. It is recommended that the FAMPO planner and NCDOT regularly communicate so that as the ITS SDP updates are occurring, those concerns and goals of each MPO are addressed through project development and planning.

This section simplifies the integration process somewhat because there are several other planning documents that should consider ITS solutions. These documents may include the CMP, CTP, transit plans, and special studies. It is anticipated any of these documents could inform the LRTP or SDP as necessary. **Table 1** lists several planning practices and the anticipated ITS related event and expected output that potentially could be required.

Table 1. Planning Practices and ITS Related Events

Planning Element	Potential ITS Event Requirements	Desired Outputs
STIP	Prepare a statewide project list based on the ranking methodology which may be informed by IDAS evaluation measures	Adapted STIP that includes appropriate ITS projects
Strategic Prioritization (led by SPOT)	Evaluate ITS projects alongside all modes of transportation projects	Prioritized list of transportation projects that include relevant ITS projects
Regional Models	Used to build IDAS model	Baseline Results
NCTP	Establishes vision, goals, and objectives that will guide SDP development; should consider ITS solutions as part of statewide project initiative; will be informed by all local, regional, and statewide planning practices with should include ITS planning	Statewide Plan that includes ITS solutions.
MTIP	Develop the Regional Priority List based on the ranking methodology which uses IDAS results to evaluate project performance alongside other modes of transportation	Adopted MTIP that includes ITS projects
L RTP	Consider ITS projects identified in the SDP that are relevant to study area; evaluate proposed projects based on IDAS evaluation measures and develop preferred alternative; inform SDP of additional ITS projects that are identified	Adopted L RTP that includes ITS projects; new ITS projects
CTP	Consider ITS projects identified in the SDP that are relevant to study area; evaluate need and intent of proposed projects; inform SDP and CTP of additional ITS projects that are identified.	Adopted CTP that includes ITS projects; new ITS projects.
CMP	Consider ITS projects identified in the SDP that are relevant to study area; consider current regional model and IDAS results and the success of previously recommended mitigation strategies which may include ITS solutions; recommend ITS projects	Adopted CMP that includes ITS projects; new ITS projects
Transit Plans	Projects must be included in the Regional ITS Architecture; project meets the FTAs Triennial Review Checklist	ITS solutions identified and meeting FTA checklist

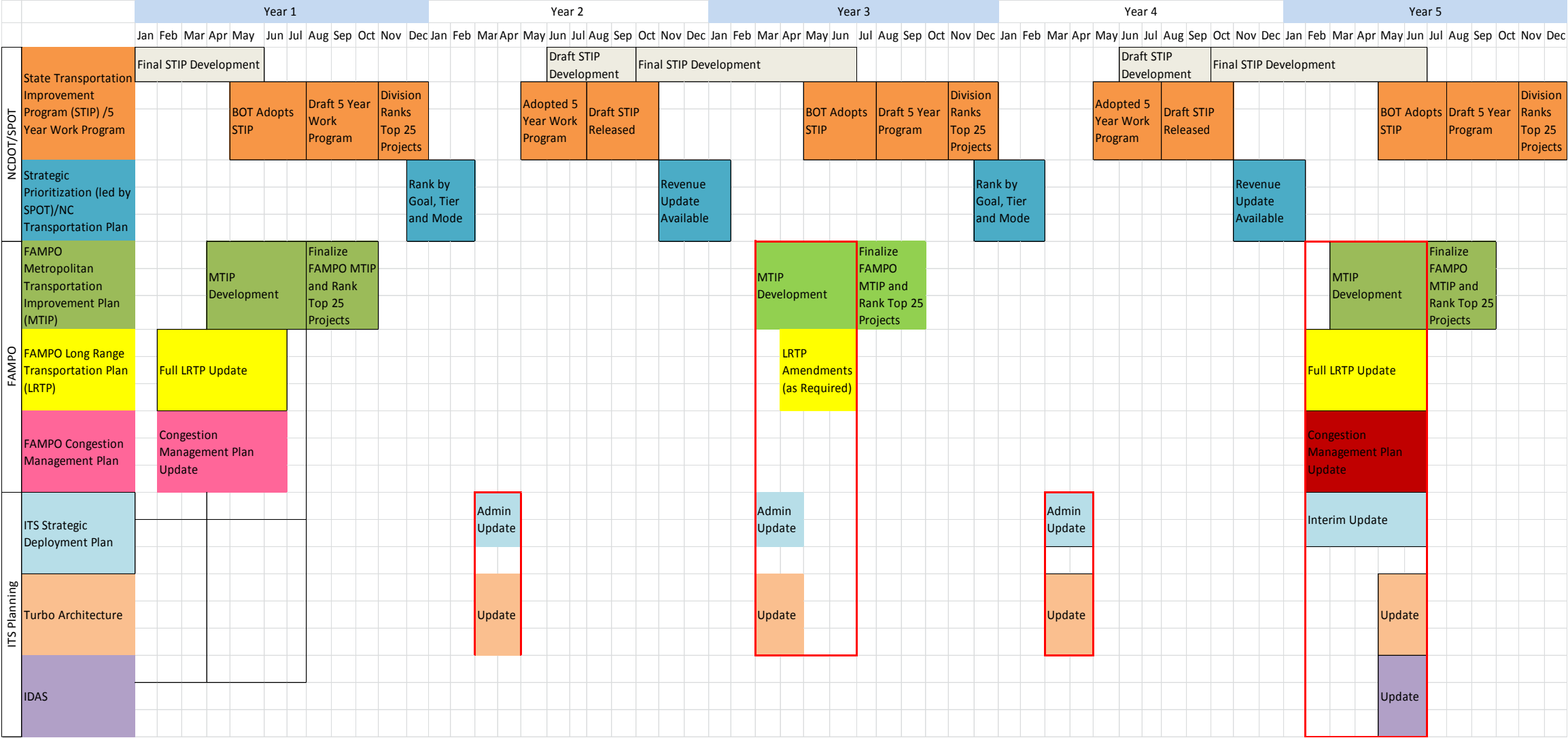
4.3. *Proposed Integration Key Elements*

The proposed ITS integration process considers several statewide and regional processes that are key to the development and implementation of transportation projects. By strategically aligning ITS planning, specifically the ITS SDP, Turbo Architecture, and ITS Deployment Analysis System (IDAS) software modeling processes, ITS projects can be efficiently incorporated and ranked with traditional transportation projects.

The proposed planning process has been developed such that ITS planning will be formally accommodated within the both statewide and regional vision, goals, and objectives developed in the NCTP. **Figure 1** illustrates that integrating ITS planning into the State and FAMPO practices can be accomplished with a cyclical flow of information used to plan and program projects. The following simplified key elements are recommended to create an integrated planning cycle.

The integration process also aligns with the ITS SDP Update Cycle established in the SDP Maintenance Plan. The maintenance plan establishes three levels of updates including administrative, interim, and full. These are described in greater detail in Section 4.4, but the levels of updates that correspond to each of the key elements are referenced below.

Figure 1 : Integrating ITS – Proposed Process



This approach is based on the processes followed during the update of the Triangle Region ITS SDP. It uses project level IDAS analysis and revised prioritized project list that are the output of the ITS SDP.

- Key Element (SDP Vision, Goals, and Objectives) – Review Goals and Objectives for incorporation into LRTP/ NCTP. The SDP Update has created a set of ITS Goals and Objectives. Consider using some of these goals and objectives during LRTP/NTCP updates. It is assumed that the MPO partners, transit agency partners, and other transportation partner agency visions and goals in a region will entertain major updates in a similar time frame and each of these should be re-visited in the major update time frame. **Full Update Activity**
- Key Element (ITS Project List Coordination) – It is envisioned that the latest, current available listing of projects that have been assessed in IDAS and are contained in the Regional Turbo Architecture Database shall be referenced by the FAMPO prior to their commencement of their LRTP updates. This should be a starting place for the FAMPO to consider the current ITS projects and offer project additions, changes, or deletion through the development of their respective LRTPs. **Interim and Full Update Activities**
- Key Element (IDAS Run) – At the stage in the FAMPO LRTP process where FAMPO has identified deficiencies in its existing plus committed (E+C) transportation network for its forecast horizon year(s), FAMPO typically begins to test projects, groupings of projects, policies, and land use scenarios and to assess how these strategies affect regional transportation network performance. This is primarily focused on those metrics available from output of the regional model (such metrics in the current 2035 LRTP include regional VMT and VHT, percent of VMT experiencing congestion, etc.). The model is best able to demonstrate improvement in these measures through shifting trips into non-single occupant vehicle (SOV) modes, by reducing overall trip making through changes in the proximity of origins and destinations, and increasing capacity to allow for trips to be made in lesser congested conditions. Also, it is typical to utilize other system deficiencies not revealed by the model from other planning reports. These may include safety deficiencies revealed in safety studies performed by NCDOT or the MPO, additional condition issues revealed in a Congestion Management Process, etc. It is at this stage that it is suggested that FAMPO consult the SDP and select those projects that address identified system deficiencies. Following selection of the SDP projects expected to impact their deficiencies, a single IDAS run (as opposed to a project by project IDAS run which had been performed for the SDP) containing all of the SDP projects identified by the MPO to affect their deficiencies shall be run on the E+C network for the MPO horizon year(s). **Interim and Full Update Activities**

- Key Element (System Evaluation) – FAMPO should compare its regional system performance measures as output in IDAS for the “with ITS” and “without ITS” alternatives as assigned on the E+C network. The difference in these values within IDAS shall be used to identify the anticipated impact of applying the SDP ITS projects to the regional system. For instance, measures such as VMT, average travel time, etc, shall be compared for the “with ITS” and “without ITS” options. The difference should be stored and used to establish the FAMPO ITS evaluation baseline. It is expected that the ITS E+C performance will be lumped into the overall system evaluation measures (by adding the IDAS reported difference to the regional model output). The sum value of the capital cost of the ITS projects contained in the ITS E+C evaluation set shall be used as a cost place holder in the LRTP financial plan. **Interim and Full Update Activities.**
- Key Element (LRTP – ITS Project Integration) – Once FAMPO has established a preferred LRTP network alternative, FAMPO should review the ITS E+C projects. This set of projects should be modified based upon changes in network conditions (e.g. consider projects on new alignment facilities and new transit routes added as part of plan). Consistent with the E+C ITS option development, only projects in the SDP that address an LRTP deficiency should be included. This ITS project set shall be considered the LRTP Recommended Plan ITS project set. It is expected that the difference in “with ITS” and “without ITS” IDAS system evaluation factors shall be added into the LRTP evaluation factors. Similarly, the cost of the ITS projects included in the LRTP Recommended Plan ITS project set shall be included in the LRTP Financial Plan. Consideration of using the change in emissions reported from the LRTP Recommended Plan for the ITS project set should be given. **Interim and Full Update Activities**
- Key Element (ITS Project Evaluation) – Once the final LRTP models are complete, the SDP should be updated in preparation for the development of the MTIP/STIP. The new baseline and recommended plan models should be used to perform a project-by-project IDAS analysis. This will result in the projects being re-ranked in the SDP based on the new data. It is expected that for interim updates, no new projects will be developed other than those that have emerged via administrative updates. It is expected that this will also change based on what projects have been completed and if there are changes to the regional transportation network. For major updates, it is expected that the entire project mix will be examined in line with changes in vision, goals, and objectives. The results of the project-by-project evaluation will be used to update the SDP project evaluation data. It is expected that this data will be used as well as those available within IDAS by FAMPO and NCDOT to develop their project rankings. Based on current practices in use by the FAMPO and proposed practices being implemented by NCDOT, the quantitative project evaluation measures in use are extracted from IDAS and the regional travel demand model and contained in the SDP and/or the IDAS results. The measures used for evaluation in FAMPO are the

same ones used in the Triangle effort (and used by NCDOT). **Interim and Full Update Activities**

- Key Element (Final STIP – ITS Project Integration) – Once the MTIP and Draft STIP are reconciled, the ITS projects should be contained in the Final STIP as well as be part of the financially constrained/air quality conforming LRTPs. **Interim and Full Update Activities**
- Key Element (NCTP) – The NCTP establishes the statewide vision and goals for a 25+-year horizon. These goals help to define the priorities and objectives for transportation planning across the state. It is expected that changes in this document may cascade into vision, goal, and objective changes in the FAMPO SDP. **Full Update Activity**

It is recognized that many of these steps happen concurrently. Therefore, it is imperative that frequent and effective communication and coordination occur between FAMPO coordinators and NCDOT staff.

Currently, the SDP provides several project evaluation factors for prioritization within the SDP including benefits, cost/benefit ratios, affecting high V/C corridors, etc. As FAMPO and SPOT project prioritization process evolves, it is envisioned that many of the values used in these processes may emerge from IDAS for most projects or that IDAS data may be normalized to SPOT/MPO data using a yet to be determined process.

4.4. ITS SDP Update Cycle

It is recommended that the ITS SDP be updated according the cycle presented in **Figure 1**. The FAMPO Regional SDP contains a Maintenance Document (which is the same document developed for the Triangle Region) that provides additional detail and checklists for guidance through these updates. There are three levels of maintenance required of the SDP. They include:

- Administrative Update (annually): The majority of this update is handled by the FAMPO and involves administrative revisions to the SDP such as updating the list of prioritized projects to represent projects that have been constructed within the previous year.
- Interim Update (every four years): This update involves more stakeholder involvement than an administrative update but focuses on an assessment of the existing plan. The interim update reviews the objectives for applicability to the region's focus and applies any determined discrepancies to the remaining components of the SDP. During this update, coordination should occur to ensure that the updated SDP is integrated and consistent with other current relevant plans, such as the NCTP, MPO LRTPs and CMPs, and other special studies that have been performed.
- Full Update (every eight years): This is an extensive stakeholder-involved

redevelopment of the SDP. The full update begins with a new visioning process and guides the stakeholders through developing a new comprehensive SDP.

The first full update shown is out of the recommended cycle; therefore, another full update is shown in two years to revisit the vision, goals, and objectives to ensure consistency with the NCTP update. The upcoming full update will only be necessary if there are extreme changes in the vision or direction of one of the stakeholder agencies. The specific recommended tasks associated with three different update cycles can be found in the SDP Maintenance Document.

5. SUMMARY

The implementation of ITS practices and systems is becoming increasingly more prevalent as space for road construction becomes limited, funding continues to decrease, and technology offers efficient, cost effective solutions. It is recommended that ITS planning become truly integrated into traditional planning practices in an effort to plan and implement projects that will most effectively meet future transportation needs and solve approaching challenges. The FAMPO Region ITS Strategic Deployment Plan Update seeks to do this by recommending a proposed integration process that identifies the most efficient planning cycle for future SDP updates. This process will best align with the key practices affecting funding and policy decisions that will allow opportunities for ITS projects to be efficiently considered and implemented. Finally, it is expected that adoption of this integration approach by FAMPO and NCDOT will establish a firm methodological basis to demonstrate adherence to the transportation federal rule 23 CFR 450.

Intelligent Transportation System Strategic Deployment Plan Update

FINAL

ITS System Replacement Report:

*A Systematic Approach for Scheduling Replacements for ITS
Devices and Systems*

Prepared for:

Triangle ITS Communications Partners



Prepared by:



Kimley-Horn
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In Association with:



ConSysTec



March 2010

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1. INTRODUCTION

The last phase of a typical systems engineering process is system retirement and replacement. This often-overlooked phase is particularly important for intelligent transportation systems (ITS) because of the use of technologies with definite lifecycles and the rapidly changing pace of technology.

The purpose of this report is to provide guidance in developing a replacement plan for a system and guidance in making the decision to continue, upgrade, replace, or retire a system or sub-system. This report will also present information on the expected useful life of various ITS components.

2. TYPICAL LIFECYCLES

In a perfect world, ITS deployments would be installed and would perform their desired functions endlessly with proper maintenance. However, that is rarely the case and often the replacement is not dictated simply by device malfunction. ITS components may require replacement for a number of planned or unplanned reasons including:

- The user need originally met by the system is no longer active.
- The system's operations and maintenance costs are no longer cost effective.
- The underlying technology is obsolete or is no longer supported by the manufacturer.
- The system is not compatible with newer hardware.

The other cause for replacement is device malfunction as the device reaches the end of its useful life due to simple wear and tear. This occurs no matter how well the component is maintained. **Table 1** presents some typical useful life guidelines for ITS components.

Table 1. Typical Useful Life for ITS Components

ITS Components	Example	Typical Useful Life
Roadside devices	DMS	10-15 years
	Non-Intrusive Detection (RADAR)	8-10 years
	CCTV	10-15 years
In-road devices	Inductive loops	5-10 years
In-vehicle devices	CCTV, AVL, AVA, APC	7-10 years
Hardwire communications	Fiber optic cable	20-30 years
Communication electronics	Transceivers, modems, radios, antennas	10-15 years
Traffic signal electronics	Controller	10-15 years
Computer equipment (central)	Workstations, servers	5-8 years
Computer equipment (field)	Notebook computers	5-8 years
Software (with regular vendor updates and maintenance)	Signal system, CCTV system, real-time AVL central software	10-12 years

The end of the useful life for most roadside devices, in-road devices, and communication equipment most likely will be signaled by a major malfunction and/or a repair cost that is a substantial percentage of the cost that would be incurred to replace the unit. Fiber optic cable has shown to have a very long useful life and could last longer than the anticipated 20 years. Computer equipment tends to experience



a shorter useful life, usually due to the obsolescence of the operating system that was originally installed and the rapidly growing computer memory and storage needs that new software applications tend to require. Upgrading the operating system could extend the useful life, but in most cases the performance of the hardware is not adequate to meet the increased demands of the upgraded operating system. Additionally, software can become obsolete as vendors drop support for the original version and begin marketing significantly upgraded or next generation versions.

Lifecycles for transit-related systems are unique to a particular agency, but some general approaches are present when looking at transit agencies across the country. Most transit authorities implement more straight forward operations systems (such as scheduling software) and continue using it for a number of years, investing in maintenance agreements and scheduled upgrades. This approach is most commonly due to the fact that these systems are tied inexorably to the authorities' business practices. Only when fundamental changes occur to the way the authority operates do these systems require significant change.

In-vehicle equipment (such as automated voice annunciation systems (AVA), automated passenger counters (APC), and closed circuit television (CCTV) cameras, etc.) typically is installed as new busses enter the fleet and thus the component's life-cycle is tied to the bus itself. Unless the equipment fails beyond repair, the individual in-vehicle components typically are not replaced on a regular schedule. Additionally, if the central software used to analyze and process information from the vehicles changes, the in-vehicle devices can remain the same with similar benefit to the agency. More often than not, the technology behind these in-vehicle devices is very mature and robust. As a result, upgrades and replacements typically are addressed during fleet changes. As a new bus enters the fleet, upgrades and replacements for the technology will be installed on the new vehicle.

More advanced operation systems (such as automatic vehicle locations systems (AVL) with arrival prediction) typically rely on real-time data communications and multiple independent systems on the vehicle. Most of these systems are replaced in five to seven-year cycles with some lasting as long as 10 years. Most vendors of AVL systems offer service agreements with a variety of options in terms of technical support and software upgrades. Many transit authorities find the investment in these services worthwhile when factoring in the many costs for having the system go down for any extended period of time.

3. REPLACEMENT APPROACH

Developing an approach for the replacement of ITS components needs to be considered during the early steps of the systems engineering process with input from stakeholders. Typically, the initial replacement plan is developed as part of the Concept of Operations during the early phases of the systems engineering process. In terms of traceability, the replacement plan is validated during the operations and maintenance phase of the process. It is during those phases of the process that the decision of when to activate the replacement plan is constantly evaluated.

3.1 Replacement Plan

The replacement plan for a region for ITS components should be specific and tailored to the actual system in use. The replacement plan may change over time as maintenance skills and costs change, and as the regional goals and stakeholders evolve. Based on the continually changing environment of ITS, this report will not present a comprehensive replacement plan for all possible ITS components anticipated. Instead, this report will present guidelines and considerations for stakeholders to reference while developing a replacement plan during the systems engineering process. This report also will prescribe how to reassess the plan over time.

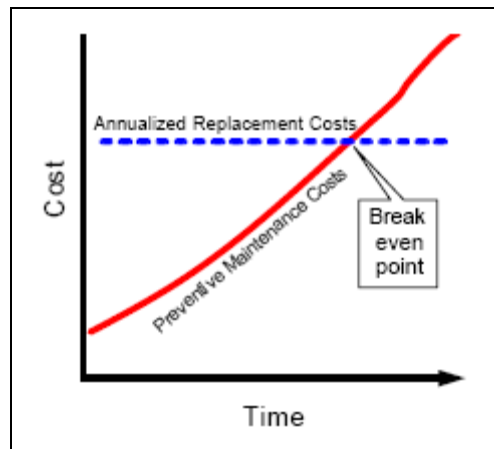


Overall, the replacement plan should be an integral part of the Concept of Operations. At a minimum, the replacement plan should have the following characteristics:

- Include all relevant stakeholders from the Concept of Operations, as well as stakeholder responsibilities for operations and maintenance of the system.
- Estimation of the expected date of replacement.
- Estimation of the expected annual costs for operations and maintenance.
- Determination of the criticality of the system (e.g., Does the system have to be fully operational during any maintenance or replacement activities?).
- For mission-critical systems, develop a plan addressing minimal downtime for an interim solution or a plan to guide the migration or switch-over to the new system.
- Identification of possible next-generation technologies that eventually could replace the proposed system.
- Identification of training and staff changes associated with system replacement.

3.2 Replacement Decision

In theory, the decision on when to invoke the replacement plan for an ITS component should be simple and straightforward based on costs. The theory is that preventative maintenance has a point of diminishing returns. This point is reached when the cost of replacement (annualized over the expected life) is equal to the maintenance cost. Past this point, there is no financial incentive to continue operating the system. **Figure 1** presents a generalized view of this scenario.



Source: *Guidelines for Transportation Management Systems Maintenance Concept and Plans*

Figure 1. Generalized View of Replacement Break-Even Point

Accurately determining or predicting this break-even point requires significant and accurate data. An agency that can provide this information most likely uses a computerized maintenance management system (CMMS). The CMMS would have to track in great detail and accuracy a



device's construction cost, replacement cost, salvage value, actual maintenance costs and hours, and expected useful life.

Most agencies do not use a sophisticated CMMS so it is difficult to know when that exact break-even point is reached and nearly impossible to predict that point in the future. In these cases, it is helpful to refer to the systems engineering process for guidance on when the decision to replace an ITS component is beneficial.

- Does the existing system still meet user needs?
- Are the actual annual operations and maintenance costs exceeding the budget?
- Would the new system have a greater benefit-cost ratio than the existing system?
- Will the existing system have a greater replacement cost in the future?
- Has this analysis considered the benefit to all stakeholders?

Overall, the systems engineering process guides owners to answer the question, "Would a new system work better and cost less to maintain?" If the answer to that question is yes, invoking the replacement plan for the component should be considered.



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Intelligent Transportation System Strategic Deployment Plan Update

FINAL SDP Maintenance Plan

Prepared for:
Triangle ITS Communications Partners

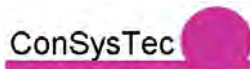


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1. INTRODUCTION

The purpose of this report is to document the recommended maintenance procedures for the Strategic Deployment Plan (SDP). The document provides a brief overview of the approach and specific checklists for the overall SDP as well as each task. The checklists, which can be found in the **Appendices**, include step-by-step guidance along with timelines required for each item and the cumulative checklist.

There is guidance for maintaining the overall SDP and several of the individual tasks associated with the development. The maintenance plan is presented for three levels of updates: administrative, interim, and full. The administrative update is intended for annual revisions to certain components of the plan where projects have progressed and documentation should be updated. The interim update is designed for a steering committee evaluation and update to certain portions of the plan. Lastly, the full update outlines the complete stakeholder involved process of revising the SDP from the vision through to a new set of prioritized projects. **Table 1** presents an overview of the included checklists and the frequency at which each should occur. If the task includes a checklist for a particular update, the **Appendix** page associated with each task is shown in the table. If no update is required, the cell will be empty.

Table 1. Summary of Update Levels and Frequency

<i>Task</i>	<i>Administrative Update</i>	<i>Interim Update</i>	<i>Full Update</i>
Complete SDP	A1	B1	C1
Best Practices			C2
Vision, Goals, and Objectives		B2	C3
Gap Assessment		B3	C4
Regional ITS Architecture	A2	B4	C5
Cost Estimate	A3	B5	C6
Maintenance Plan*			*
Integration with Planning*			*
Project Evaluation and Prioritization	A4	B6	C7
Frequency	Annually	Every 4 Years	Every 8 Years

**These tasks have specific guidelines that drive their maintenance and do not have a specific checklist.*

Unlike the majority of tasks, maintenance for Best Practices, the Maintenance Plan, and Integration with Planning are not driven by frequency. Outside of the full update associated with the SDP every eight years, a revision for each of these tasks is driven by a specific occurrence. Maintenance associated with Best Practices is outlined as an ongoing task for the steering committee and stakeholders with a new Best Practices Report being developed via a checklist process during each full update. Recommendations such as attendance at conferences, professional meetings, webinars, and other training opportunities are important to stay current with changing technologies and the benefits associated with the identified best practices. Maintenance of the Maintenance Plan itself is driven by significant changes in the other tasks. This maintenance document should provide a comprehensive reference and step-by-step guidance for the components of the SDP and revisions should only be warranted as the individual components change. Lastly, Integration with Planning should only require revisions or modifications as local, state, and federal requirements are modified or established.

2. ADMINISTRATIVE UPDATE

An “administrative update” is defined as addressing changes and modifications to the SDP that have been identified since the previous update. The revisions should be made within each related component and communicated to the stakeholders for acceptance.

Administrative updates are recommended for project-specific tasks such as the regional architecture, cost estimate data, and project evaluation and prioritization. The regional architecture maintenance plan includes a project architecture conformance form to be submitted with each project. These forms should be collected throughout the year and one task can be performed to make necessary modifications within the regional and project architectures. Bid sheets from each year should also be assembled and reviewed annually for their potential impact on the specific cost estimates for each deployment type. This is not intended to be an exhaustive, in-depth cost comparison, but a quick comparison of unit costs with component estimates. Lastly, it is recommended that the project list included within the deployment plan receive an annual update. This administrative update is to update projects that become funded, move into construction, or are completed. The approximate timeline for an administrative update is one month, as shown in **Figure 1**. The administrative update checklists are in **Appendix A**.

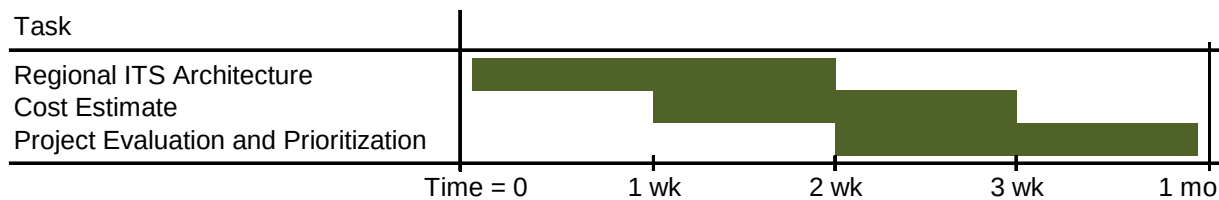


Figure 1. Timeline for Administrative Update

3. INTERIM UPDATE

An “interim update” is defined by providing a review and revision of specific components of the SDP based on their alignment with other planning elements outlined in the integration document. It is not intended to develop the SDP from scratch, but to identify progress in deployment since the previous revision and determine possible discrepancies and misalignments that may need revision.

The maintenance schedule includes alternating interim and full updates for the SDP. Based on the proposed process for integrating ITS projects into the Metropolitan Planning Organization (MPO) and transit planning processes, interim updates should occur four years after each full update. To align with the planning cycle and ensure consistency between the SDP and the North Carolina Transportation Plan, the first full update should occur in two years. As such, the first interim update should occur in six years. The interim update includes participation from the stakeholders and begins with an assessment of the current objectives. Next, the gap assessment, ITS regional architecture, and regional costs are revised. Finally, a new list of prioritized projects is created based on the updated data. The approximate timeline for an interim update is 10 months, as shown in **Figure 2**. The interim update checklists are in **Appendix B**.

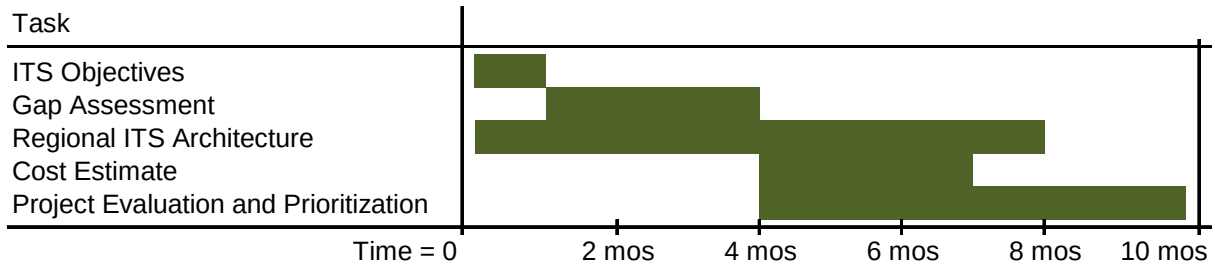


Figure 2. Timeline for Interim Update

4. FULL UPDATE

A “full update” is defined by revisiting and assessing the existing SDP from the Vision, Goals, and Objectives all the way through to the Cost/Benefit document that prioritizes projects for the region. Each component of the SDP may require varying levels of intensity and focus, but the intent is to revisit each component and confirm that the comprehensive SDP aligns with stakeholders’ vision and goals, and that the plan will guide the region to deploy technologies that successfully improve the identified objectives.

It is anticipated that the administrative and interim updates will provide an opportunity to verify that the region is maintaining alignment with the established vision. However, significant changes within the region, such as new technology developments or variations in the regional growth, can warrant a full update that reviews the vision, goals, and objectives. Following the integration schedule, the first full update shown is out of the recommended cycle; therefore, another full update is shown in two years to revisit the vision, goals, and objectives to ensure consistency with the North Carolina Transportation Plan update. The upcoming full update will only be necessary if there are extreme changes in the vision or direction of one of the stakeholder agencies. From that point forward, full updates should occur every eight years. The SDP full update process includes the creation of a new regional vision, goals, and objectives, as well as a gap assessment, cost analysis, and other steps that feed into project development and prioritization. The full update completely rewrites the SDP and requires a 12 month investment from the stakeholders, as shown in **Figure 3**. Checklists associated with a full SDP update are in **Appendix C**.

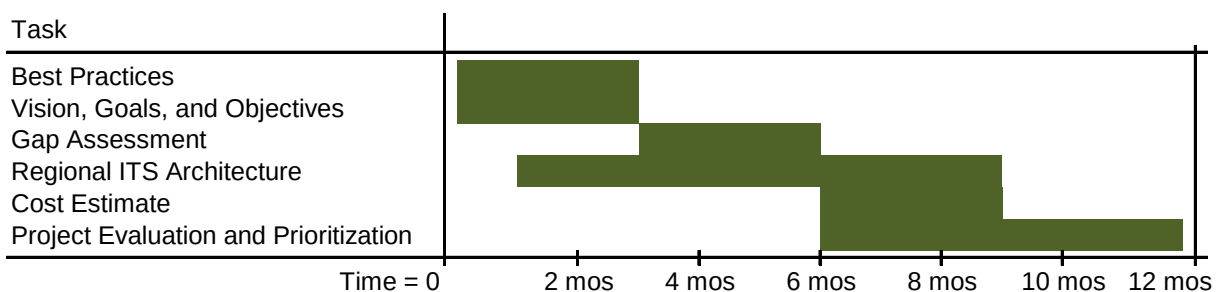


Figure 3. Timeline for Full Update



5. MAINTENANCE PROCESSES FOR INDIVIDUAL TASKS

In addition to the checklists provided in the Appendix, this section provides more detailed guidance for several of the SDP components. These procedures are provided for the Gap Assessment, Regional Architecture Maintenance, Cost Database Maintenance, an overview of integrating IDAS analysis, and maintain the project evaluation matrix and project prioritizing.

5.1 Gap Assessment

As part of a full update, stakeholders will need to perform a full gap assessment of the regional progress related to the established goals and objectives. It is important to obtain the most current version of the region's Vision, Goals, and Objectives and confirm the most recently outlined objectives in the SDP. Each objective should be reviewed individually to identify the associated market packages from the National ITS Architecture. Market packages are individual components of the architecture that address specific services such as surface street control, network surveillance, or automatic passenger counters for transit vehicles. The most current National Architecture along with definitions for all of the available market packages can be accessed at <http://www.iteris.com/itsarch/>.

Stakeholders should then perform a qualitative analysis of the region's current inventory relative to each market package. For example, with respect to surface street control, the region's technological and geographic coverage should be assessed. Each market package should receive a rank based on the established five-point descriptor scale (no deployment, minimal deployment, moderate deployment, significant deployment, or full deployment).

The establishment of regional targets relative to each market package is the next step in the gap assessment. The target should be a consensus agreement by the stakeholders as it will identify where the stakeholders wish to focus future initiatives and deployments. Each market package should be ranked using the same five-point descriptor scale applied to the inventory assessment.

Using the established inventory and regional target, the gap for each market package can now be defined based on the variance between the existing deployment or inventory and the regional target. Both technologic gaps and geographic gaps should be determined for each market package. Technological gaps exist when the infrastructure base is lacking or the corresponding technology is currently limited or not in use in the region. Geographic gaps exist when ITS equipment covers less physical area than is desirable and can be addressed through extensions of existing deployments.

5.2 Regional ITS Architecture

The ITS Architecture developed for the Triangle Region addresses the Region's vision for ITS implementation at the time the plan was developed. As the Region grows, needs will change, and, as technology progresses, new ITS opportunities will arise. Shifts in regional needs and focus as well as changes in the National ITS Architecture will necessitate that the Triangle Regional ITS Architecture be updated to remain a useful resource for the Region.

5.2.1 *Procedure for Submitting ITS Architecture Changes Between Scheduled Updates*

Documentation for needed updates of the Regional ITS Architecture will need to be submitted to the maintainer of the regional ITS architectures, which is the NCDOT ITS Project Development Group. Between interim and full plan updates, administrative updates



will be required to accommodate ITS projects deployed in the Region. For situations where a change to the Regional ITS Architecture is required, an ITS Architecture Maintenance Documentation Form has been developed and is included in **Appendix D**. This form should be completed and submitted to NCDOT whenever a change is proposed.

The Maintenance Change Request Form identifies three levels of modifications. They include:

- Level 1 – Basic changes that do not affect the structure of the architecture
Examples include: Changes to stakeholder or element name, element status, or data flow status.
- Level 2 – Structural changes that impact only one agency
Examples include: Addition of a new market package or modifications to an existing market package that affects only one agency.
- Level 3 – Structural changes that have the potential to impact multiple agencies
Examples include: Addition of a new market package or modifications to an existing market package that involves multiple agencies or incorporation of a new stakeholder into the architecture.

In the process of documenting the change, the stakeholder proposing the change and the appropriate local MPO should contact all agencies that will be impacted to obtain feedback. The defined architecture review committee will review and accept the proposed changes when they are submitted and incorporate the changes into the market package diagrams and Turbo Architecture database. Most interim changes will not impact the Regional ITS Architecture document. If an interim change does impact the document, the committee will decide whether or not the change is significant enough to require an immediate update, or if the change can simply be documented for incorporation during the next complete update.

5.2.2 Maintenance of Baseline Documents

The NCDOT will be responsible for maintaining the official baseline documents for the regional ITS architecture. The following items are the components of the architecture baseline.

- Regional ITS Architecture Document
- Set of Customized Market Packages
- Turbo Architecture Database

The official Regional ITS Architecture document, in Microsoft Word format, will be held by the NCDOT and a PDF version of the document will be available for general distribution. A version number and date will be included on the cover page.

The customized market packages, Turbo Architecture database and other baseline components also will be held and maintained by the NCDOT. Each document will use a versioning scheme that identifies the baseline and revision number. For example, since this architecture is an update of the initial release of the Triangle Regional ITS Architecture, the documents at the conclusion of this effort will be version 2.00. Minor revisions will be 2.01, 2.02, etc. The next full update to the document will be version 3.00.



Table 2 summarizes the components of the Regional ITS Architecture and identifies the current version at the completion and release of this document. This table should be updated any time an interim update to the architecture document is performed.

Table 2. Summary of Baseline Architecture Components

Architecture Component	Format	Version at Completion of Update
Architecture Document	Microsoft Word (.doc)	2.0
Customized Market Package Diagrams	Microsoft Visio (.vsd)	2.0
Turbo Architecture Database	Turbo Database (.tbo)	2.0

When completing the change form, the requesting agency should identify the baseline document versions that they are intending to modify to reduce the potential for confusion.

5.3 Cost Estimate Database

To update the cost information developed for this project, stakeholders should consult the Cost Estimate Spreadsheet (“spreadsheet”) and the Cost Estimate Report (“report”) in concert. The report will provide an explanation of terms used in the spreadsheet and reference sources for costs. The following sources also may be consulted for additional data and guidance.

Archive of NCDOT Bidtabs: <http://www.ncdot.org/doh/preconstruct/ps/contracts/letting.html>

USDOT ITS Cost Database: <http://www.itscosts.its.dot.gov/>

Inflation Calculator: <http://www.dollartimes.com/calculators/inflation.htm>

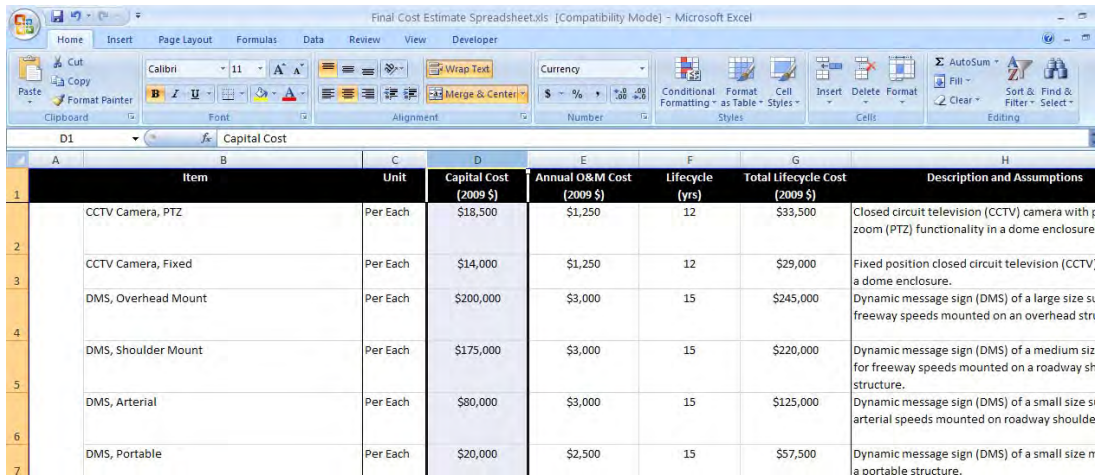
It should be noted that all local costs within the spreadsheet were prepared with costs in 2009 dollars. For costs in future years, the inflation calculator shown above should be used to generate equivalent 2009 dollars.

5.3.1 Updating Capital Costs

The capital costs in the spreadsheet were prepared using actual costs from current local North Carolina project data, or from non-local and more generalized sources (underlined in the spreadsheet).

The reviewer should consult the NCDOT bidtabs to determine if the local capital costs in the spreadsheet are in line with costs from recent North Carolina projects. If not, the values in column D of the spreadsheet should be revised to reflect more appropriate device costs. The reviewer also should determine if any non-local capital costs can now be revised and aligned with costs from recent North Carolina projects. It is preferred that local data is used when available to provide more appropriate cost estimates and IDAS analysis.

Stakeholders should consult the USDOT ITS Cost Database to determine if any updated capital costs from that database are relevant to the spreadsheet line items. It is important that the stakeholders reference and revise the description and assumptions for each item to ensure a fair comparison between the USDOT ITS Cost Database and the spreadsheet. Any identified cost updates should be made directly in column D of the spreadsheet as highlighted in **Figure 4**.



	A	B	C	D	E	F	G	H
		Item	Unit	Capital Cost (2009 \$)	Annual O&M Cost (2009 \$)	Lifecycle (yrs)	Total Lifecycle Cost (2009 \$)	Description and Assumptions
1		CCTV Camera, PTZ	Per Each	\$18,500	\$1,250	12	\$33,500	Closed circuit television (CCTV) camera with zoom (PTZ) functionality in a dome enclosure
2		CCTV Camera, Fixed	Per Each	\$14,000	\$1,250	12	\$29,000	Fixed position closed circuit television (CCTV) in a dome enclosure.
3		DMS, Overhead Mount	Per Each	\$200,000	\$3,000	15	\$245,000	Dynamic message sign (DMS) of a large size for freeway speeds mounted on an overhead structure.
4		DMS, Shoulder Mount	Per Each	\$175,000	\$3,000	15	\$220,000	Dynamic message sign (DMS) of a medium size for freeway speeds mounted on a roadway shoulder structure.
5		DMS, Arterial	Per Each	\$80,000	\$3,000	15	\$125,000	Dynamic message sign (DMS) of a small size for arterial speeds mounted on roadway shoulder structure.
6		DMS, Portable	Per Each	\$20,000	\$2,500	15	\$57,500	Dynamic message sign (DMS) of a small size in a portable structure.

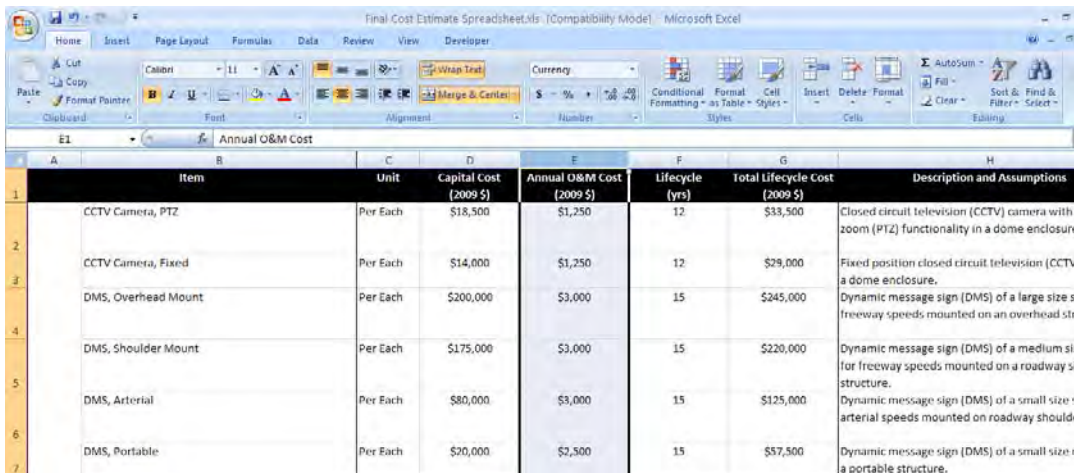
Figure 4. Capital Costs

5.3.2 Updating Annual Operations and Maintenance Costs

The annual operations and maintenance (O&M) costs in the spreadsheet were prepared using actual costs from local North Carolina agencies, or from non-local and more generalized sources (underlined in the spreadsheet). Note that these costs are assumed to be the total lifetime O&M costs averaged over the expected number of years.

The reviewer should consult the budgets and expenditures of NCDOT Divisions and other agencies to determine if the local annual O&M costs in the spreadsheet are in line with costs from North Carolina deployments. If not, the values in column E of the spreadsheet may be revised. The stakeholders also should determine if any non-local annual O&M costs can now be revised based on costs from North Carolina deployments. Similar to the capital costs, using local data to support O&M costs is preferred.

Stakeholders should consult the USDOT ITS Cost Database to determine if any updated annual O&M costs from that database are relevant to the spreadsheet. It is important that the stakeholders reference and revise the description and assumptions for each item to ensure a fair comparison between the USDOT ITS Cost Database and the spreadsheet. Any identified O&M updates should be made directly in column E of the spreadsheet as highlighted in **Figure 5**.



	A	B	C	D	E	F	G	H
		Item	Unit	Capital Cost (2009 \$)	Annual O&M Cost (2009 \$)	Lifecycle (yrs)	Total Lifecycle Cost (2009 \$)	Description and Assumptions
1		CCTV Camera, PTZ	Per Each	\$18,500	\$1,250	12	\$33,500	Closed circuit television (CCTV) camera with zoom (PTZ) functionality in a dome enclosure
2		CCTV Camera, Fixed	Per Each	\$14,000	\$1,250	12	\$29,000	Fixed position closed circuit television (CCTV) in a dome enclosure.
3		DMS, Overhead Mount	Per Each	\$200,000	\$3,000	15	\$245,000	Dynamic message sign (DMS) of a large size for freeway speeds mounted on an overhead structure.
4		DMS, Shoulder Mount	Per Each	\$175,000	\$3,000	15	\$220,000	Dynamic message sign (DMS) of a medium size for freeway speeds mounted on a roadway shoulder structure.
5		DMS, Arterial	Per Each	\$80,000	\$3,000	15	\$125,000	Dynamic message sign (DMS) of a small size for arterial speeds mounted on roadway shoulder structure.
6		DMS, Portable	Per Each	\$20,000	\$2,500	15	\$57,500	Dynamic message sign (DMS) of a small size in a portable structure.

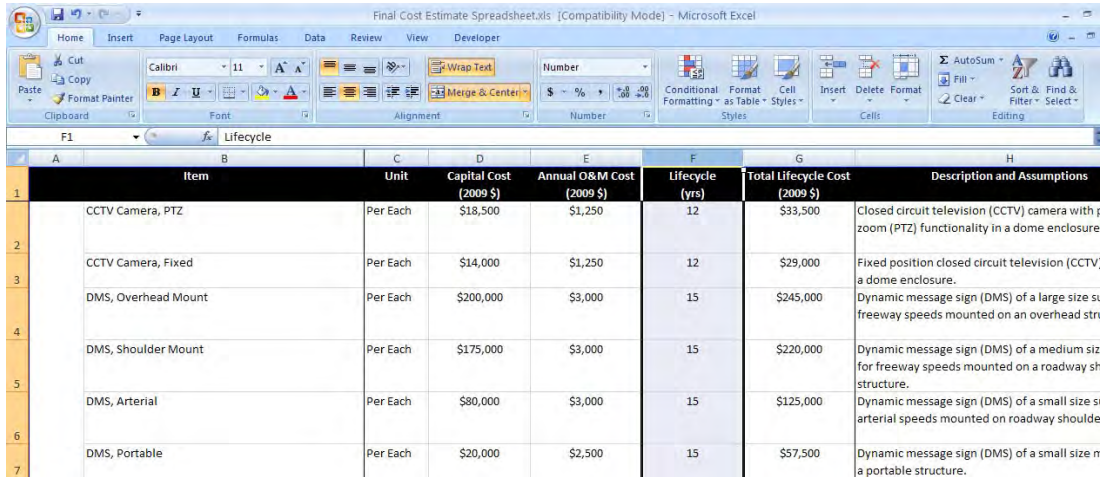
Figure 5. O&M Costs

5.3.3 Updating Lifecycles

The expected lifecycles in the spreadsheet were prepared using recommendations from local North Carolina agencies, or from non-local and more generalized sources (underlined in the spreadsheet).

Stakeholders should consult the engineers of NCDOT Divisions and other agencies to determine if the local expected lifecycles in the spreadsheet are in line with those from North Carolina deployments. If not, the values in column F of the spreadsheet should be revised. Stakeholders also should determine if any non-local expected lifecycles can now be revised based on North Carolina deployments. Using local data to support the spreadsheet is preferred over non-local data.

Stakeholders should consult the USDOT ITS Cost Database to determine if any updated expected lifecycles are relevant to the spreadsheet. It is important that the stakeholders reference and revise the description and assumptions for each item to ensure a fair comparison between the USDOT ITS Cost Database and the spreadsheet. Any updates should be made directly in column F of the spreadsheet as highlighted in **Figure 6**.



	A	B	C	D	E	F	G	H
		Item	Unit	Capital Cost (2009 \$)	Annual O&M Cost (2009 \$)	Lifecycle (yrs)	Total Lifecycle Cost (2009 \$)	Description and Assumptions
1		CCTV Camera, PTZ	Per Each	\$18,500	\$1,250	12	\$33,500	Closed circuit television (CCTV) camera with zoom (PTZ) functionality in a dome enclosure
2		CCTV Camera, Fixed	Per Each	\$14,000	\$1,250	12	\$29,000	Fixed position closed circuit television (CCTV) in a dome enclosure.
3		DMS, Overhead Mount	Per Each	\$200,000	\$3,000	15	\$245,000	Dynamic message sign (DMS) of a large size for freeway speeds mounted on an overhead structure.
4		DMS, Shoulder Mount	Per Each	\$175,000	\$3,000	15	\$220,000	Dynamic message sign (DMS) of a medium size for freeway speeds mounted on a roadway shoulder structure.
5		DMS, Arterial	Per Each	\$80,000	\$3,000	15	\$125,000	Dynamic message sign (DMS) of a small size for arterial speeds mounted on roadway shoulder structure.
6		DMS, Portable	Per Each	\$20,000	\$2,500	15	\$57,500	Dynamic message sign (DMS) of a small size in a portable structure.
7								

Figure 6. Lifecycles

5.3.4 Updating Lifecycle Costs

The total lifecycle cost in column G of the spreadsheet, highlighted in **Figure 7**, is automatically calculated from values in columns D, E, and F. Revisions to this column are not required as they are revised based on modifications in other columns.



	A	B	C	D	E	F	G	H
		Item	Unit	Capital Cost (2009 \$)	Annual O&M Cost (2009 \$)	Lifecycle (yrs)	Total Lifecycle Cost (2009 \$)	Description and Assumptions
1		CCTV Camera, PTZ	Per Each	\$18,500	\$1,250	12	\$33,500	Closed circuit television (CCTV) camera with zoom (PTZ) functionality in a dome enclosure
2		CCTV Camera, Fixed	Per Each	\$14,000	\$1,250	12	\$29,000	Fixed position closed circuit television (CCTV) in a dome enclosure.
3		DMS, Overhead Mount	Per Each	\$200,000	\$3,000	15	\$245,000	Dynamic message sign (DMS) of a large size for freeway speeds mounted on an overhead structure.
4		DMS, Shoulder Mount	Per Each	\$175,000	\$3,000	15	\$220,000	Dynamic message sign (DMS) of a medium size for freeway speeds mounted on a roadway structure.
5		DMS, Arterial	Per Each	\$80,000	\$3,000	15	\$125,000	Dynamic message sign (DMS) of a small size for arterial speeds mounted on roadway structure.
6		DMS, Portable	Per Each	\$20,000	\$2,500	15	\$57,500	Dynamic message sign (DMS) of a small size for a portable structure.
7		Variable Retention Lane	Per Each	\$8,000	\$500	10	\$13,000	Inductive loop installed in the pavement.

Figure 7. Lifecycle Costs

5.3.5 Adding New ITS Items

It is expected that, over time, additional ITS items will be identified as potential deployments for the region and should be added to the spreadsheet. This is accomplished by inserting a new row in the appropriate section of the spreadsheet. Stakeholders then should make sure that all text and cost fields are appropriately completed.

5.4 IDAS Modeling

There is not a continuous maintenance associated with the IDAS software. Instead, when new projects are identified, revised costs are established, or project details are modified, it may be necessary to perform an analysis on the new or revised project(s). More detailed guidance related to use and application of the IDAS software is provided in the IDAS Manual.

The first step is to confirm the most current adopted regional travel demand model (TDM). Next, the proposed projects that require analysis should be identified and the details confirmed. The required details include the location, proposed ITS components, and estimated costs. Additionally, the benefits database and potential local benefits data need to be referenced to confirm the anticipated benefits of the deployment. For project analysis, reference Section 4 of the IDAS Manual.

If the project analysis is being performed separately from the overall project evaluation and prioritization, the calculated benefits can be extracted and used as needed within the project programming process. If the analysis is part of an update to the overall SDP, then stakeholders should reference Section 5.5 of this document for details pertaining to the project evaluation approach.

5.5 Project Evaluation and Prioritization

As the region progresses and continues to deploy and implement ITS projects, it is important for the stakeholders to maintain the project evaluation and prioritization documentation. Each year, projects that are funded should be updated and newly identified projects should be captured. In order to confirm that projects are compared on the same level, stakeholders should confirm the most currently adopted regional TDM. If it has not been updated, then newly identified projects can be compared directly with projects currently in the matrix. If a new TDM has been adopted,



then all projects will need to be analyzed with IDAS following the guidance provided in Section 5.4 of this document.

5.5.1 Funded Projects

The system preservation tab is the first category within the matrix and is intended to capture the inventory of current deployments. Once funding for a project has been identified, that project should be extracted from its current tab (or category) and moved to the system preservation tab. The life expectancy for ITS components can vary between device types. In order to help the stakeholders plan for future replacements, projects containing device types with varying anticipated life expectancies must be segmented. Each preservation project created should include components that have the same life expectancy. For example, CCTV cameras and detection both have a 10 year life expectancy and can be packaged into a field device project, but DMS and fiber optic communications require individual projects for each since their life expectancy is 15 and 20 years, respectively.

Once the projects are established, they should be entered into the project preservation tab with the anticipated year of implementation and the expected life expectancy completed. The life expectancy can be extracted from the cost spreadsheet discussed in Section 5.3. Next, the capital costs for the project should be confirmed and revised if needed and entered. Lastly, the system preservation tab and the original tab that contained the project both should be resorted to integrate potential changes in ranks.

5.5.2 Newly Identified Projects

During the interim and full updates of the SDP, the Gap Assessment should be reviewed to determine potential focus areas that may require new projects. The stakeholders should obtain the latest version of the cost spreadsheet to derive unit costs for the project components and derive the overall capital costs for each new project. The O&M costs also should be confirmed against the most recent cost spreadsheet.

Within the evaluation matrix, the correct tab or category should be selected and a row inserted for each project. It is important that the stakeholders identify all of the project related data and complete those columns within the matrix.

The values for Benefit / Cost, Travel Time Reliability, and Emission Reduction are provided from the IDAS results and obtaining these values is presented in Section 5.4. The volume/capacity (V/C) ratio is captured from the TDM by weighting the V/C for all of the links touched by the proposed project. The System Preservation score is calculated from the anticipated year of implementation and life expectancy of the project. It is important that the “year” listed in the raw data column be updated to the current year. This value also is referenced to score each of the projects.

5.5.3 Results

Once the project lists have been updated within each tab, the projects should be sorted by Rank. Once sorted, the stakeholders should assess the timeframe column and determine if any of them should be revised based on the new ranking. If so, the corresponding short, medium, and long term timeframe should be revised in the timeframe column.

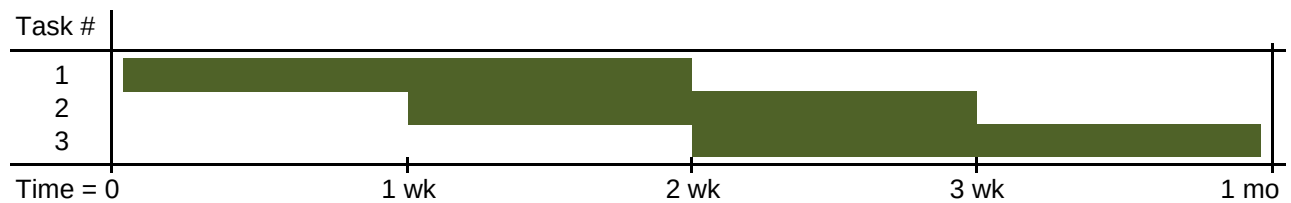
A1 - SDP - Administrative Update Checklist

The SDP Administrative Update is performed annually and focuses on updates related to changes in projects.

Task

- ☐ 1 Update the Regional ITS Architecture (see A2).
- ☐ 2 Revise Cost Estimate data as warranted by recently constructed projects (see A3).
- ☐ 3 Update Project Evaluation and Prioritization (see A4).

A1 Timeline



A2 - Regional ITS Architecture - Admin Update Checklist

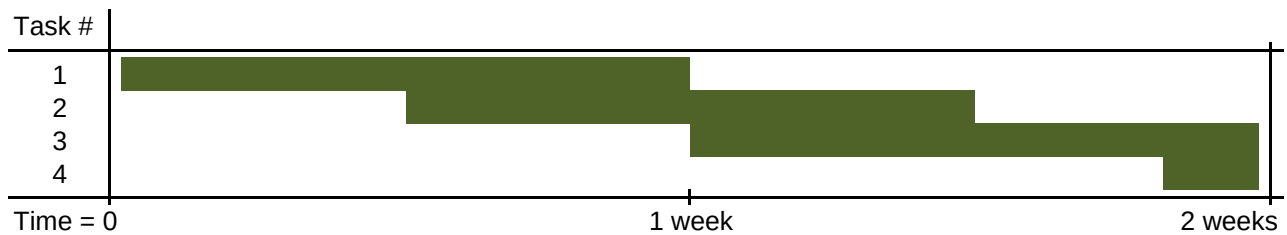
Section 5.2 of the SDP Maintenance Plan contains detailed information on the Maintenance Process and associated review structure. As Change Request Forms are submitted, they should be reviewed and addressed using the process identified in Section 5.2 of the SDP Maintenance Plan.

This checklist addresses the process for periodic maintenance of the Regional ITS Architecture.

Task

- ☐ 1 Solicit Regional ITS Architecture Change Request Forms (this is the responsibility of the Maintenance Manager and should be performed annually prior to the beginning of the SDP update process with the forms being collected during the first week of the update).
- ☐ 2 Utilize the Maintenance Process (Section 5.2 of the SDP Maintenance Plan) to evaluate and address any requested changes.
- ☐ 3 Update the appropriate baseline document(s) to address changes approved as part of Task 2. These may include: Architecture document, Visio Customized Market Packages, and/or Turbo Architecture database.
- ☐ 4 Distribute the updated baseline documents to stakeholders.

A2 Timeline

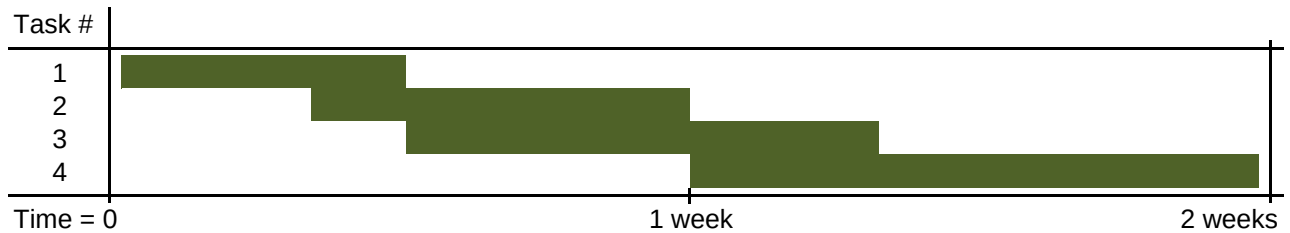


A3 - Project Costs Estimates Database - Admin Update Checklist

Task

- ☐ 1 Review the Cost Estimate Report and Cost Estimate Spreadsheet.
- ☐ 2 Identify any ITS elements that previously used national cost information for which local cost data is now available. In the Cost Estimate Spreadsheet, national cost data is underlined for designation.
- ☐ 3 For all ITS elements identified in previous step, using actual project bid tabs for NCDOT construction projects since the last update or other local data, update the capital costs in the cost spreadsheet.
- ☐ 4 Revise Cost Estimate Report and Spreadsheet, if warranted.

A3 Timeline



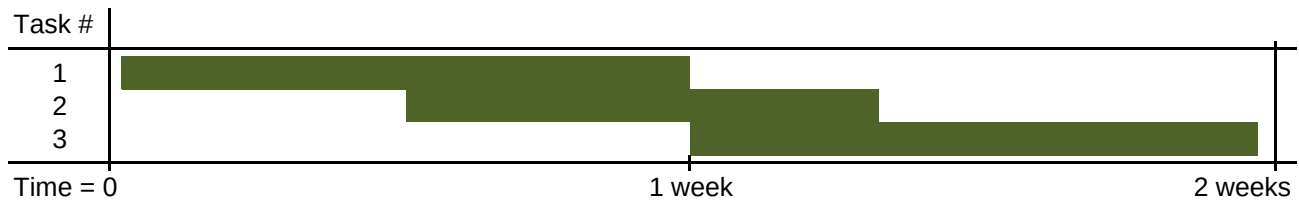
A4 - Project Evaluation and Prioritization - Admin Update Checklist

The Project Evaluation Matrix is a transparent, quantifiable method of ranking proposed projects based on IDAS, regional travel demand model, and system preservation data. The Evaluation Matrix considers five categories of information quantified into points for ranking. These categories include: benefit/cost, travel time reliability, on or adjacent to high V/C facility, system preservation, and emissions reduction. For the administrative update, no change is made to the prioritization, the lists and associated project maps are simply updated to reflect the projects that have been constructed.

Task

- ☐ 1 Review current project lists. Move constructed projects to preservation tab in the evaluation matrix.
- ☐ 2 Revise GIS mapping of projects.
- ☐ 3 Replace the project maps (Appendix A) and the Evaluation Matrix (Appendix C) in the Project Evaluation and Prioritization Report.

A4 Timeline



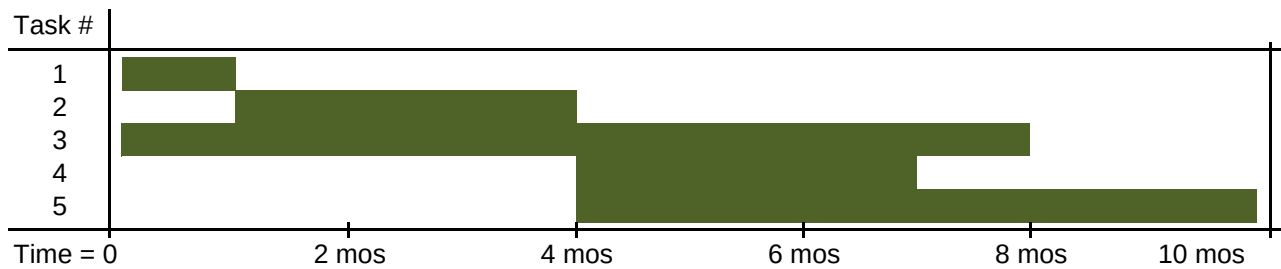
B1 - SDP - Interim Update Checklist

The Strategic Deployment Plan is a compilation of six individual tasks. The interim update for the Strategic Deployment Plan revises these components based on the existing vision and goals. The objectives are revisited to ensure they align the stakeholders abilities to meet the goals.

Task

- ☐ 1 Review and Revise ITS Objectives (see B2).
- ☐ 2 Review and Revise the Gap Assessment (see B3).
- ☐ 3 Review and Revise Regional ITS Architecture (see B4).
- ☐ 4 Review and Revise Cost Estimate Data (see B5).
- ☐ 5 Revise Project Evaluation and Prioritization (see B6).

B1 Timeline



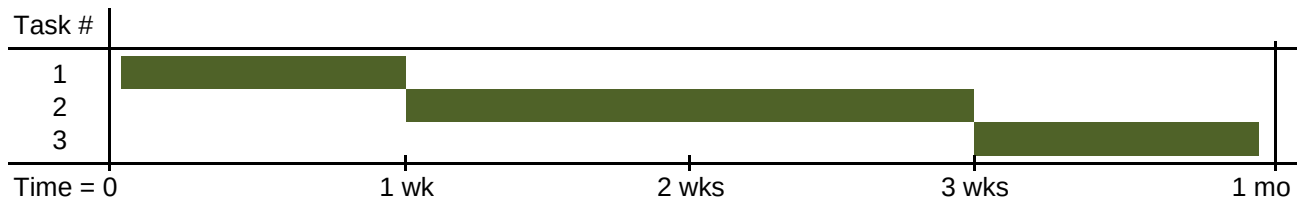
B2 - Vision, Goals, and Objectives - Interim Update Checklist

The interim update for the VGO is focused on a review and analysis of the objectives alone.

Task

- ☐ 1 Review the current objectives for alignment with the region's (or statewide) progress.
- ☐ 2 Refine existing and establish new objectives as necessary. Refine through stakeholder involvement.
- ☐ 3 Document final objectives.

B2 Timeline



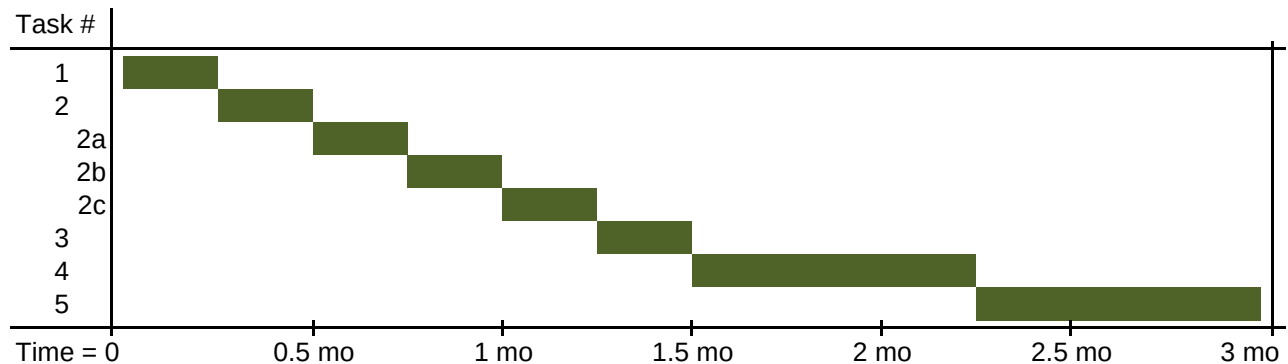
B3 - Gap Assessment - Interim Update Checklist

The Gap Assessment analyzes regional objectives and the market packages (as defined by the National ITS Architecture - www.iteris.com/itsarch) that can address those objectives. It performs an assessment of the existing status, regional target, and the identified technological and geographic gaps.

Task

- ☐ 1 Confirm the most current objectives established for the region and review the market packages identified to address each objective.
- ☐ 2 Confirm current market packages and identify additional market packages needed to deploy services that would enable the region to meet each objective.
- ☐ 2a Based on a five-point descriptor scale (no deployment, minimal deployment, moderate deployment, significant deployment, full deployment), rank each additional market package based on a general assessment of the region's current deployment.
- ☐ 2b Based on the region's interest in each service area, use the five-point descriptor scale from Task 2a to establish a regional target for each new market package.
- ☐ 2c Define the gap for the new market packages defined by using the five-point descriptor scale defined in Task 2a. The gap quantifies the existing deployment versus the regional target. For example, if the current deployment is significant and the regional target is full, the gap would be
- ☐ 3 Identify the number of objectives address by the new market packages and revise the summary of market packages to show the number of objectives addressed.
- ☐ 4 Review the existing status, regional target, and identified gap in the original report and update according to the progress that has been made since the report was written.
- ☐ 5 Revise the Gap Assessment Report as needed.

B3 Timeline



B4 - Regional ITS Architecture - Interim Update Checklist

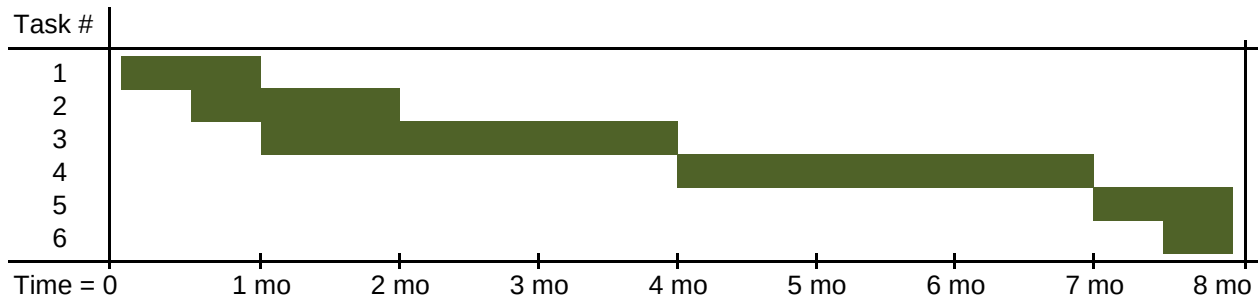
Section 5.2 of the SDP Maintenance Plan contains detailed information on the Maintenance Process and associated review structure. As Change Request Forms are submitted, they should be reviewed and addressed using the process identified in Section 5.2 of the SDP Maintenance Plan.

This checklist addresses the process for periodic maintenance of the Regional ITS Architecture.

Task

- ☐ 1 Solicit Regional ITS Architecture Change Request Forms (this is the responsibility of the Maintenance Manager and should be performed annually prior to the beginning of the SDP update process).
- ☐ 2 Utilize the Maintenance Process (Section 5.2 of the SDP Maintenance Plan) to evaluate and address any requested changes.
- ☐ 3 Hold a series of stakeholder workshops to update the Visio market package diagrams to reflect changes resulting from project implementation or changing regional needs, changes in the National ITS Architecture, and the addition of any new stakeholders or ITS services that were not previously included.
- ☐ 4 Prepare a draft of the updated architecture and submit to stakeholders for review and comment.
- ☐ 5 Update the appropriate baseline document(s) to address changes approved as part of Task 2. These may include: Architecture document, Visio Customized Market Packages, and/or Turbo Architecture database.
- ☐ 6 Distribute the updated baseline documents to stakeholders.

B4 Timeline



B5 - Project Costs Estimates Database - Interim Update Checklist

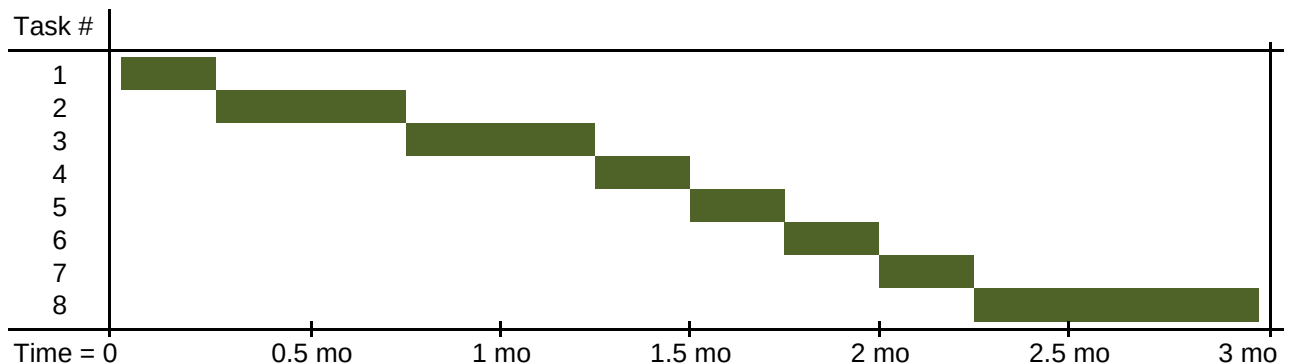
Task

- ☐ 1 Review the Cost Estimate Report and Cost Estimate Spreadsheet.
- ☐ 2 Identify any ITS elements that previously used national cost information for which local cost data is now available. In the Cost Estimate Spreadsheet, national cost data is underlined.
- ☐ 3 For all ITS elements identified in previous step, develop capital costs, annual operations and maintenance costs, and expected lifecycle as described in the report and below.
- ☐ 4 For all ITS elements using national cost information, update costs and lifecycles using the ITS Cost Database (<http://www.itscosts.its.dot.gov/>).
- ☐ 5 After reviewing the capital costs section of the Report, update the capital costs from local data in the spreadsheet using, but not limited to, the list of references provided.*
- ☐ 6 After reviewing the operations and maintenance costs section of the Report, update the annual O&M costs from local data in the spreadsheet using, but not limited to, the list of references provided.*
- ☐ 7 After reviewing the lifecycle estimates section of the Report, update the lifecycle years estimate and the total life cycle cost in the spreadsheet using, but not limited to, the list references provided.*
- ☐ 8 Revise Cost Estimate Report and Spreadsheet.

*References for updating cost information:

- Actual project bid tabs for NCDOT construction projects since last update
- Inventory of regional transit-related technologies compiled by ITRE
- Plan for regional transit-related technologies compiled by ITRE
- Estimates of annual operations and maintenance costs from local NCDOT Division
- Informal conversations with product vendors

B5 Timeline



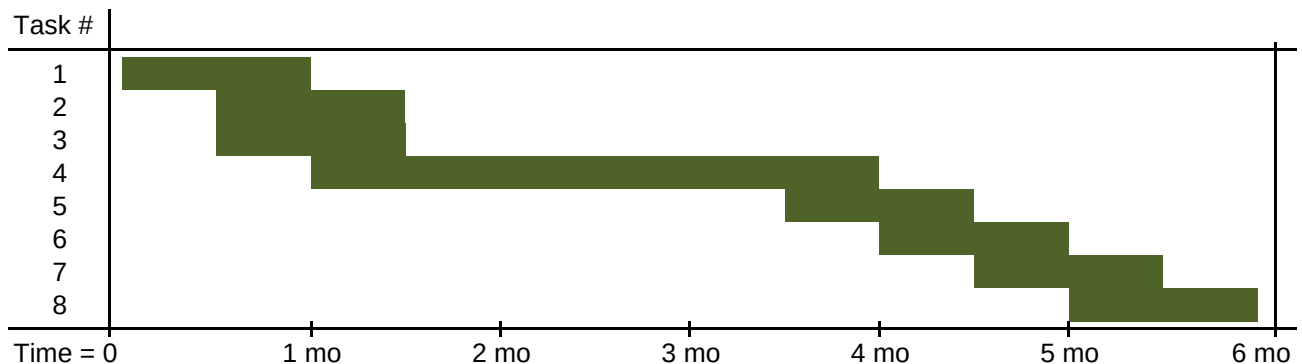
B6 - Project Evaluation and Prioritization - Interim Update Checklist

The Project Evaluation Matrix is a transparent, quantifiable method of ranking proposed projects based on IDAS, regional travel demand model, and system preservation data. The Evaluation Matrix considers five categories of information quantified into points for ranking. These categories include: benefit/cost, travel time reliability, on or adjacent to high V/C facility, system preservation, and emissions reduction. For the administrative update, no change is made to the prioritization, the lists and associated project maps are simply updated to reflect the projects that have been constructed.

Task

- ☐ 1 Review current project lists. Move constructed projects to preservation tab.
- ☐ 2 Add new projects as identified by Gap Assessment (see B3).
- ☐ 3 Obtain current Regional Travel Demand Model data.
- ☐ 4 Use IDAS (See IDAS Manual) for project analysis. If a newer version of the Travel Demand Model has been adopted, all projects must be reevaluated.
- ☐ 5 Update the evaluation matrix (Appendix C of the Project Evaluation and Prioritization Report) to reflect the current project list (see A4).
- ☐ 6 Populate the evaluation matrix with the appropriate results data from the IDAS and Regional Travel Demand Models.
- ☐ 7 Normalize the raw data and assign point values to each project (Section 4.2 of the Project Evaluation and Prioritization Report).
- ☐ 8 Rank projects based on points.

B6 Timeline



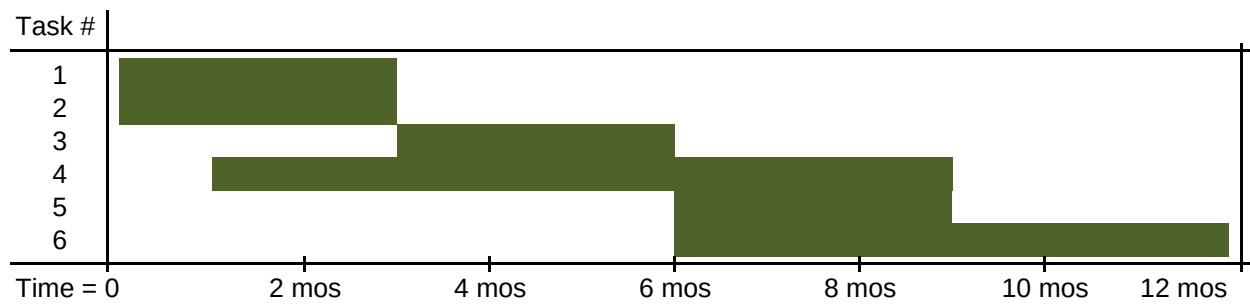
C1 - SDP - Full Update Checklist

The Strategic Deployment Plan is a compilation of seven major tasks. The full update is based on developing the SDP from a vision through to a prioritized list of projects. These tasks are based on developing each component and not a review or revision of the previous version. It includes a new assessment of the current regional status.

Task

- ☐ 1 Develop Summary of Best Practices (see C2).
- ☐ 2 Develop ITS Vision, Goals, and Objectives (see C3).
- ☐ 3 Develop Gap Assessment (see C4).
- ☐ 4 Develop Regional ITS Architecture (see C5).
- ☐ 5 Develop Cost Estimate Data (see C6).
- ☐ 6 Develop Project Evaluation and Prioritization (see C7).

C1 Timeline

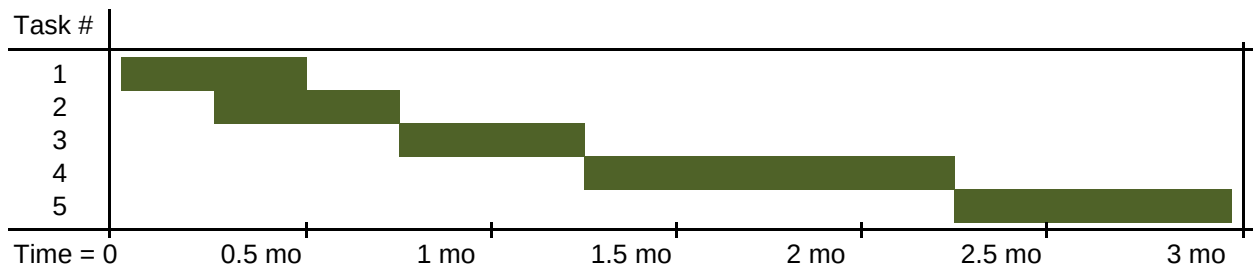


C2 - Best Practices Research and Report - Full Update Checklist

Task

- ☐ 1 Conduct a literature review of new and emerging technologies. Document potential areas of interest for detailed research.
- ☐ 2 Conduct an internal brainstorming session with key stakeholders to discuss potential topic areas for research.
- ☐ 3 Assemble results of literature review and brainstorming into a single list of research topics. Distribute to stakeholders for review and ranking of topics.
- ☐ 4 Identify the highest scoring topic areas for additional research. Organize and conduct one-on-one interviews with agencies involved with each research topic.
- ☐ 5 Develop a document summarizing the results of the in-depth research.

C2 Timeline

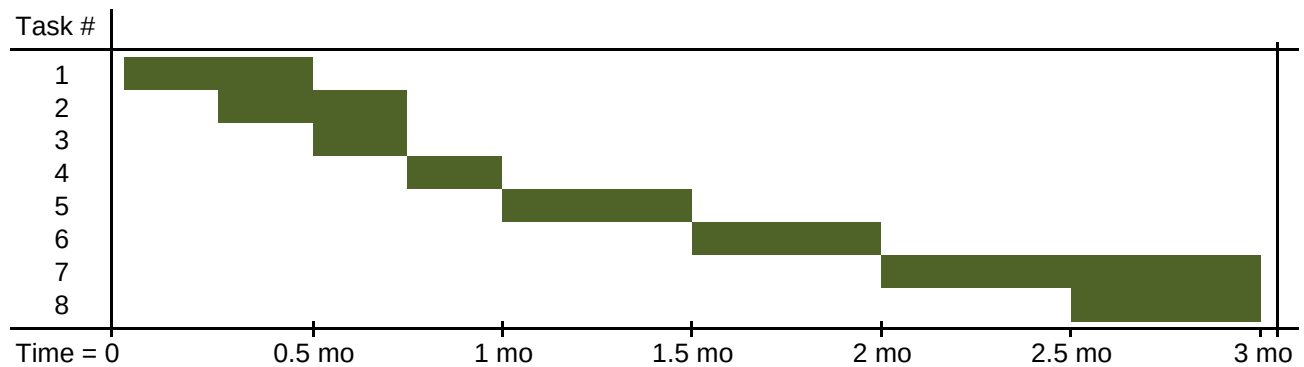


C3 - Vision, Goals, and Objectives - Full Update Checklist

Task

- ☐ 1 Assemble and review vision documents from federal, state, local and regional stakeholder agencies.
- ☐ 2 Determine if Vision documents have changed since previous SDP VGO Report. (If so, proceed with steps 3-8)
- ☐ 3 Extract key terminology from stakeholder agencies' Vision and Goals documents and identify commonly used phrases.
- ☐ 4 Conduct committee brainstorming session to merge commonly used phrases into a single vision statement. Existing Vision statement can be used as a starting point.
- ☐ 5 Refine vision statement through stakeholder review.
- ☐ 6 Draft goals based on the refined vision statement. Refine through stakeholder involvement.
- ☐ 7 Draft objectives to address developed goals. Refine through stakeholder involvement.
- ☐ 8 Develop Vision, Goals and Objective Report.

C3 - Timeline



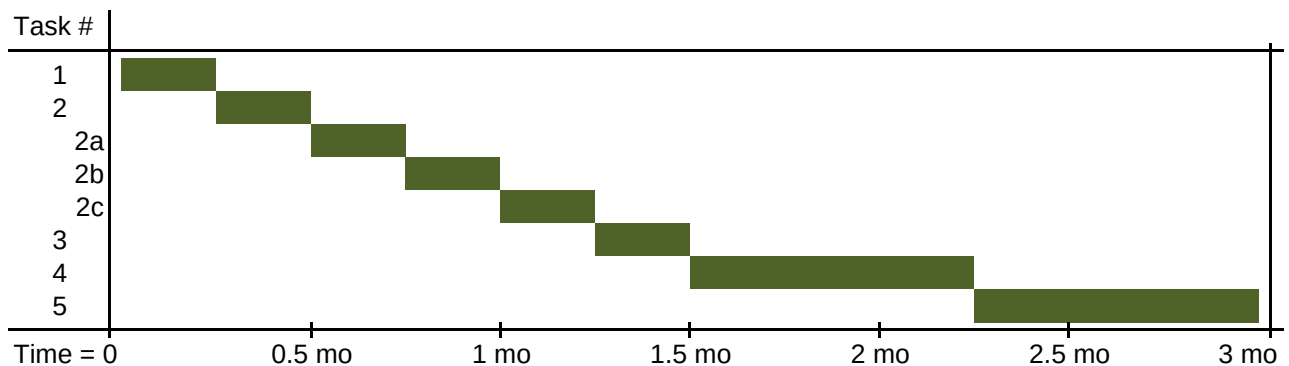
C4 - Gap Assessment - Full Update Checklist

The Gap Assessment analyzes regional objectives and the market packages (as defined by the National ITS Architecture - www.iteris.com/itsarch) that can address those objectives. It performs an assessment of the existing status, regional target, and the identified technological and geographic gaps.

Task

- ☐ 1 Confirm the most current objectives established for the region and review the market packages identified to address each objective.
- ☐ 2 Confirm current market packages and identify additional market packages needed to deploy services that would enable the region to meet each objective.
- ☐ 2a Based on a five-point descriptor scale (no deployment, minimal deployment, moderate deployment, significant deployment, full deployment), rank each additional market package based on a general assessment of the region's current deployment.
- ☐ 2b Based on the region's interest in each service area, use the five-point descriptor scale from Task 2a to establish a regional target for each new market package.
- ☐ 2c Define the gap for the new market packages defined by using the five-point descriptor scale defined in Task 2a. The gap quantifies the existing deployment versus the regional target. For example, if the current deployment is significant and the regional target is full, the gap would be
- ☐ 3 Identify the number of objectives address by the new market packages and revise the summary of market packages to show the number of objectives addressed.
- ☐ 4 Review the existing status, regional target, and identified gap in the original report and update according to the progress that has been made since the report was written.
- ☐ 5 Revise the Gap Assessment Report as needed.

C4 Timeline



C5 - Regional ITS Architecture - Full Update Checklist

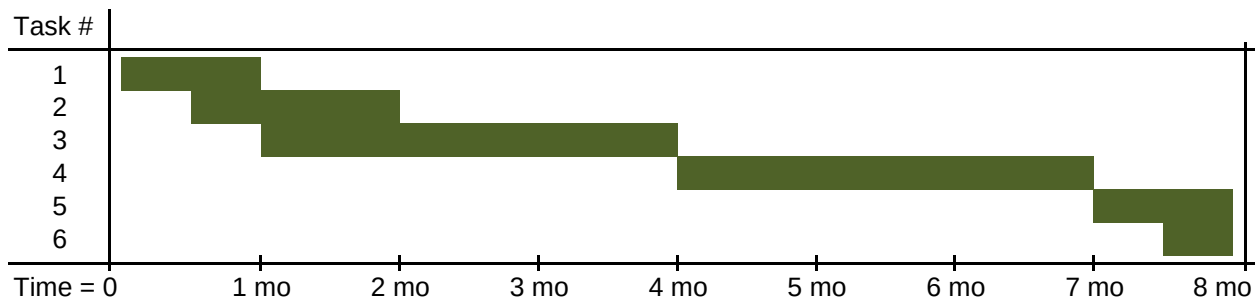
Section 5.2 of the SDP Maintenance Plan contains detailed information on the Maintenance Process and associated review structure. As Change Request Forms are submitted, they should be reviewed and addressed using the process identified in Section 5.2 of the SDP Maintenance Plan.

This checklist addresses the process for a complete update of the Regional ITS Architecture.

Task

- ☐ 1 Solicit Regional ITS Architecture Change Request Forms (this is the responsibility of the Maintenance Manager and should be performed annually prior to the beginning of the SDP update process).
- ☐ 2 Utilize the Maintenance Process (Section 5.2 of the SDP Maintenance Plan) to evaluate and address any requested changes.
- ☐ 3 Hold a series of stakeholder workshops to update the market package diagrams to reflect changes resulting from project implementation or changing regional needs, changes in the National ITS Architecture (www.iteris.com/itsarch), and the addition of any new stakeholders or ITS services that were not previously included.
- ☐ 4 Prepare a draft of the updated architecture and submit to stakeholders for review and comment.
- ☐ 5 Update the appropriate baseline document(s) to address changes approved as part of Task 2. These may include: Architecture document, Visio Customized Market Packages, and/or Turbo Architecture database.
- ☐ 6 Distribute the updated baseline documents to stakeholders.

C5 Timeline



C6 - Project Costs Estimates Database - Full Update Checklist

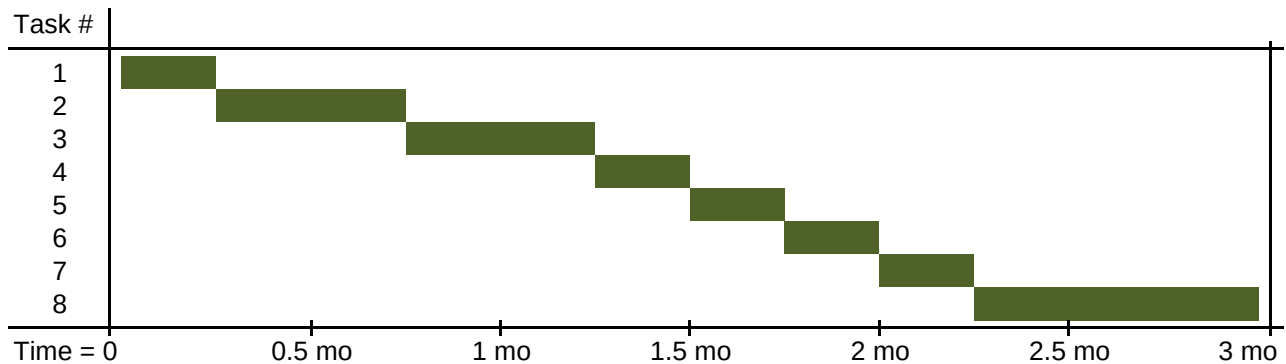
Task

- ☐ 1 Review the Cost Estimate Report and Cost Estimate Spreadsheet.
- ☐ 2 Identify any ITS elements that previously used national cost information for which local cost data is now available. In the Cost Estimate Spreadsheet, national cost data is underlined.
- ☐ 3 For all ITS elements identified in previous step, develop capital costs, annual operations and maintenance costs, and expected lifecycle as described in the report and below.
- ☐ 4 For all ITS elements using national cost information, update costs and lifecycles using the ITS Cost Database (www.itscosts.its.dot.gov).
- ☐ 5 After reviewing the capital costs section of the Report, update the capital costs from local data in the spreadsheet using, but not limited to, the list of references provided.*
- ☐ 6 After reviewing the operations and maintenance costs section of the Report, update the annual O&M costs from local data in the spreadsheet using, but not limited to, the list of references provided.*
- ☐ 7 After reviewing the lifecycle estimates section of the Report, update the lifecycle years estimate and the total life cycle cost in the spreadsheet using, but not limited to, the list references provided.*
- ☐ 8 Revise Cost Estimate Report and Spreadsheet.

*References for updating cost information:

- Actual project bid tabs for NCDOT construction projects since last update
- Inventory of regional transit-related technologies compiled by ITRE
- Plan for regional transit-related technologies compiled by ITRE
- Estimates of annual operations and maintenance costs from NCDOT Division 5
- Informal conversations with product vendors

C6 Timeline



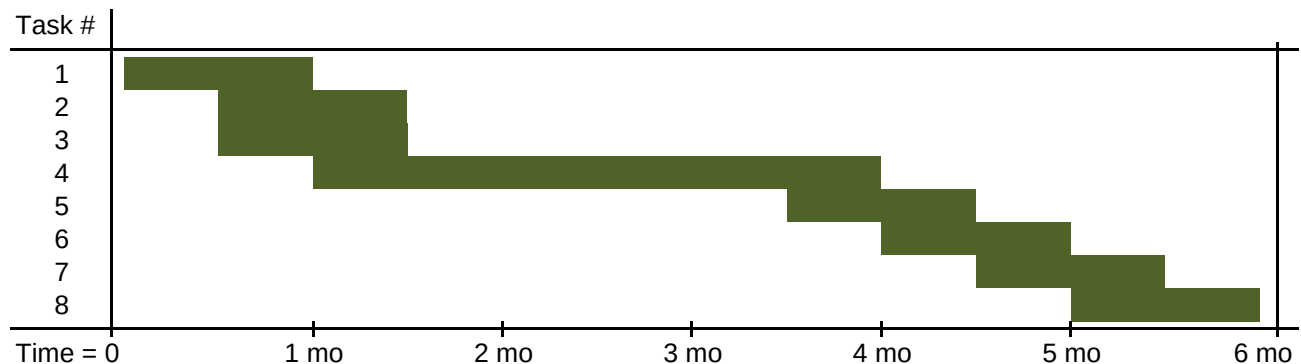
C7 - Project Evaluation and Prioritization - Full Update Checklist

The Project Evaluation Matrix is a transparent, quantifiable method of ranking proposed projects based on IDAS, regional travel demand model, and system preservation data. The Evaluation Matrix considers five categories of information quantified into points for ranking. These categories include: benefit/cost, travel time reliability, on or adjacent to high V/C facility, system preservation, and emissions reduction. For the administrative update, no change is made to the prioritization, the lists and associated project maps are simply updated to reflect the projects that have been constructed.

Task

- ☐ 1 Review current project lists. Move constructed projects to preservation tab.
- ☐ 2 Add new projects as identified by Gap Assessment (see C4).
- ☐ 3 Obtain current Regional Travel Demand Model data.
- ☐ 4 Use IDAS (See IDAS Manual) for project analysis. If a newer version of the Travel Demand Model has been adopted, all projects must be reevaluated.
- ☐ 5 Update the evaluation matrix (Appendix C of the Project Evaluation and Prioritization Report) to reflect the current project list (see A4).
- ☐ 6 Populate the evaluation matrix with the appropriate results data from the IDAS and Regional Travel Demand Models.
- ☐ 7 Normalize the raw data and assign point values to each project (Section 4.2 of the Project Evaluation and Prioritization Report).
- ☐ 8 Rank projects based on points.

C7 Timeline





Maintenance Change Request (MCR) Form to be Completed by the Stakeholder

To Be Completed by Stakeholder(s) Requesting Changes

Agency	
Agency Contact Person	
Telephone	
Fax	
E-Mail	
Change Request (CR) Information	
Please indicate the type of change: ☐ Level 1: Basic changes that do not affect the structure of the architecture Examples include: Changes to stakeholder or element name, element status, or data flow status ☐ Level 2: Structural changes that impact only one agency Examples include: Addition of a new market package or modifications to an existing market package that affects only your agency ☐ Level 3: Structural changes that have the potential to impact multiple agencies Examples include: Addition of a new market package or modifications to an existing market package that involves multiple agencies, incorporation of a new stakeholder into the architecture	
Describe requested change	



What, if any, market packages are impacted by the proposed change? Note: If the proposed change involves creating or modifying a market package please attach a sketch of the new or modified market package.			
Does the proposed change affect any additional stakeholders?	Affected Agency	Authorized Representative	Date of Agency Concurrence
Applicable Baseline Document Versions	Website:		Turbo Architecture:
	Market Packages:		Architecture Document:



Maintenance Change Request (MCR) Form to be Completed by Maintenance Manager

Date CR Received:		Date CR Logged:		CR Number:	
Date of Review:	Performed By:	Recommendation: ☐ Approve and Include ☐ More Information Required		Comments:	
Documents Affected: ☐ Market Packages ☐ Turbo Architecture ☐ Architecture Document					
Do changes necessitate immediate revision and distribution of architecture document? ☐ Yes ☐ No					
Document Update Record					
Document	Market Packages	Turbo Database	Document		
Change Required	☐	☐	☐		
Timeframe	☐ Immediate	☐ Immediate	☐ Immediate		
	☐ Next Update	☐ Next Update	☐ Next Update		
Date Completed					

Intelligent Transportation System Strategic Deployment Plan Update

FINAL Cost Estimate Report

Prepared for:
Triangle ITS Communications Partners



Prepared by:



Kimley-Horn
and Associates, Inc.

In Association with:



March 2010
011494053

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1. INTRODUCTION

The purpose of this report is to provide context and documentation to the accompanying *Cost Estimate Components for ITS Projects* spreadsheet.

2. COST ESTIMATE SPREADSHEET LAYOUT

The cost estimate spreadsheet was developed to provide capital costs, annual operations and maintenance costs, and expected lifecycle for specific ITS elements as they are being combined to form an ITS project. These costs will be utilized for the ITS Deployment Analysis System (IDAS) based benefit-cost assessment, the Turbo Architecture database, as well as for strategic deployment plan project cost reporting.

2.1 ITS Elements

The majority of the cost estimate spreadsheet defines all of the elements that could be used to form an ITS project in North Carolina. The elements are grouped into similar themes such as roadway devices or TMC components. Each element also is defined in unit terms of “per item” for devices, “per mile” for communications, and “lump sum” for software and integration elements. Finally, the last two columns of the spreadsheet give context to each element by giving a brief description and listing a number of specific items that were used to build the element costs.

2.2 Capital Costs

The capital costs for each ITS element are presented in 2009 dollars. It is important to note that the capital costs are for the installation of that ITS element within a larger construction project. Thus, the capital costs do not consider construction costs such as mobilization and training, which are considered “soft costs”, and will be discussed in **Section 3.1 Soft Costs**.

The capital costs for the spreadsheet were developed using a number of references.

- Actual project bid tabs for NCDOT construction projects from January 2003 to June 2008
- *ITS Cost Database*, maintained by US DOT and available at <http://www.itscosts.its.dot.gov/>
- Inventory of regional transit-related technologies compiled by ITRE
- 2007-2012 plan for regional transit-related technologies compiled by ITRE
- Informal conversations with product vendors

2.3 Operations and Maintenance Costs

The annual operations and maintenance costs also are presented in 2009 dollars. These costs are intended to portray the total cost for operating and maintaining an ITS element over its life, but are averaged to provide an annual cost. It is important to note that this does not include any replacement costs associated with a device at the end of its life. It is expected that the actual operations and maintenance costs for an ITS element would be lower than the annual average early in the lifecycle but higher than the annual average later in the lifecycle.

The operations and maintenance costs for the spreadsheet were developed using a number of references.

- Estimates of annual operations and maintenance costs from NCDOT Division 5



- 2009 budget for SCDOT ITS Maintenance (provided during the Best Practices task)
- *ITS Cost Database*, maintained by US DOT and available at <http://www.itscosts.its.dot.gov/>
- Inventory of regional transit-related technologies compiled by ITRE
- 2007-2012 plan for regional transit-related technologies compiled by ITRE

2.4 Lifecycle

The lifecycle of an ITS element is presented in the expected number of years between installation and replacement. For some elements, the expected replacement is not based on product malfunction and inoperability, but rather, based on the end of vendor support or product compatibility (such as computers and software).

The lifecycle estimates for the spreadsheet were developed using a number of references.

- Estimates of annual operations and maintenance costs from NCDOT Division 5
- 2009 budget for SCDOT ITS Maintenance (provided during the Best Practices task)
- *ITS Cost Database*, maintained by US DOT and available at <http://www.itscosts.its.dot.gov/>
- Inventory of regional transit-related technologies compiled by ITRE
- 2007-2012 plan for regional transit-related technologies compiled by ITRE

3. OTHER COST CONSIDERATIONS

As mentioned above, the cost estimate spreadsheet does not consider other soft costs that are not tied to a specific construction element, but nonetheless, are part of an overall project. When considering costs for ITS elements and projects over an uncertain timeframe, it is important to also consider and account for an inflation rate and discount rate. These other cost considerations are discussed below.

3.1 Soft Costs

After combining desired ITS elements from the spreadsheet to form a construction cost, other costs should be added to form a total project cost. Below are the most typical soft costs.

- Design engineering typically is about **10%** of the construction cost.
- Construction engineering and administration typically is about **15%** of the construction cost.
- Mobilization of the contractor typically is about **5%** of the construction cost.
- Traffic control for the work typically is about **2%** of the construction cost.
- Training of the end-users (NCDOT or municipality) typically is **2%** of the construction cost.

3.2 Inflation Rate

In this context, the inflation rate refers to an annual rate of change (increase or decrease) in the purchase price of a good or service. This is important because the costs presented in the spreadsheet are based on 2009 dollars. If the ITS element is not going to be purchased until later, the inflation rate must be applied to determine what the cost will be at that time.

Using historical bid tab data from NCDOT starting in 2003, a general inflation rate for ITS projects in North Carolina was determined to be **3%**. This inflation rate was determined by looking at similar groups of ITS elements.

- Commodity elements that are defined by NCDOT standards that do not change much over time (such as fiber optic cable, messenger cable, junction boxes, conduit, etc.) appear to have



a recent annual inflation rate around 2%. These elements typically comprise about 40% of an ITS project's total cost.

- Electronic elements that are defined by NCDOT standards that do not change much over time (such as field cabinets, signal controllers, etc.) appear to have a recent annual inflation rate around 2%. These elements typically comprise about 20% of an ITS project's total cost.
- Electronic elements that use constantly-changing technologies (such as CCTV cameras, dynamic message signs, vehicle detectors, etc) appear to have a recent annual inflation rate around 0% because these vendors tend to offer levels of product functionality (such as basic and advanced). Over time, the prices for each level will remain the same, but features and functionality trickle down from the top as they become less expensive. These elements typically comprise about 10% of an ITS project's total cost.
- Software elements that are project-specific are difficult to analyze for cost over time because each instance is different. Thus, it is recommended that an annual inflation rate of 0% be applied to these elements, for similar reasons to those explained in the previous bullet. These elements typically comprise about 10% of an ITS project's total cost.
- Labor elements (such as integration and installation) appear to have a recent annual inflation rate around 10%. These typically comprise about 20% of an ITS project's total cost.

The inflation rate is applied using the following equation:

- $\text{Future Amount} = \text{Present Amount} \times (1 + \text{Inflation Rate})^{\text{Number of Years}}$

3.3 Discount Rate

Typically, a discount rate is used in benefit-cost analysis to account for the time value of money. When considering benefits and costs, they both have a greater value if they are recognized sooner and must be discounted if recognized later. The discount rate also accounts for interest rates and inflation rates.

Selecting the proper discount rate for a benefit-cost analysis is often difficult. The U.S. Government published *Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs* in 1992 suggesting that a discount rate of 7% be used for benefit-cost analysis of federally funded programs. FHWA published *Life-Cycle Cost Analysis in Pavement Design – Interim Technical Bulletin* in 1998 that looked at discount rates for various pavement design programs over time and determined an appropriate range of 3-5% for discount rates. Overall, determining an applicable discount rate is debatable and constantly changing.

It is important to note that a discount rate is only applicable to benefit-cost analysis and should not be used in calculations where a future cost is determined from a present cost (such as shown in the inflation rate section above). This report presents a discount rate for an agency that is using the cost spreadsheet for developing a benefit-cost analysis in the IDAS program and desires to change the software's default value of 7% for the discount rate.

The discount rate is calculated using the following equation:

- $\text{Discount Rate} = [(1 + \text{Interest Rate}) / (1 + \text{Inflation Rate})] - 1$
- Or a simple approximation is: $\text{Discount Rate} = \text{Interest Rate} - \text{Inflation Rate}$

Using an inflation rate of 3% as developed above and a current Federal Reserve interest rate of 0.25%, a current recommendation for a discount rate would be -2.75%.



4. PROJECT EXAMPLE

A simple example is presented here to illustrate how to use the cost estimate spreadsheet and inflation rate when developing projects. For this example, assume a Triangle agency is planning to expand their existing DMS system in 2015 by installing two arterial DMS units with short haul electrical service and dial-up modems.

Using the cost estimate spreadsheet, the expected capital construction cost in 2009 dollars of **\$164,500**.

- DMS, Arterial (quantity of 2 with a unit cost of \$80,000 each) = \$160,000
- Electrical service for device, short haul (quantity of 2 with a unit cost of \$1,500 each) = \$3,000
- Dial-up connection to device (quantity of 2 with a unit cost of \$750 each) = \$1,500
- Assume that the central software and hardware is already in place.

To convert this capital cost to equivalent dollars in 2015, apply an inflation rate of 3%. This equates to a capital construction cost in 2015 of about **\$196,500**.

- $\$164,500 \times (1.03)^6 = \$196,421$

Finally, the soft costs discussed above are applied to construction costs to develop a total project deployment cost of about **\$259,400** in 2015 dollars.

- Design engineering (10%) = \$19,650
- Construction engineering and administration (15%) = \$29,475
- Mobilization (5%) = \$9,825
- Traffic control (2%) = \$3,930
- Assume no training is necessary since there is an existing DMS system.



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FHWA. *Life-Cycle Cost Analysis in Pavement Design – Interim Technical Bulletin*. Publication No. FHWA-SA-98-079

Office of Management and Budget (1992 October): *Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs*. <http://www.whitehouse.gov/omb/rewrite/circulars/a094/a094.html>.



Kimley-Horn
and Associates, Inc.

APPENDIX A – COST ESTIMATE SPREADSHEET

Appendix A - Cost Estimate Spreadsheet

Item		Unit	Capital Cost (2009 \$)	Annual O&M Cost (2009 \$)	Lifecycle (yrs)	Total Lifecycle Cost (2009 \$)	Description and Assumptions	Items Included in Costs
Roadway Devices	CCTV Camera, PTZ	Per Each	\$18,500	\$1,250	12	\$33,500	Closed circuit television (CCTV) camera with pan, tilt, zoom (PTZ) functionality in a dome enclosure.	Camera, enclosure, positioning system, pole attachment, metal pole and foundation, control cabinet, controller, cabling
	CCTV Camera, Fixed	Per Each	\$14,000	\$1,250	12	\$29,000	Fixed position closed circuit television (CCTV) camera in a dome enclosure.	Camera, enclosure, pole attachment, metal pole and foundation, control cabinet, controller, cabling
	DMS, Overhead Mount	Per Each	\$200,000	\$3,000	15	\$245,000	Dynamic message sign (DMS) of a large size suitable for freeway speeds mounted on an overhead structure.	Sign, structure and foundation, control cabinet and foundation, controller, cabling
	DMS, Shoulder Mount	Per Each	\$175,000	\$3,000	15	\$220,000	Dynamic message sign (DMS) of a medium size suitable for freeway speeds mounted on a roadway shoulder structure.	Sign, structure and foundation, control cabinet and foundation, controller, cabling
	DMS, Arterial	Per Each	\$80,000	\$3,000	15	\$125,000	Dynamic message sign (DMS) of a small size suitable for arterial speeds mounted on roadway shoulder structure.	Sign, structure and foundation, control cabinet and foundation, controller, cabling
	DMS, Portable	Per Each	\$20,000	\$2,500	15	\$57,500	Dynamic message sign (DMS) of a small size mounted on a portable structure.	Sign, structure, trailer, control cabinet, cabling
	Vehicle Detection, Loops	Per Each	\$8,000	\$500	10	\$13,000	Inductive loops installed in the pavement to monitor four lanes of traffic.	Saw cut, lead-in cable, junction box, conduit, cabinet, amplifiers
	Vehicle Detection, Radar	Per Each	\$8,000	\$1,250	10	\$20,500	Radar detector installed on the side of a roadway to monitor four lanes of traffic.	Detector, wood pole, pole attachment hardware, riser, cabling, cabinet, amplifiers
	Vehicle Detection, Video	Per Each	\$20,000	\$1,500	10	\$35,000	Video detector installed on the side of a roadway to monitor four lanes of traffic.	Camera, wood pole, pole attachment hardware, riser, cabling, cabinet, processors
	<u>Ramp Meter</u>	<u>Per Each</u>	<u>\$45,000</u>	<u>\$4,000</u>	<u>5</u>	<u>\$65,000</u>	Ramp meter installed on a freeway on-ramp.	Signal indication, signal mast arm and mounting, pavement markings, conduit, cabling, cabinet and foundation. Excludes vehicle detection on freeway.
	<u>Highway Advisory Radio</u>	<u>Per Each</u>	<u>\$35,000</u>	<u>\$1,000</u>	<u>15</u>	<u>\$50,000</u>	Highway advisory radio (HAR) transmitter installed on a roadway with a warning sign.	Radio transmitter, antenna, broadcast license fee, controller, battery backup, cabinet, cabling, warning sign with flashing beacons.
	Traffic Signal Cabinet/Controller, NCDOT Standard	Per Each	\$14,000	\$1,000	10	\$24,000	Replacement of an existing signal controller to an Oasis 2070 controller and an existing signal cabinet to a 332 style cabinet.	Controller, local software, cabinet, detector amplifiers, conflict monitor, cabinet wiring, cabinet foundation.
	Signal Priority/Preemption Receiver	Per Each	\$4,000	\$200	5	\$5,000	Installation of a receiver at a single four-approach intersection for signal priority operations. Emitter is covered under separate item.	Receiver device, cabling, processor.
	<u>Lane Control Gates</u>	<u>Per Each</u>	<u>\$75,000</u>	<u>\$1,200</u>	<u>20</u>	<u>\$99,000</u>	Installation of lane control gates at a single location.	Gates, support structures and hardware, cabinet, controller, cabling
	<u>Environmental Sensing Station</u>	<u>Per Each</u>	<u>\$75,000</u>	<u>\$6,000</u>	<u>25</u>	<u>\$225,000</u>	Installation of a environmental sensing station (ESS) for providing data to weather information system.	Pavement sensors, subsurface sensors, precipitation sensor, wind sensor, air temperature and humidity sensors, visibility sensors, processing unit, cabinet, cabling
	<u>Weigh-In-Motion Station</u>	<u>Per Each</u>	<u>\$25,000</u>	<u>\$2,500</u>	<u>10</u>	<u>\$50,000</u>	Installation of a single-lane weigh-in-motion system for commercial vehicles.	Scales, lead-in cable, conduit, controller, overhead lane control structure and signs
	<u>Informational Kiosk</u>	<u>Per Each</u>	<u>\$8,000</u>	<u>\$750</u>	<u>5</u>	<u>\$11,750</u>	Informational kiosk displaying NCDOT's 511 and TIMS websites, installed at a rest stop or similar location.	Computer, modem, enclosure.

Appendix A - Cost Estimate Spreadsheet

Item		Unit	Capital Cost (2009 \$)	Annual O&M Cost (2009 \$)	Lifecycle (yrs)	Total Lifecycle Cost (2009 \$)	Description and Assumptions	Items Included in Costs
Communications for Roadway Devices	Fiber Optic Cable on Freeway, Small Count	Per Mile	\$86,500	\$750	30	\$109,000	Fiber optic cable (12 fibers or less) installed in underground conduit (75% trenched, 25% drilled) along a freeway.	Cable, two conduits, tracer wire, junction boxes, splice enclosures, fiber splices, delineator markers.
	Fiber Optic Cable on Freeway, Medium Count	Per Mile	\$88,000	\$2,250	30	\$155,500	Fiber optic cable (between 24 and 96 fibers) installed in underground conduit (75% trenched, 25% drilled) along a freeway.	Cable, two conduits, tracer wire, junction boxes, splice enclosures, fiber splices, delineator markers.
	Fiber Optic Cable on Freeway, Large Count	Per Mile	\$89,000	\$3,500	30	\$194,000	Fiber optic cable (144 fibers or more) installed in underground conduit (75% trenched, 25% drilled) along a freeway.	Cable, two conduits, tracer wire, junction boxes, splice enclosures, fiber splices, delineator markers.
	Fiber Optic Cable on Arterial, Small Count	Per Mile	\$19,000	\$750	30	\$41,500	Fiber optic cable (12 fibers or less) installed on existing utility poles along an arterial or collector street.	Cable, messenger cable, splice enclosures, fiber splices.
	Fiber Optic Cable on Arterial, Medium Count	Per Mile	\$20,250	\$2,250	30	\$87,750	Fiber optic cable (between 24 and 96 fibers) installed on existing utility poles along an arterial or collector street.	Cable, messenger cable, splice enclosures, fiber splices.
	Fiber Optic Cable on Arterial, Large Count	Per Mile	\$21,500	\$3,500	30	\$126,500	Fiber optic cable (144 fibers or more) installed on existing utility poles along an arterial or collector street.	Cable, messenger cable, splice enclosures, fiber splices.
	Fiber Connection to Device	Per Each	\$3,500	\$250	10	\$6,000	Integration of an ITS device to a fiber optic communications network.	Optical transceiver, patch panel or interconnect center, fiber splicing, jumper cables.
	Wireless Connection to Device	Per Each	\$12,000	\$600	10	\$18,000	Point-to-point 900 MHz radio connection to an ITS device.	Two radio modems, two antennas, cabling, one repeater station.
	Dial-Up Connection to Device	Per Each	\$750	\$750	20	\$15,750	Dial-up connection over a phone line to an ITS device.	Phone modem, cabling, phone service.
	Leased Line Connection to Device	Per Each	\$800	\$3,000	20	\$60,800	DSL-speed data connection (300 to 1000 kbps) to an ITS device using a third-party service.	DSL modem, cabling, data service.
Power for Roadway Devices	Electrical Service for Device, Short Haul	Per Each	\$1,500	\$750	20	\$16,500	Provision of electrical service for an ITS device when a power source is near.	Electrical service, wires, conduit.
	Electrical Service for Device, Long Haul	Per Each	\$2,500	\$750	20	\$17,500	Provision of electrical service for an ITS device when a power source is not present or at a distance greater than 1,000 feet.	Electrical service, wires, conduit.
	Solar Power for Device	Per Each	\$7,000	\$400	5	\$9,000	Installation of solar powered hardware for providing electrical service to an ITS device.	Field investigation, solar panels, battery, cabinet, cabling.
Transportation Management Center (TMC)	Operator Console Workstation	Per Each	\$3,500	\$100	5	\$4,000	Installation of a computer workstation for a TMC operator.	Workstation computer, dual monitors, network connection, basic productivity software.
	Notebook Computer	Per Each	\$4,000	\$200	5	\$5,000	Install of a notebook computer for TMC field technicians.	Rugged computer, remote network connection, basic productivity software.
	Local Area Network, Small	Lump Sum	\$12,000	\$600	5	\$15,000	Installation and integration of a local area network for a small TMC of less than 5 operators.	10/100 Ethernet switch, firewall, network management software, cabling.
	Local Area Network, Large	Lump Sum	\$50,000	\$1,500	5	\$57,500	Installation and integration of a local area network for a large TMC of less than 10 operators with remote connections to no more than 2 other facilities.	10/100/1000 Ethernet switch, firewall, network management software, domain server, cabling.
	Local Area Network, Enterprise	Lump Sum	\$100,000	\$5,000	5	\$125,000	Installation and integration of an enterprise-level local area network for a large and complex TMC.	10/100/1000 Enterprise Ethernet switch, firewall, network management software, domain server, cabling.
	Video Wall, Small	Lump Sum	\$25,000	\$1,250	10	\$37,500	Installation of a two-monitor video wall for displaying five CCTV video feeds in a TMC.	LCD monitors, monitor framing unit, analog video matrix switch or Ethernet-based digital switch, cabling.
	Video Wall, Medium	Lump Sum	\$70,000	\$3,500	10	\$105,000	Installation of an eight-monitor video wall for displaying twenty CCTV video feeds in a TMC.	LCD monitors, monitor framing unit, analog video matrix switch or Ethernet-based digital switch, cabling.
	Video Wall, Large	Lump Sum	\$160,000	\$8,000	10	\$240,000	Installation of a sixteen-monitor video wall for displaying fifty CCTV video feeds in a TMC.	LCD monitors, monitor framing unit, analog video matrix switch or Ethernet-based digital switch, cabling.

Appendix A - Cost Estimate Spreadsheet

Item		Unit	Capital Cost (2009 \$)	Annual O&M Cost (2009 \$)	Lifecycle (yrs)	Total Lifecycle Cost (2009 \$)	Description and Assumptions	Items Included in Costs
TMC Software and Hardware	CCTV System	Lump Sum	\$75,000	\$3,750	10	\$112,500	Installation of TMC software and hardware for deploying a CCTV view and control system.	Comm server, software server, software license, joystick control panels.
	DMS System	Lump Sum	\$40,000	\$2,000	10	\$60,000	Installation of TMC software and hardware for deploying a DMS control system.	Comm and software server, software license.
	Detection System	Lump Sum	\$25,000	\$750	10	\$32,500	Installation of TMC software and hardware for deploying a vehicle detection monitoring and data archiving system.	Comm and software server, software license.
	Closed Loop Signal System	Lump Sum	\$80,000	\$4,000	10	\$120,000	Installation of TMC software and hardware for deploying a closed loop signal system .	Comm and software server, software license. Excludes signal cabinets and controllers.
	Central Signal System	Lump Sum	\$300,000	\$15,000	10	\$450,000	Installation of TMC software and hardware for deploying a central signal system.	Comm server, software server, software license. Excludes signal cabinets and controllers.
	Traffic Adaptive Signal System	Lump Sum	\$100,000	\$10,000	10	\$200,000	Installation of TMC software and hardware for deploying a traffic adaptive signal system.	Comm and software server, software license.
	<u>Emergency Vehicle Signal Priority System</u>	<u>Lump Sum</u>	<u>\$50,000</u>	<u>\$5,000</u>	<u>10</u>	<u>\$100,000</u>	Installation of TMC software and hardware for deploying a emergency vehicle signal priority system.	Comm and software server, software license.
	<u>Transit Signal Priority System</u>	<u>Lump Sum</u>	<u>\$200,000</u>	<u>\$10,000</u>	<u>10</u>	<u>\$300,000</u>	Installation of TMC software and hardware for deploying an advanced transit vehicle signal priority system.	Comm and software server, software license.
	<u>Incident Response System</u>	<u>Lump Sum</u>	<u>\$150,000</u>	<u>\$30,000</u>	<u>10</u>	<u>\$450,000</u>	Installation of TMC software and hardware for deploying an incident response system to assist TMC operators.	Comm server, software server, database server, software license.
	<u>Basic Ramp Metering System</u>	<u>Lump Sum</u>	<u>\$25,000</u>	<u>\$1,500</u>	<u>10</u>	<u>\$40,000</u>	Installation of TMC software and hardware for deploying a basic ramp metering control system.	Comm and software server, software license.
	<u>Advanced Ramp Metering System</u>	<u>Lump Sum</u>	<u>\$100,000</u>	<u>\$10,000</u>	<u>10</u>	<u>\$200,000</u>	Installation of TMC software and hardware for deploying an advanced ramp metering control system that adapts to real-time vehicle conditions.	Comm and software server, software license.
	<u>HAR System</u>	<u>Lump Sum</u>	<u>\$15,000</u>	<u>\$750</u>	<u>10</u>	<u>\$22,500</u>	Installation of TMC software and hardware for deploying a HAR control system.	Comm and software server, software license.
	<u>HOV/HOT System</u>	<u>Lump Sum</u>	<u>\$100,000</u>	<u>\$10,000</u>	<u>10</u>	<u>\$200,000</u>	Installation of TMC software and hardware for deploying a lane control system for HOV or HOT facilities.	Comm and software server, software license.
	<u>Basic Remote Weather Information System</u>	<u>Lump Sum</u>	<u>\$75,000</u>	<u>\$9,000</u>	<u>10</u>	<u>\$165,000</u>	Installation of TMC software and hardware for deploying a basic remote weather information system (RWIS) to measure temperature, precipitation, and wind.	Comm and software server, software license, subscription to meteorological service.
	<u>Enhanced Remote Weather Information System</u>	<u>Lump Sum</u>	<u>\$115,000</u>	<u>\$10,000</u>	<u>10</u>	<u>\$215,000</u>	Installation of TMC software and hardware for deploying an enhanced remote weather information system (RWIS) to also measure visibility, humidity, water levels, and pavement temperature.	Comm and software server, software license, subscription to meteorological service.
Toll Plazas	<u>Electronic Toll Reader</u>	<u>Per Each</u>	<u>\$15,000</u>	<u>\$300</u>	<u>10</u>	<u>\$18,000</u>	Installation of an toll tag reader for a single lane at a toll plaza.	Tag receiver, cabling.
	<u>License Plate Reader</u>	<u>Per Each</u>	<u>\$25,000</u>	<u>\$500</u>	<u>10</u>	<u>\$30,000</u>	Installation of a license plate reader camera for a single lane at a toll plaza.	Camera, cabinet, cabling.
	<u>Electronic Toll Collection System</u>	<u>Lump Sum</u>	<u>\$50,000</u>	<u>\$5,000</u>	<u>10</u>	<u>\$100,000</u>	Installation of software and hardware for deploying an automated electronic toll collection system.	Software server, commerce server, software license.

Appendix A - Cost Estimate Spreadsheet

Item		Unit	Capital Cost (2009 \$)	Annual O&M Cost (2009 \$)	Lifecycle (yrs)	Total Lifecycle Cost (2009 \$)	Description and Assumptions	Items Included in Costs
Vehicle Devices	Signal Priority/Preemption Emitter	Per Each	\$750	\$100	5	\$1,250	Installation of an emitter on a single transit or emergency vehicle for signal priority operations. Receiver is covered under separate item.	Emitter, cabling.
	MDC/AVL Transponder	Per Each	\$5,500	\$1,000	10	\$15,500	Installation of a mobile data computer (MDC) transponder with automatic vehicle location (AVL) functionality for a transit or emergency vehicle.	MDC transponder, GPS antenna, cabling, power connection.
	Automatic Voice Annunciation System	Per Each	\$8,800	\$1,000	10	\$18,800	Installation of equipment in a single transit vehicle to provide an on-board automatic voice annunciation system (AVAS) with audio and visual announcements.	AVL module, speaker system, on-board processor, message board
	Integrated Automatic Passenger Counters	Per Each	\$2,700	\$200	10	\$4,700	Installation of equipment in a single transit vehicle for an automatic passenger counter (APC) integrated with an AVAS to provide passenger ridership information.	Door sensors, on-board processing unit
	Standalone Automatic Passenger Counters	Per Each	\$7,000	\$750	10	\$14,500	Installation of standalone equipment in a single transit vehicle for an automatic passenger counter (APC) to provide passenger ridership information.	Door sensors, on-board processing unit
	Standalone Security CCTV Camera	Per Each	\$8,000	\$1,000	10	\$18,000	Installation of a standalone CCTV camera with recording functionality on a transit vehicle for security purposes.	Camera, cabling, processor for digital storage of video
	Central Security CCTV Camera	Per Each	\$4,000	\$5,000	10	\$54,000	Installation of a CCTV camera on a transit vehicle that broadcasts to a central location for viewing and recording.	Camera, cabling, processor, communications.
	On-board Diagnostics/AVM	Per Each	\$1,000	\$20,000	15	\$301,000	Installation of on-board diagnostic equipment or automatic vehicle monitoring (AVM) equipment on a transit vehicle for maintenance tracking and in-route troubleshooting.	Engine and other component sensors, on-board processor
	Electronic Farebox	Per Each	\$13,200	\$1,250	15	\$31,950	Installation of electronic farebox in a transit vehicle.	On-board processor, farebox, card reader
	Transit Stop DMS, Large	Per Each	\$25,200	\$2,500	10	\$50,200	Installation of a 10-line dynamic message sign at a transit terminal for providing passenger information.	Sign, wire-line communications
	Transit Stop DMS, Small	Per Each	\$6,700	\$750	10	\$14,200	Installation of a 2-line dynamic message sign at a single transit stop for providing passenger information.	Sign, cellular communications

Appendix A - Cost Estimate Spreadsheet

Item		Unit	Capital Cost (2009 \$)	Annual O&M Cost (2009 \$)	Lifecycle (yrs)	Total Lifecycle Cost (2009 \$)	Description and Assumptions	Items Included in Costs
Vehicle Operations Hardware and Software	Paratransit Scheduling Software	Lump Sum	\$90,000	\$10,000	10	\$190,000	Installation of software and hardware for deploying a paratransit scheduling system.	Software server, software license.
	Operations Management System	Lump Sum	\$300,000	\$25,000	10	\$550,000	Installation of software for managing transit operations.	Software server, software license.
	Trip Planner System	Lump Sum	\$350,000	\$25,000	10	\$600,000	Installation of a web-based trip planner system for passenger trips.	Software server, software license.
	On-line AVL System	Lump Sum	\$250,000	\$10,000	10	\$350,000	Installation of software and hardware for deploying an online real-time automatic vehicle location (AVL) tracking system.	Communication and software server, software license.
	Real-Time Passenger Information System	Lump Sum	\$500,000	\$25,000	10	\$750,000	Installation of a system to determine real-time bus arrival information and disseminate the information for pre-trip and in-route trip planning purposes.	Communication and software server, software license.
	AVAS System	Lump Sum	\$50,000	\$5,000	10	\$100,000	Installation of software and recording station hardware for deploying an automatic voice annunciation system (AVAS).	Software server, software license.
	APC System	Lump Sum	\$65,000	\$6,000	10	\$125,000	Installation of analytical software and hardware for deploying an automatic passenger counter (APC) system.	Software server, software license.
	Vehicle Communications Network	Lump Sum	\$19,000	\$2,000	10	\$39,000	Installation of a bi-directional network for data communications with transit vehicles over a local area.	Communications hardware.
	CCTV System	Lump Sum	\$4,000	\$200	10	\$6,000	Installation of a single CCTV system viewing station.	Workstation hardware and software.
	AVM System	Lump Sum	\$20,000	\$2,000	10	\$40,000	Installation of an automatic vehicle monitoring (AVM) system for on-board diagnostics.	Software server, software license.
	MDC System	Lump Sum	\$65,000	\$5,000	10	\$115,000	Installation of a mobile data computer (MDC) systems with central monitoring.	Communication and software server, software license.
	Paratransit Interactive Voice Response	Lump Sum	\$50,000	\$7,500	10	\$125,000	Installation of software and hardware for deploying an interactive voice response (IVR) system for paratransit patrons.	Communication and software server, software license.
	Fixed Route Interactive Voice Response	Lump Sum	\$30,000	\$3,000	10	\$60,000	Installation of software and hardware for deploying an interactive voice response (IVR) system for fixed route systems.	Communication and software server, software license.
	Runcutting, Scheduling, and Rostering Software	Lump Sum	\$85,000	\$17,000	10	\$255,000	Installation of a system for automated scheduling, runcutting, and rostering for transit vehicles and workers.	Servers, software, software license.
	<u>Commercial Vehicle Weigh Station System</u>	<u>Lump Sum</u>	<u>\$275,000</u>	<u>\$27,500</u>	<u>10</u>	<u>\$550,000</u>	Installation of software and hardware for operating a weigh station with citation functionality.	Servers, software, software license.
NOTE: Other project costs (such as design engineering, contract administration, mobilization, traffic control, and training) are discussed in Section 3.1 of the accompanying report.								
NOTE: Items with costs based on non-local (national) data are underlined.								