The SPARC NEWSLETTER
July 2025

A publication of the Southern PA Amateur Radio Club

Repeater Site History

by T.O.M.
Info drawn from IEEE, ATTLL, TPA, Ham and Eggers Club History, Vol. I, II (Jim Ibaugh), and people/places/things I know/knew. ...you asked for it, so it's long.

America. Home of the free. We have fought many wars to stay that way. Like for instance, most of my life was occupied with fighting a long war. Which war was that?

The Cold War. Kruschev pounding his shoe on the table. Bomb drills in school. CD shelters. Air raid siren tests. The UN is the sparring ground. Two evenly matched foes with equal capabilities, at opposite ends, with completely different views of those governed. One valuing person-hood, individual liberties, corn-on-the-cob, good smokes, and self-determinism. The other, collectivism, subservience, self-sacrifice to the state, lousy cigs, and crappy cars.

Like, just before I wrote this article, on our club tower, appearing as if an omen, the eagle watches over it all and decides who is prey and who is friend. I guess I am too old, my meat would be too tough to eat, so I was allowed to pass. Friend.

People were sacred after WW2. We, the “victors”, knew, more than anyone else, the absolute devastation capable with nuclear weapons. All it would take is for someone else, especially unfriendly to our nation-state, for whatever reason, to get their hands on that destructive power, and deliver it here, to these United States.

And that “getting the bomb by someone else” is exactly what happened. Someone else did get this “weapon of mass destruction”, and also developed ways to get them here, like long range bombers and missiles.

What would happen if we had a war? How would we know who got bombed or invaded? Where should we send troops, food, aid, etc? How would our military and people stay connected? The USA is a big country!

Communication infrastructure is one of the things that makes a nation state.

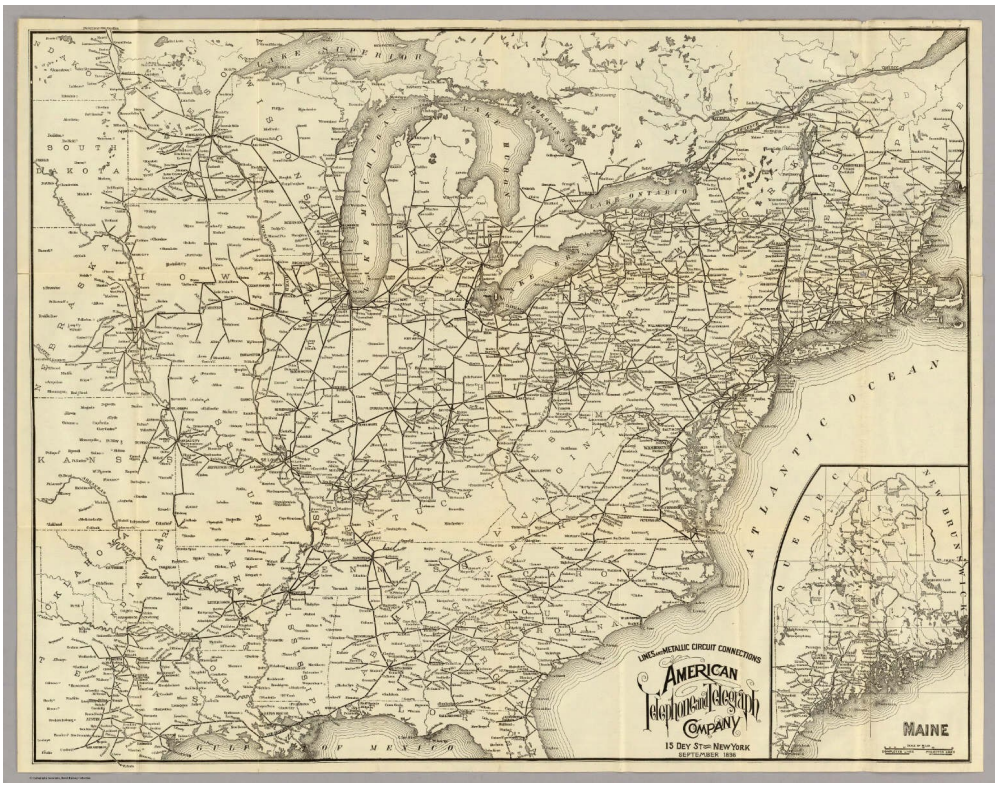
At the end of WW2, we had something that was little better than string-can telephony holding our country communication network together. But wait. In order to make this seem important, we need to do a wee bit of background on the development of our national communications infrastructure. What was the communications structure like in the past? Why is it this way? Who does what? Why?

HISTORY:

Well, let’s look a bit back in time to get an idea what things were like, and see what was available. Like a lot of things, it starts with trains. Let me explain why. Here’s a map of rail

lines around the civil war, 1862.

And here’s a map of the telegraph lines about 1898.



Notice anything? Look closely. The lines seem similar. There’s a reason for this. Telegraph wires were initially owned strictly by the railroads and ran right along side the railroad tracks. The necessity to exchange train schedules, and clock timing synchronism was paramount to reducing the possibility of train collisions, cargo coordination, and passenger lists.

So telegraph lines and their maintenance were initially part of the railroad. But this wasn’t really optimal. You had train people, hired by the railroads, who were not really experts in the new field of electricity, doing long range wire interconnects. These people set up and maintained this long distance communications network. Also, remember, these are telegraph lines. Land-line, DC, CW. Telephony will eventually follow with the development of electrical amplification, the vacuum tube, but not yet.

Sure. The railroads needed these communication lines, but often the lines sat idle. Once the day’s train schedules were passed and the clocks were synchronized between stations, the lines were not needed for the rest of the day. So, some railroad employee quickly got the idea to send messages from town to town as a service. You could go to the train station and pay somebody at the railroad office to send your message to the next town.

During the Civil war, the military and political significance of having a fast, reliable national communications network became a salient interest. As with many things, there was a cross-pollination between commercial and government technical developments.

So, this “inter-town message service” grew, and eventually split off to become a separate company. The company took over care and feeding of the lines, and was called American Telegraph and Telephone. This company had one product. They provided “Lines and Metallic Circuit Connections”, referred to as “long-lines” between cities. The lines initially ran along rail right of ways. The railroad became just another customer to the long-line company, passing messages between stations. Line development, maintenance and upkeep was no longer a railway issue. Train people got back to doing train things.

Meanwhile, many cities also had little local growing independent telephone and/or telegraph companies that passed messages between subscribers in that town. These local companies could pass messages in their own towns, among their own subscribers, but what about from city to city? Well, the railroads were not interested in anything but ATT long-lines on their right of ways. So another telephone company could not just “put up a line” along the tracks. But, the cities were already connected with the ATT long-lines. So how can we hook everything together?

The long-line company had this one expensive, and carefully guarded corporate asset of wires between cities. In a way, it had a monopoly, too. So, what ended up happening was that a local commercial telephone or telegraph company in a city could “buy” time on the long lines to pass messages between other city companies. This allowed local companies to pass long distance messages and phone calls through the long lines. ATT long-lines would charge for the message use.

If you are old enough to remember such ancient errata, there were actually “local” and separate “long distance” charges on your phone bills. This kind of stuff went on well into the 1990’s. Usually, the two separate companies had their respective separate stockholders and profit margins. Long distance communication was an expensive luxury. The long-lines were expensive to maintain, few circuits, and, well, long.

Initially, you had to “get” a long distance line, usually by asking your local telephone company operator. Then you waited as they found you an open circuit on the long lines, and haggled to get you hooked up. Then you were billed for this extravagant long distance luxury. This was the pattern of “placing a long distance call”. Later this was automated in most regions, but even well into the 1980’s, some regions still had pulse dial and operator-assisted long distance.

There were also some companies, like Western Union, that would do only telegraphy, and would bulk lease sets of long-lines between cities, to send messages via teletype. That’s what a “telegram” was. Your message would come in on the teleprinter, someone would cut out the strips of text for you, glue it on a piece of paper, and then it would be hand delivered to you. Thus, the telegram boy was a thing. You paid by the word. It was certainly cheaper than telephoning, quicker than mailing, and replaced manual telegraphy altogether.

-...- (dah-di-di-di-dah, that's a "break" in CW. It means Sam's going to rabbit-hole a little.)

What? Whad'ya say? What's a teletype? Well, it's a mechanical machine you hook to a telegraph line, to … It's mechanical speed was limited by the inertia of… In 1928, Harry Nyquist at ATT labs determined that… There were several kinds developed all around the world to replace human telegraphers that….

Sheesh. Hey. Doesn't everybody have one? Take a quick look in your garage, man! There's probably one there you didn't notice. Here's one of my old ones, in my garage, see?

OK, it's kinda dusty. I don't do much mechanical RTTY nowadays, but I used to. For years, way before JST8CALL, back even before packet radio bulletin boards, even before land line packet BBS systems and 300 baud modems, way-way back when I was in high-school, I had a model 28 ASR teletype with mechanical selective call option (selcall), in the basement of my folk's house.

This machine was hooked to a 2 meter radio (first an AM rig, then FM), that would come on and print only if it heard my call. Using this mechanical device, a modulator-demodulator (modem), and a radio, it would listen to a frequency, all day and night. If this contraption heard my call come over the radio, it would turn itself on, type the message, then turn itself off again. Gee! Who'd ever need that?

That was like e-mail back then, only on radio. Someone could send me a message and I could read it whenever I got around to it. Just think. It was kinda like the Meshtastic things I have now, only people actually used them to send and receive messages to each other, and they were high power ham only. They also magically worked without internet, because there wasn't one. ...Yeah. "What happens if the internet goes down?!" Most of my life was lived with "the internet down", and "no Wi-Fi". I survived.

This brings up a point. One of my sons was telling me how I couldn't tell him anything because I didn't know anything about how he lived now, how different things are, that I could not possibly understand what he deals with, with a life filled with instant messaging, and social media. I said he was exactly right. We old people INVENTED all that stuff.

Maybe I will do a talk and demo on old school mechanical ham radio RTTY sometime. Let me know. I have petty much a whole 1950's RTTY station.

Anyway, I digress. Back to our program.

-...-

By 1909, the long line telegraph (now mostly teletype) and telephone lines went westward, covering the country, and looked like this. They added lines where the populations grew, just like the rail lines grew to where the people were. Even now, air flights, Amazon, Door-Dash, and cell service still does this same thing today. Go where the people and money is.

Something different happened about the mid 1920's, though. This would upset the whole

long-line business. A new communication system came to be, that could provide an alternative to the long line. It was magic. It didn't need railroads, wires and right-of-ways.

It was radio communication. No sooner than radio came to be, that people started to use it to get around the expense and monopoly of corporate long-lines. In fact, the mere presence of the long-lines business gave a boost to the development and investment in the research and properties of improving radio in general. Radio sped up the connection of places both far and remote. No more "long distance" charges.

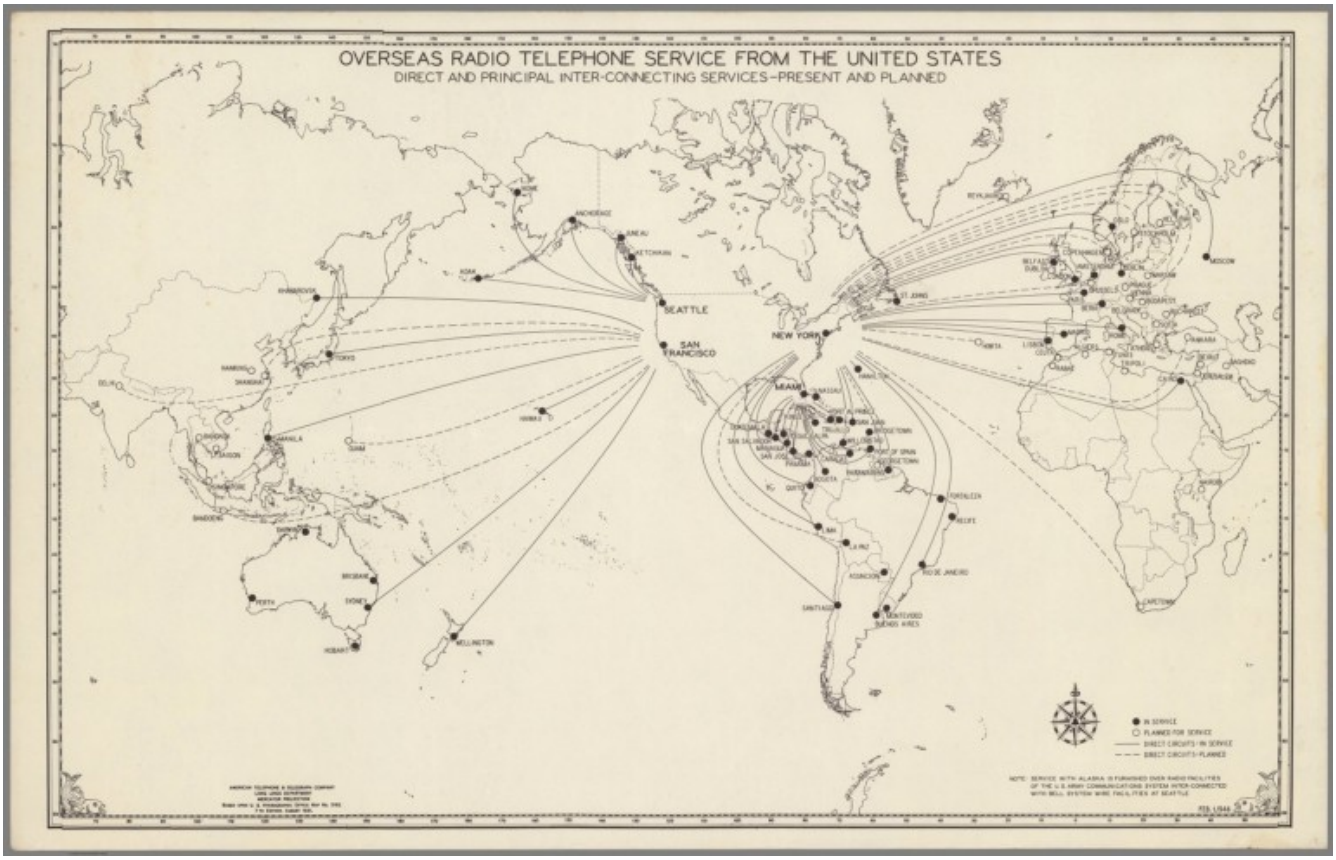
But this didn't happen quickly. Radio was in it's infancy. It showed lots of promise, and there was a lot more to gain from it, but it wasn't ready to replace wires. This new fangled radio did have distinct advantages, though. Long lines generally didn't go to islands or way out in the country, but radio signals did. In fact, radio signals went wherever you wanted to send them, cheaply. …well, most of the time. There was no single company, either. Anyone could put up a radio transmitter. But it was just starting out. How well did it work?

Radio was unreliable. We are talking HF radio back then. The path to magic, far-away places was by ionospheric propagation. Us hams know that HF propagation is not exactly 100% reliable, to say the least. We tend to enjoy this aspect as a challenge, and maybe it fulfills some hunting urge, but to a business man who needs to sell or buy some stock immediately, they need to get their message from the island of Tonga to NYC now, not when the band is open.

On the other hand, long wires just worked, well… when they didn't get washed away, broken, or cut by someone. But compared to HF radio, they were much more reliable. That fickle ionosphere was, well, fickle. Maybe now you can also start to see why satellites became a thing. Imagine a "Radio Relay in the sky!"

As to their credit, the long-line company saw radio as a viable connection method. Why not both? So they also started to invest heavily in developing radio. Ever hear of Bell Labs? This was a research arm of the ATT long-line company. It was here where the computer (switching), transmission line theory (long-lines), transistors (high-reliability amplifiers), space relay (satellites), and all sorts of other things were researched and developed. Radio and ionospheric propagation research was just another thing that came from this private investment by ATT.

So, by the mid 1930's, in addition to long-line wires, there was HF radio links to just about everywhere, with everybody competing to develop all sorts of stuff to make radio better. Companies naturally invested and developed where the future money was. Here's a map of HF based telephone circuits that covered most of the globe:

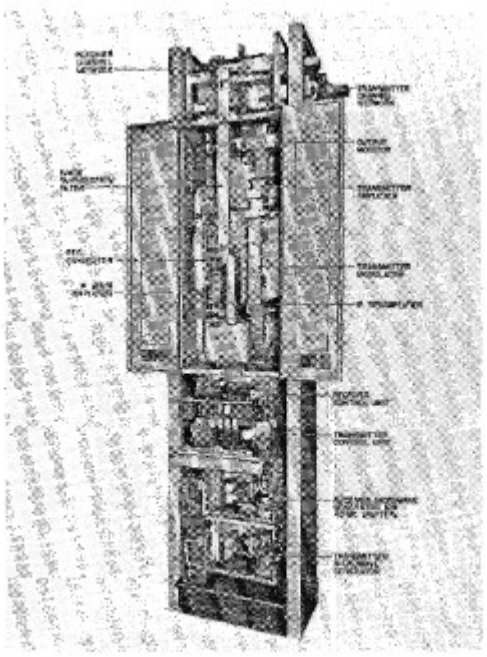


After WW2 and RADAR, there was also all this new microwave stuff that was developed. Microwave, line-of-sight, reliable data communications were in use by the end of WW2. This technology was quickly transferred into the private sector. Microwave radio relay could do away with wires and right-of-way limitations. A system of microwave relay stations could also handle much greater bandwidth at much lower cost than stringing wires or coax.

Thus, the birth of terrestrial microwave relay infrastructure.

The first private sector microwave relay equipment used was WW2 surplus AN/TRC-6 transmitter receivers in the 3.7-4.2 GHz band, honking out a massive 1 watt of RF power. These could support up to 500 multiplexed analog voice channels, or one 525 line black and white TV channel in a 10 MHz bandwidth FM modulation time division multiplex fashion. The initial terrestrial microwave link system was built as a study to compare coaxial to terrestrial microwave links. In the 1945 study, the first cities, New York, Philly, Baltimore, and DC were connected.

Using new theories from Bell Labs, that were developed during the war, the Friis equations and calculations showed that a site spacing of about 27 miles would provide about a 13 db S/N margin with around a 98% reliability. So sites with desired elevations were chosen, and the first link system was put together.



Microwave repeater bay, TD-2 system (Reprinted from the *Bell Syst. Tech. J.* Copyright 1951, AT&T).

The microwave links proved so successful, that by the time the study had completed in 1947, plans had been made to connect all the way to Chicago. ATT also envisioned a country-wide infrastructure of high bandwidth microwave terrestrial links. Coaxial cable generally proved to be equal or inferior in terms of bandwidth, downtime, maintenance, and costs. The terrestrial RF microwave link infrastructure was born.

I can go on, but it's time to drop anchor. Like: "...didn't ATT also develop fiber optics?"

AT&T Long Lines

So now we have a bit of history under our belts, let's get to the microwave sites dotting the countryside. And more to it, how about our site?

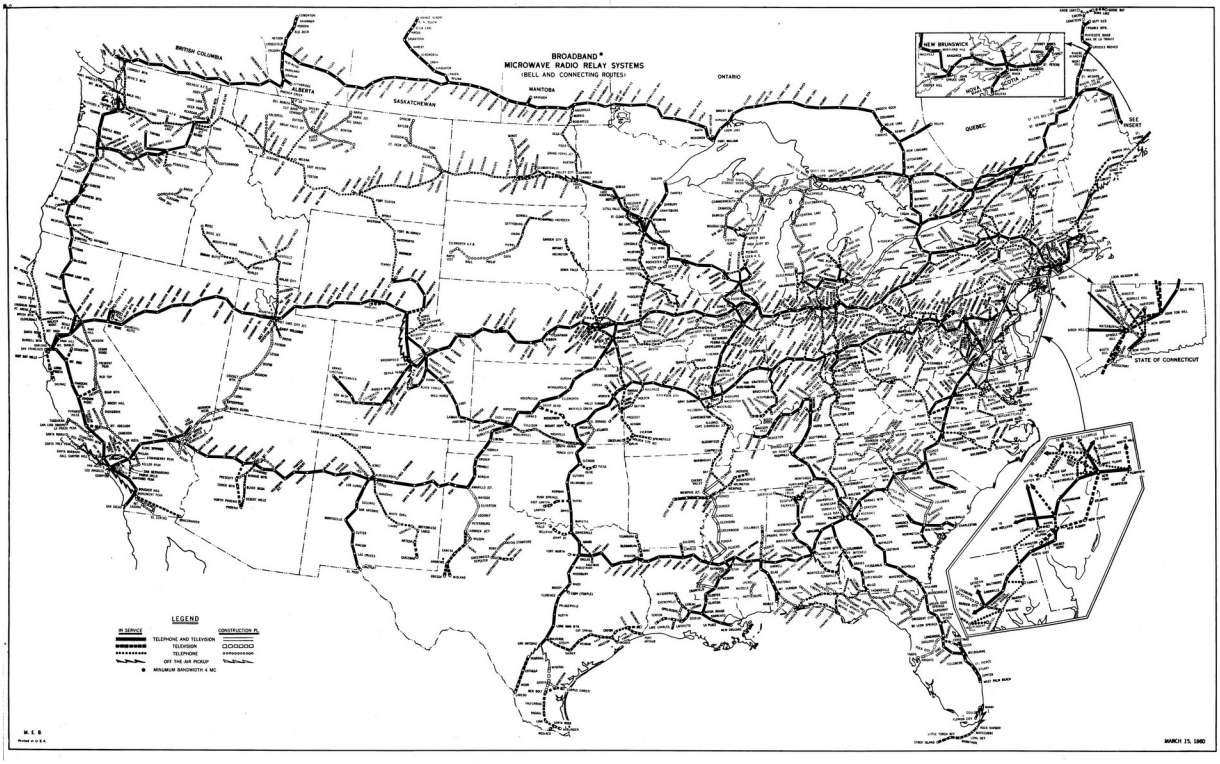
This RF based infrastructure was meant to augment and backup coaxial and twisted pair long line infrastructure. Many cities were connected with both cable and microwave flavors by the mid 1950's. Television also was a new media and was a bandwidth hog, so in addition to coaxial cables, more and more microwave links were used to interconnect cities. Soon, microwave relay sites dotted the landscape.

These “feed scoop” parabolic slice horns were operated around 4-6 GHz. Like the first link, many signals were time division multiplexed for voice, video, and data. Also, take note. These microwave links were the first “digital” modulation schemes to be used widely. So, sampling and digital signal theory developed in WW2, became a part of the electrical engineering curricula in colleges around the country. This was prerequisite “grease” for the future computer development.

Also, these sites continued to connect places previously isolated from each other with telephone and television. Suddenly, you could watch video from anywhere across the country, in real time, on your home TV. This gave television networks and broadcast media great power. Everyone wanted a TV. There’s a fire? turn on the TV. Earthquake? TV. Political rally? TV. Presidential debate? TV. Oh, and don’t forget syndicated broadcast shows. What were once syndicated shows on radio, were now on TV, nation-wide.

Of course, this went both ways. War? TV. Propaganda? TV. Impeachment trials? TV. Riots? TV. Murders and executions? TV. Stupid advertisements? TV. All this, primarily over the terrestrial microwave infrastructure. Yep. Welcome to USA.

By 1960, the US of A was covered with paths of microwave links throughout the country. Take a look at this map, and the older maps and see if there are any correlations. I bet there are places that show on several maps. Some of these sites go way back, were bought from farmer’s fields or taken as chunks of old rail rite-of-ways.

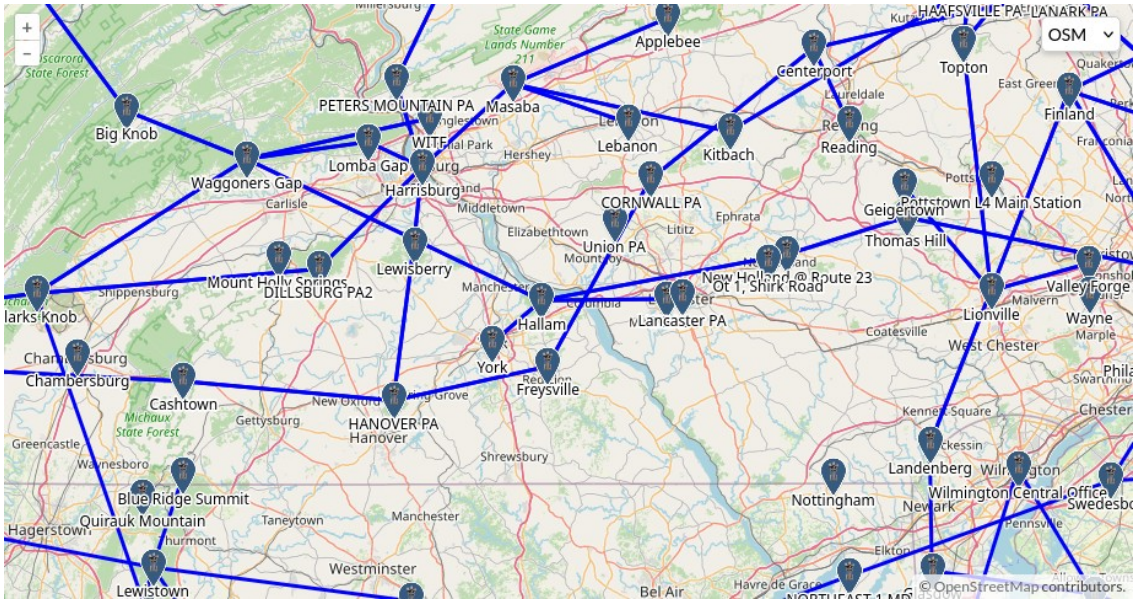


All of these sites were equipped with generators, and some with living quarters, and chosen to provide routing both through major cities, and around them in a bypass mode.

Remember these were all built during the height of the cold war. Some of these sites were even designed to survive nuclear blasts, and were chosen to operate even if a particular city was totally devastated. Others were designed to operate totally automatically, in case, as it said in one ATT operations manual, “...personnel were not available due to fallout.”

Many buildings and structures even incorporated the microwave link dishes as part of their architecture. Just as now, it is trendy to have “...a T-1 line” and “fiber backbone” for your internet connection, it was trendy and a point of great pride to have a direct link to the microwave infrastructure. Many businesses and media companies wanted to have a set of “feed scoops” on their roof. Sexy.

So, many relay sites were located at television stations, hospitals, and businesses. Lancaster General still has some old microwave link scoops. Take a look for me. I haven’t checked in a while. And also, as an aside, LGH used to have a ham station for emergency use, apparently. I wonder if that’s still around. A closet somewhere? Well, anyway, here’s a map of the terrestrial links in our little neck of the woods.



You can see our beloved SPARC site listed as “Union, PA” Also notice that WGAL and WITF have their own sites at their studios. Downtown Metroplex Lancaster has one at the hospital. Beautiful New Holland had one of the earliest sites, as it was key to going west out of Philly. The site is gone, but it was located on “Tower Road”. Go figure.

Notice the sites seem to be in pairs, in some places? Often, a higher site would have another site nearby, that was not as high, to serve as a “backup” or “alternate”. Apparently, this was done on purpose, in case the high site was blasted away somehow. Our “Union, PA” site was apparently a “fill” site for the Cornwall one. It was also probably designed to operate unattended. Fallout, remember?

Some sites are still not listed on-line, and are only known by their ATT designators. These sites are listed as “sensitive”, meaning they are key to the fiber optic backbones and military communications infrastructure. You don’t know where they are, do you? Well, hush up!

Well, what about our site in particular? A short peek around and I found some leftovers. When our site was first purchased, it had some of the cold war requisite parts still in place. It had this nifty mid-1960 diesel generator for backup power with a swell underground fuel storage tank in the front of the lot.

The repeater building also had rack rails where the TD-2, or whatever, racks of equipment were hung. These ceiling mounts are still used by all the repeaters, links, and Wi-Fi-linked chicken-cookers in the building, now. You can still see the old land-line rails in the ceiling, if you look up. See those metal rails? They scream industry standard “telco”.

Also, while you are snooping, take a look at where the cables pass from the tower into the building. Notice those funny rectangular holes that the cables are poked through?

Those rectangles just happen to be the exact dimension for 4 GHz waveguide, so all the waveguide went out there. I think it’s nice we still use these holes to pass RF. (..and an occasional bird.) It’s kinda sentimental, really.

Yes, but as far as equipment goes, that's about all is left of the originals. ATT took the microwave equipment away, probably to be used elsewhere or scrapped. I personally recall when hamfests were awash with 4 GHz waveguide, back when copper was not of scrap value. Now, it's like gold.

Also, the original generator had to go. It was fine, but in the people's republic of PA, having an underground fuel tank of any kind is a great expense, liability, and tax burden. (a.k.a. govt' revenue stream) So, be happy with the new auxiliary power plant. Give it a hug, and trim the weeds away from it when you pass it by, ok?

Look at this place. To start, the building needed painting, and all the old club stuff had to be moved to the new site. Here's what things looked like at first.

So this is where you come in. Yes, it was about $75k, so pay your dues. The mortgage is not free and clear. Donate to the club. It WILL go away if you don't spend the cash.

The club is what it is because you put effort into making it better. Look at it now. Compare to these old photos.

Someone before you had to put in time, talent, and treasure to get it to where it is now. Someone else raised funds, (subs anyone?) begged for grants, put up cash, paid mortgage, bills and insurance, and figured out some way how to make the club work financially.

Still others mowed, cleared weeds, did carpentry, put up antennas, fixed doors and windows, painted, built new buildings, shopped for parts, organized, and did whatever the site needed.

Others even put up antennas, set up and maintained the myriad equipment that is there now, all the repeaters, links, controllers, internet, you-name-it. It's a heap of stuff! I think the site

has more RF flowing through it than it ever did!

And to those that did do, and those that still do, THANK YOU! It is a truly beautiful site, but it will only continue with you, the members. So with our effort, the little “Union, PA” ATT long-line microwave site will exist well in the future.

Maybe I will do more on this later, like exactly what kind of equipment was used or whatever. But that’s enough for now.

Firecracker Hamfest

The Firecracker Hamfest this July 5, brought in only about $150, but that’s better than $0. Drop me an e-mail about who went, who did what, and what was sold, and I will write it up in here. I can’t expect K3TED to remember everything.

Thank you to all those who sold and manned the tables. It was worth the volunteer effort. You guys are some of those who keep the club going, pure and simple, for the rest of us freeloaders.

How’d Field Day Go?

Field day was a great time at the site this year. The taj-ma-potty was even pumped out prior to this special occasion. Mark, K3MRK, manned his smooth, fancy, grill and launched dogs and burgers. Some brought other sides. Many radios were operated external of the power grid, both CW and SSB. Batteries and even solar power was used. The bands this year were ok ...not great, but ok.

Nobody braved the nocturnal shifts, and there was no break in the heat, but we are only old human hams, who need our CPAP machines, nite-cap gin-and-tonics, water picks, beauty rest and memory foam or sleep-number mattresses, anyway. I am not who I was when I was 20 and could sleep on a tree root in a snow drift with a K-mart sleeping bag. No more.

During the event, the peach orchard was sprayed, thus performing a bonus de-lousing of all personnel at the Union site. The farmer came over, took a look at us, and said “...no fear of any genetic problems with you guys. You guys are all too old.” I don’t know if this was to indicate that I was beyond “fathering years”, but I guess so. Anyway, my rash has cleared up since then.

There was off-and-on rain, lightning, and subsequent evacuations to the air-conditioned

comfort of the nifty clubhouse. Nothing blew away, no lightning struck the tower or gear, and everyone's pop-up shelter provided adequate protection. I don't know how we scored, but I, personally, had an excellent time whether on or off the air.

More Plate Tectonics

by Sam W3IHM

Here we are again, back on this thing. Yep.

Every time I powered this rig up on FM, the SSB buttons just mocked me in mocking fashion, with a mockery that galled me to the deepest gall of my visceral mockdom. I HAD to figure out some repair for the IF filter, ANY repair, so I could operate this on SSB again, and shut up those mocking buttons.

Well, I was determined and bound to my cheapskate, frugal, Germanic roots to NOT spend more than the $50 I paid for the rig for another crystal filter. Sure, so what was the solution? Well... Here's what I ended up doing.

I pulled the old filter apart. Sure. Maybe it was just a loose solder connection? A bt of corrosion, perhaps. Maybe just some oxidation on a high Q section. It was made of four filters like these ones.

Yeah. Nothing special. Four little crystal filter elements, only with that danged 10.75 MHz IF frequency. The four were wired in series, with some parallel capacitors, used to align all the individual filters to make a bandpass of about 2.1 kHz. I thought maybe

perhaps just one was bad, open or whatnot. But, no, all seemed to pass RF, but the loss was quite high for each and every one.

Am I nuts? Let's check something. I measured a filter I had, for my Icom IC-751A, just to get an idea what one of these filters would loose, if it was healthy. I had this filter, still in it's little cardboard box, now over 35 years old, in my junk. It looked almost exactly the same. I used that as reference, and my bad filter was over 30 dB worse than that! I tried the two other extra filters I had, both of similar construction, except with a center of around 9 MHz, but they all agreed. That filter was just lossy. Eek!

So I made a 3-pin test jig, complete with 1k ohm loads, and tested each of the four 10.75 MHz crystal filter elements, hoping that only one was bad, but, no, all seem to be lossy. I even tried some of my other 10.7 MHz crystal filter elements I had around, and for whatever the reason, these old Icom 10.75 MHz crystal filter elements were all about 10-20 dB more lossy than anything I had in my extensive junk problem hoard.

So these lossy 10.75 MHz filter elements were maybe dying of old age? Was it a cleaning issue? Was it due to crystal aging? Anyway, what to do?

Well, I took the two of the least lossy ones, and made a two-element 10.75 MHz filter that would have to do. I could tweak the band pass to about 1.9 kHz bandwidth, but the stop band performance was, well, two filters shy. But now I had a loss that was appropriate to what it should be. It wasn't perfect, but it would let me run SSB.

Let me say that I was weaned on a National HRO-7, with an ARC-5 190-550 kc tuneable IF, and the slugs pulled all the way out, so the subsequent two crystal filter IF for SSB and CW useage was even a bit too fancy for my tastes. We are talking 2 meters SSB anyway. The band is not like a contest on 20 meters. I got the opposite sideband down to like 40 dB, so that's fine.

So I am done with this puppy. I can gaze upon it's visage, with peace, now. Sure, but be warned fellow amateurs. Out there in some flea market, is a rig that is tantalizingly cheaper than cheap. It is alluring you, with it's sexy escutcheons, company logos, and fancy illuminated dials. It looks for you, awaiting to pounce on your fiscal cheapness, ready to infect you with bad, lossy, or damaged crystal filters.

The cure is indeed unobtanium. You have been warned.

Meeting Night

The SPARC monthly general membership meeting is the fourth Tuesday of the month,

June the 24th at 7:00 PM. The meeting is being held at the Clubhouse. Bring your snacks and hike out your trash. Who ate all the Cheetos?

License Test Sessions

Testing is conducted at the SPARC site on the first Tuesday of every month. Fee to take the exam. It is $14.00 payable on the K3IR website or in person, cash or check only.

You can pre-register to take the technician test, or upgrade, at Hamstudy.org. There is also a link on the K3IR web site. If you do not already have one, go to fcc.gov and register for a FRN (Federal Registration Number).

Upcoming Hamfests

There may be others. Poke around on QRZ and Facebook, but here's a few.

Saturday, August 9th, 2025

Cincinnati Hamfest
8am to 2pm
Clermont County Fairgrounds
1000 Locust Street
Owensville, OH 45160

CincinnatiHamfest.org

Saturday, August 9th, 2025

Adirondack Hamfest
8am to noon
Lake Pleasant Public Library
2864 State Route 8
Speculator, NY 12164

https://www.adkhamfest.org/home

Saturday, October 1, 2025

Red Rose Hamfest
339 East Main Street

New Holland, PA

www.w3rrr.org

Looking For Volunteers

SPARC currently has 131 “active” members on the roster. We have a lot to offer to our members. At this time we have a dedicated group of hardworking volunteers who keep the site running. Some say this is typical with most organizations. I don't think SPARC should be “typical” We need more real active members. Jobs range from the highly technical to the mundane but ALL are important. Please look at the list below and see if there is a place for you.

IT Team

Tower climbers and ground help

Operating building maintenance and cleaning

Operating building equipment maintenance and improvement

Porta Potty cleaning (not Pumping!)

Adopt a Highway crew

Elmers and Elm’ettes

Hamfest help, planning, etc.

Meeting programs and talks

Antennas! ...always more, bigger, higher.

Someone to take the trash home and pitch it when it’s full.

Someone else to either eat or toss the old stuff in the fridge.

Joke Corner:

Q; “What do you call a group of high-functioning autistic people?”

A; “An engineer’s meeting.”