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The Technology Is Ready but the FAA Is Not

By Mike Jones

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The recent surge of radar outages at Newark International Airport has caught the attention of politicians, the FAA, and the average American. System failures have been plaguing that airport since the end of last summer. Unhappily, Newark isn't the only tower with problems.

For the past fifty years, the technology and capabilities of America's 520 air traffic control towers has ossified. They are still tall buildings with big windows. The controllers still use analog radios to shuffle aircraft on the pavement below. They still print paper "flight strips" denoting which airplanes will be next on the dance floor. While there have been modest improvements — most towers now have a STARS radar display showing airborne traffic —by and large the actual controlling is done with the Mark 1 eyeball, aided by binoculars.

Low Tech But High Cost

These low-tech towers are ferociously expensive to build and maintain. Each tower needs to accommodate the requirements of the controller's "cab", which is the lofty office where the controllers do their jobs. But they also need elevators, HVAC systems, electrical power, plumbing, fire suppression, break rooms, bathrooms, equipment maintenance, and all the accoutrement of a small office, all perched hundreds of feet in the air.

How expensive? Ridiculously so. The cab for a new tower costs about $100,000 per square foot. The new 370-foot tall tower at Charlotte Internation cost $94 million. Teeterboro got a new tower for only $73 million, while Asheville's (NC) new facility was a deal at only $55 million. Even towers at small G.A. airports cost about $15 million. Because of these exorbitant expenses, the FAA generally is refusing to fund any new towers despite the increased demand for them.

The equipment required for an ATC tower is stipulated by the FAA and varies based on the number of aircraft operations expected at that airport. But each of the components are separate, proprietary systems. The devices don't talk to each other and are not integrated in any way, which increases the maintenance and support costs.

"A new air traffic control tower costs about $100,000 per square foot."

Congress approved $25 billion in the 2021 Infrastructure Investment and Jobs Act for replacement towers, and in 2023 the FAA published a plan implement the replacement of dozens of antiquated control towers with new ones. The new Transportation Secretary, Sean Duffy, has been on television clamoring for $31 billion to fund new infrastructure. But building more costly towers isn't going to bring the system into the 21st century. The FAA is a silo-filled bureaucracy. One observer who works with the FAA told me the organization has a team of sixty people specifying new radio systems. In Canada, the same work is done by two people.

Barely mentioned in all the publicity about "fixing" the ATC system was the opportunity to upgrade the entire airport air traffic control ecosystem with a new capability, usually termed a "remote digital tower." Digital towers are now widely used across Europe and Asia and have been proven to deliver a

significant upgrade in airport ATC capabilities at a far lower cost, with the capital costs alone as much as 90% less than a traditional brick-and-mortar tower.

Four companies have incubated this technology to the point where it now is operationally feasible on a large scale. Saab has had operational systems at Swedish airports since 2015 and also has a large footprint in the UK, including managing all the traffic at the busy London City Airport. Searidge Technology has 35 operational sites in 25 countries. Another leader is Indra, a Spanish technology and consulting firm, who has been working with Kongsberg Defence & Aerospace for the Norwegian government. The other major player is Frequentis, an Austrian technology company joining forces with RTX (formerly Raytheon). Frequentis has invested $100 million in their system, and has the first (and so far only) installation being stress-tested at the FAA test facility at Atlantic City Airport. If all goes well, it could be certified by the end of 2025.

The Frequentis Design

Dieter Eier is the tea-drinking president of Frequentis USA, and he reports the company's background is centered around linking audio and video into integrated command centers. Frequentis built the Scotland Yard control centers in London that integrate video from 60,000 security cameras. The company also had a major integration contract from the FAA in response to the 9/11 disaster. Frequentis is a key supplier of digital voice switches, with installations at over 200 airports, TRACONS, and ATC

Dieter Eier, president of Frequentis USA

centers. Frequentis books about $500 million in annual revenues.

Frequentis is currently on their third iteration of refinements for their remote tower system. Their first installation was in Florida at an Air Force base; their second was at Moody Air Force Base, in Georgia, and the third was in Corpus Christi, Texas. Their latest version is installed at Atlantic City for the FAA certification testing.

Eier estimates they made twenty upgrades to the software while operating down in Florida. “We listened to both the controllers and the results of the evaluation from Miter [Corporation],” Eier said. By the time they were done, “the feedback from Corpus Christi was just overwhelmingly positive.”

Their latest system involves mounting high-resolution visual and thermal cameras on a mast roughly between forty and one hundred feet tall. Eight cameras form the primary system while another eight are back-up systems which substitute instantly and automatically if a failure is detected. On top of the mast are “pan, tilt, and zoom” (PTZ) cameras which are manually operated by each controller, giving them the ability to zoom in on any point of interest. Each camera has a lens-cleaning system which ensures the image is never degraded by rain, ice, or dust. The system collects roughly 22 gigabytes of video and audio data per second and routes it via fiber optic links back to the control center, which can be anywhere.

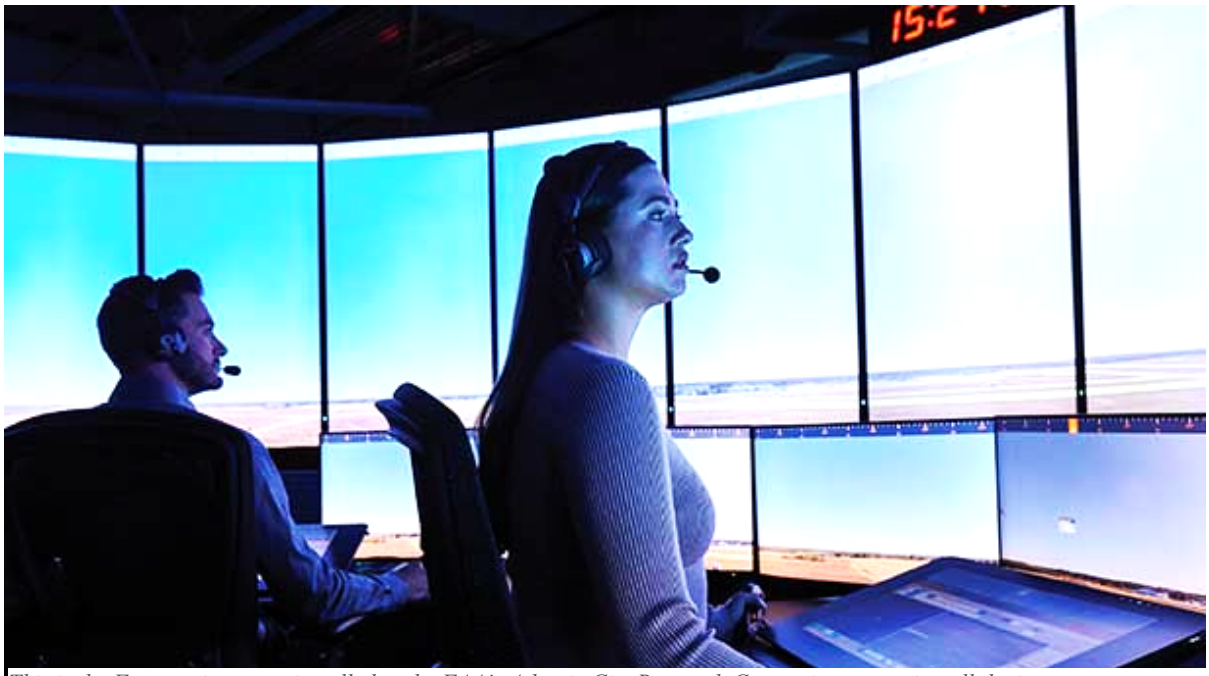
The images are displayed on a panel of fourteen high-resolution flat panel displays arranged in an arc of about 220˚. The video images are compressed so that 360˚ perspective from the mast-mounted cameras is displayed in front of the controllers and they no longer need to twist around to look behind them.

Tim Arnett is the program manager at Frequentis, and has spent six year climbing towers and calibrating cameras. “I thought the high-definition video was wonderful, until you see [an airport] in 4K. Once the controllers saw 4K, they said we have to have 4K. We listened and learned.”

During each installation, they learned more about what the technology could do and what controllers wanted. Two weeks before they went live in Florida they added the joystick to the PTZ camera controllers. “You can zip around the airport like a video game,” Arnett told me.

Arnett was worried about the “stitching” of the images, and the wrap-around effect of compressing a 360˚ field of view onto a 200˚ panorama. In their first tests in Florida, Arnett took his car around the field while one of the controllers was on the phone, looking at the screens. The controller reported the stitching was perfect, without a blind spot or gaps. When Arnett drove off the edge of the display to the right, he and his car instantly showed up on the left side.

“This technology is really, really hard,” Eier agreed, and noted merging videos together seamlessly is an artform. “Plus, you have to project the panorama, the curvature of the earth, onto a flat screen so that it doesn’t look like fish-eye. To make the runway look straight, that’s the art.”



This is the Frequentis system installed at the FAA’s Atlantic City Research Center, incorporating all the improvements Frequentis has developed in their first three prototype installations. This system is configured for the biggest and busiest airports, and could be simplified for deployment at less demanding airports. With luck, the FAA could finish testing and certify the system before year’s end.

Eier reports the system relies on three rapidly evolving technologies: the cameras, the computer monitors, and the availability of fiber optic links. In the past ten years, he reports, “camera technology just didn’t get incrementally better. It jumped! From 2018, when [the Searidge system in] Colorado went in, to 2024 when we built our system at the FAA’s tech center, it’s a world of difference. It’s unbelievable.”

Larry Major is the Director of Business Development at Frequentis, and he concurs with Eier’s opinion of the optical improvements. “I visited the system in Corpus Christi, and the controllers were looking at the 4K screens with binoculars,” he recalled. “I thought they were teasing me. But the resolution on the screen is so good they could actually see airplanes with binoculars they couldn’t see with their eyes.”

Added Capabilities

Compared to an ordinary control tower, the Frequentis system offers controllers a variety of enhanced capabilities that a glass-and-steel tower simply can’t match. First and foremost is enhanced situational awareness.

Because the images the controllers are watching are computer screens, it was easy for Frequentis to label each aircraft, truck, and tug on the airport with a computer-generated tag. That tag follows the aircraft even beyond visual range. Tags can also be generated for prominent navigational reporting points such as lakes, towers, or terrain.

The system also self-generates warning boxes around unexpected or unusual objects, such ramps closed for maintenance. “If an object moves, we put a square box around it. It can highlight a car, or a seagull,” Eier said. “And we’re working on adding [artificial intelligence]. We’re getting better every quarter, every year.”

Tim Arnett is the project leader on the remote digital tower technology for Frequentis. On his left is a typical camera installation for an airport, showing the eight primary cameras. The housing has been designed for sixteen cameras, and the additional eight are back-up systems. Each camera comes with a lens cleaning system to keep snow, ice, dust, or pollen from degrading the imagery.

Of course, night is another issue for controllers relying on their eyes. At night or in fog, airports are incredibly dark, with just the pulsing lights of planes and trucks denoting their progress across the field. With the Frequentis system, the controllers merely switch to the thermal mode. Airplanes, vehicles, and wildlife can be seen in full detail. This reporter watched a recording of a fox as it ran across a runway, directly in front of departing A-10 jets. Neither the controllers in the regular tower nor the pilots in the aircraft saw the near-miss, which could have caused catastrophic damage had the animal been sucked into an engine.

“One time they were having a base exercise, in the woods, they had some people pretending to attack the base,” Eier recalled. “We watched them on infra-

red, and called base security… 'Now he's there, there's another one right there.' That was really interesting. A big boost for security."

Controllers also value the versatility of the PTZ cameras. In addition to their ultra-high resolution — reportedly able to spot airplanes more than fifteen miles away — the PTZ cameras swivel and tilt with incredible speed, using a joystick at the controller's station. "Suppose he's looking over at that hangar, because there's something weird going on," Eier suggested. "He presses this button here and the PTZ Is locked in and automatically will follow the target. These are great tools to help controllers do their job better." The PTZ camera even has a light gun built into the system, allowing the famous red and green signals to be aimed with pin-point accuracy.

> ***"You can zip around the airport like a video game!"***
>
> ***Tim Arnett, Frequentis USA***

The Frequentis system has been built with robust security and the reliability expected from an aeronautical system. The system includes fully automatic redundancy on every component, including electrical power and the diverse routing of the fiber optic links. The system latency is measured in milliseconds, and the system has been engineered to operate ten years between major failures. "You can't add safety on at the end. You have to design it and built it with safety already in it," Eier explained. All of these investments give Eier great confidence the system will pass the FAA's "safety case."

International Experience

Remote towers are increasingly popular outside of the U.S. in countries which have privatized their air traffic control services. Privatized services must be focused on costs and productivity

Today, one of the leaders in remote tower deployment is Norway, which privatized their ATC services into a company called Avinor. As a cost-cutting and productivity measure, Avinor has built a complete air traffic control center in Bodø, Norway with the capacity to run up to fifty airports. The system was based on the Indra technology from Spain. AFIS officer Morten Eliseussen is one of the most experienced controllers at that center.

“My job has become easier and much more transparent,” he emailed to me. “The technical solutions are absolutely fantastic… We have just as good an overview as before, but now it’s on a large screen—and actually much better in the dark, thanks to the infrared cameras.”

Currently, eleven airports are operated from Bodø, and they will transfer three more airports in Spring of 2025. In 2026 seven more towers are planned to be transferred. For even more efficiency, the Bodø system now allows a single air traffic controller to manage up to three towers simultaneously. Norway has invested about $125 million in this project, a far cry from the billions budgeted by the FAA for glass-and-steel traditional towers.

Saab has operations in Sweden but also has been testing their system at Cork, Ireland. In a study published in 2018, researcher Wen-Chin Li estimated a remoter tower reduced operating costs by £1.3 million per year. Perhaps even more importantly, no safety violations or operational issues arose during the live tests. The author concluded the traffic control services were “at least as safe” as the traditional air traffic services.

The systems are spreading, but only outside of the U.S. For example, Frequentis operates a half-dozen remote towers at airports in Germany. Penang International (PEN) and Johor Bahru (JHB) in Malaysia are served with remote control centers centralized in Kuala Lumpur. Australia is deploying the technology at the Western Sydney Airport (opening in 2026).

In the U.S., this technology could have enormous impact. First, it could modernize the out-dated systems used at the existing towers across the

The centralized Indra Systems control center in Bodø, Norway currently is serving eleven airports, some of them hundreds of miles away. Eventually this one center will provide ATC services to all fifty airports in Norway, far less expensively and more efficiently than having fifty lightly-used towers scattered around the Arctic Circle.

country. Secondly, it would be an integrated system, with modern, reliable components sharing data as desired — no more silos of data. It would add capabilities current towers cannot deploy. And, because a remote tower costs about 1/20th of a standard tower, ATC services could be extended to dozens, potentially hundreds, or small airports which could benefit from ATC services.

Is this a potentially big deal? You bet it is. In 2021 (the last year for which I was able to find data) there were 3,076 airports in the National Plan of Integrated Airport Systems (NPIAS). Only 520 of those airports have tower services today meaning something around 2,500 airports vital enough to be included in NPIAS are lacking control towers. These include important airports, like Decatur, Alabama, with 167,000 operations annually and Farmingdale on

Long Island with 165,000 operations. Meanwhile, relatively small airports like Waterloo, Iowa and Groton, Connecticut have towers, even though they each produce a little over 20,000 operations annually. Being able to affordably provide tower services to more airports will be an important boost for aviation safety.

FAA Perspective

The FAA has a poor history of managing innovative technology gracefully. It's a big bureaucracy that is risk-averse. Majors noted that in Canada, a team of only two people test, certify and procure all the aviation radios the airports need. At the FAA, the same work is done by a group of sixty.

But not all of the delays originate at the FAA. Congress has had difficulty funding multi-year technology projects. It also has burdened the agency a bewildering array of sometimes conflicting obligations and constraints, which makes it difficult to operate in a business-like fashion. But these systems are working quite successfully and safely in a dozen other countries. Perhaps the current emphasis on government efficiency will "stir the pot" and allow a modicum of innovation to make it through the FAA's lengthy certification process.

About the Author

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