"Project 25" National Standard Two-way Voice/Data Radio Communications
Implementation Concept & Proposal

Monroe County Control Center

June 24, 2019

Preface

Currently the Monroe County Control Center utilizes approximately forty (40) FCC licensed radio channels to conduct business on a twenty-four hour by 365 days a year basis. We use these frequencies to communicate with our Police, Fire, Emergency Medical Services, Emergency Management and Public Works partners.

99% of our current radio networks are "conventional analog". There is one (1) system that is used by our administration and operations which is a stand-alone P25 digital system. This system is used for field deployments. We chose to utilize "P25" because of its signal quality and the ability to have secure communications for our field operations.

Our analog networks afford no provision for secure communications, particularly with respect to our Law Enforcement folks. These officers are dealing with some very serious individuals and they need secure communications to give them an advantage to enhance their security as they fulfill their duties.

What does "Analog" mean in public safety radio?

A good analogy would be to think of how one's cell phone performed 15 to 20 years ago.   The voice quality was fair to midland specifically; when the signal was poor the conversation quality became very broken up and barely audible, "like talking through a snowstorm". This level of audio quality leads to assumptions being made as to what did the person on the other end of the radio really say, because at this point it's your best guess. This is not a good scenario.

What does "Digital" mean in public safety radio?

A fair comparison would be to think of one's current version cellphone audible quality. It's crisp and clear when there's a signal, and when the signal drops off so does the audio. Simply put, "it's either there or its not".

What is P-25 and how can it help the Monroe County Control Center and its public safety partners?

Project 25 (P25 or APCO-25) is a suite of standards for digital mobile radio communications designed for use by public safety organizations in North America. P25 radios are a direct replacement for analog UHF (example FM) radios but add the ability to transfer data as well as voice, allowing for a more natural implementation of encryption or messaging.

P25 radios are commonly implemented by dispatch organizations, such as Police, Fire, and EMS providers, using vehicle-mounted radios combined with walkie-talkie handheld use.

Starting around 2012, products became available with the newer phase 2 modulation protocol, the older protocol known as P25 became P25 phase 1.

P25 phase 2 products use the more advanced AMBE2+ vocoder, which allows audio to pass through a more compressed bit stream and provides two TDMA voice channels in the same RF bandwidth (12.5 kHz), phase 1 can only provide one voice channel.

The two protocols are not compatible. However, P25 Phase 2 infrastructure can provide a "dynamic transcoder" feature that translates between Phase 1 and Phase 2 as needed. In addition, phase 2 radios are backwards compatible with phase 1 modulation and analog FM modulation, per the standard. On the other hand, EU area created the standard for Terrestrial Trunked Radio similar to Project 25.

From the Series: "The Tait Radio Academy"

"The radio technologies previously mentioned are all open standards, which means that equipment from different manufacturers can work together. Digital radio, however, does offer some particular advantages over analog.

Security: One of the most important advantages is security. With digital, encryption can be used without degrading the quality of the audio or the range at which the radio works.

Data: Digital radio technologies make use of IP-based networks. This means that the data capabilities are increasingly flexible.

Spectral efficiency: Digital makes better use of channels than analog, so the utilization, or spectral efficiency, of digital systems tends to be greater than for analog systems.

Clear audio: There is also a better opportunity for reducing background noise in digital, because we can screen the noise and interference out more effectively. This occurs all the way to the edge of coverage – giving clearer audio than analog at greater distances.

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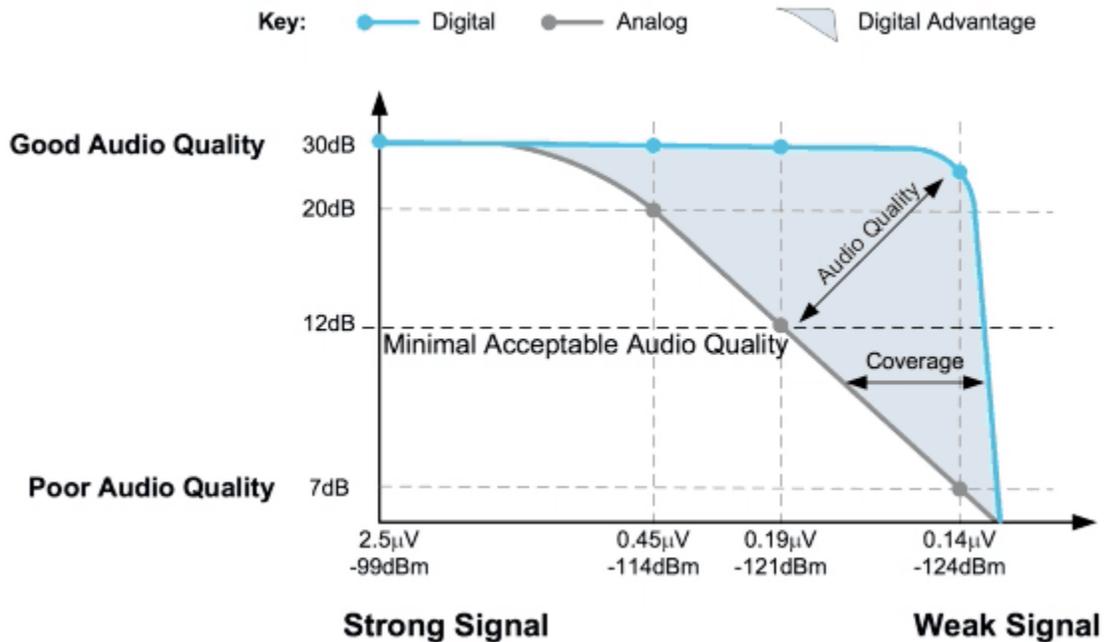
These are some powerful advantages of the modern digital standards that have emerged over the last few decades."

Why should we consider a change to the P-25 technology?

Each year we see a consistent increase in the number of calls for service. More importantly as one Fire Chief said to me in a meeting, *"We now have homes and emergency calls in places where we didn't have homes before, and now that we do our radios do not work".*

This single statement tells me that:

    A. New Homes equal more people. More people, means more opportunity for incidents to occur; i.e. the calls for service/response continue to rise.

    B. Our radio coverage or "footprint" hasn't changed, however, there are places where we've never had people prior to the last several years. The original radio coverage was originally designed to cover what was "the need" at the time of the installation. The needs of our providers and our agency have dramatically changed.

Our Police officers, by virtue of the increase in criminal activity, are spending more time out of their vehicles and inside of buildings handling investigations. They are working more in a "mobile environment", whether on foot and using their portable radios or in their patrol vehicle, which has become their "mobile office".

- Current radio resources; we are operating on thirty-four (34) radio channels and networks which our folks are responsible to monitor. Even though there is the perception of a lot of channels, they allow for only one person to talk on them at a time.

- When a frequency is busy all others on the channel have to wait, or they have to change their radio channel which is not always an option because of circumstances that they might be engaged in.

- We are licensed on more radio frequencies than any of our surrounding Counties. However, in retrospect, we are underutilizing the potential of efficiencies that could be afforded to us through a regimented implementation process. This process would make the consideration for planning, budgeting and implementing more palatable for us and our field providers.

- A police officer that has a real emergency would have no way to inhibit anyone who has his/her normal operating channel to stop talking.

- With a P25 trunked network, as the systems administrator, we'll be able to set "network access priorities" to provide those that require immediate system access to do so. In addition we will be able to disable unauthorized user radios on the system.

- The system I'm proposing would be manufacturer agnostic and it is based upon a National Standard. This means to the end users that they will have choices of radio manufacturers. They will not be tied to one manufacturer to "hold them hostage" for product limitations or pricing.

How Could We Improve Our Radio Coverage?

1. The first "normal" steps would be to:

   a. Add additional radio repeaters.
   b. Add radio voting receivers in more places.
   c. Add additional tower sites, which means real estate and construction.
   d. Try to change our current radio systems to a different frequency/band.
   e. Apply the benefits of newer technology to maximize the existing frequency's being used and not have the impact of new construction or buildout costs.

   All very expensive and each a very slow and time consuming process,

   There are significant costs associated with real estate acquisition, construction of towers and buildings as well as the cost of the radio equipment and other ancillary expenses.

2. Other: This is a very expensive as well as a long drawn out process, and most likely the optimum band is not likely to be approved due to already existing channel congestion.

3. To attempt to apply the capabilities of new and emerging "technology" to maximize the existing frequencies being used and not have the overall "new construction" or buildout costs with the other options.

4. There is a transition that makes sense. I am recommending a "phased-in approach" which will work towards building radio coverage first, and capacity in the later stages of the project.

5. Finally, when you migrate to a real true P25 National Standard format, field users will have the opportunity to have options with respect to numerous radio manufacturers. The equipment is not proprietary to one single manufacturer.

How Could We Increase the Capacity of our Radio Networks?

1. Adding more radio channels. This requires additional radio and ancillary infrastructure, but it also keeps the number of available radio channels unmanageable from a field provider's perspective, but also from a dispatcher's view. One person can only be held responsible to multi-task to a certain point. Extending that threshold could compromise the field unit's life-safety. One issue is that this does not fix the problem, but actually exacerbates what the real issues there are.

2. Adding more radio channels is time consuming, very expensive, does not increase the efficiencies of our staff and most likely would not occur through the FCC license coordination process.

3. What about a "phase- in" approach?

Why consider a "Phased-in" Plan to migrate to P25?

Overall Objectives:

- To allow for our agency and our partners to have ample notice to change out their equipment.
- To give our agency a sustainable approach to which we can budget in a reasonable way.
- To enhance radio coverage in a sensible and systematic way.
- To provide additional capacity "buildout" for more field users radios.
- Any solution must be done in a systematic and methodical fashion so that we and our partners can grow together and without bankrupting either one of us in the process.
- To build a system in such a way so as not to purchase it now and totally replace it in five years or so.
- To incorporate any components currently in place now into a "master system" in the future.
- To take advantage of today's technology moving into the future.

Proposed Project Implementation Plan

P-25 Transition Phase 1-step 1 (May 2019)

In order to understand what impact and benefits a digital P25 radio system can have for the end users, MCCC will provide a countywide P-25 Interop simulcast radio channel for user agencies to experiment with in their jurisdictions.

This new six-site simulcast P25 dual mode, UHF radio network, which will be initially take the name, "P-25 IOP" (Interoperability), will be broadcasted from the following MCCC tower sites; Camelback Mountain, Foxtown Hill, Pimple Hill, Coolbaugh, Wind Gap, Shawnee Mt. and Monomonock. Utilizing the control center's recently upgraded microwave radio network, the six transmitters will simulcast (at the same time in synchronization). This will result in a blanket of coverage throughout Monroe County.

Once completed and officially online, a twelve (12) month evaluation period will commence. It is during this period that Police, Fire, EMS and MCCC personnel can test the signal levels and coverage in their areas to determine how the coverage and audio compares to their existing analog radio channel(s). This window of time affords them the opportunity to experiment with, and get used to the difference in audio quality between analog and digital.

Included in this step will be the acquisition of radios for coverage tests.

Budgetary Cost: $312,315.84, 00 (PA Co Stars Contract 012-108)

P-25 Transition Phase 1-step 2 (October 2019)

As EMS communications in Monroe County are in the VHF radio spectrum, a single site P25 VHF conventional channel will be brought online at the Camelback tower site. While not simulcast like the P25-IOP channel will be, this will give EMS users the opportunity to converse on a VHF P25 channel and become acclimated to the audio produced in digital mode. This step will add capacity to the already overcrowded single channel for EMS operations.

Budgetary Cost: $39,886.60 (PA Co Stars Contract 012-108)

Note: (Optional: 100% Performance Bond for Phase 1- add $5,635.22 to the total of Step 1 & 2)

P-25 Transition Phase 2: (Mid-year 2020)

To install two (2) additional parallel P25 National Standard Conventional Simulcast Radio networks. Again using radio frequencies that are already licensed by the MCCC.

After that network is installed, optimized and accepted, move on to Step 3.

Cost of Step 2: $500,000,000.00 (**Budgetary**)

P-25 Transition Phase 3: (Spring 2020)

This phase of the migration involves interaction with the public safety agencies. Now having had the opportunity to field test the P-25 IOP channel for several months; Fire, Police and EMS should now have an understanding of P25 digital signaling. In order to ensure field users are satisfied with what's to come, user group meetings will occur during this time to address their concerns, solicit feedback, and consider integrating ideas and suggestions they have which may work to the benefit of all. With the information gathered, the final planning stages for a countywide P25 Phase 2 radio system can take place. It is during this phase that the Fire, Police and EMS agencies should finalize their arrangements to complete the purchasing of P25 capable radios. ***See the P25 Portable and Mobile Radio Specifications segment for specifications.***

P-25 Transition Phase 4: (2021-2022)

The fourth and final phase of transitioning to a new countywide P25 radio system provides for the complete build-out of a multi-channel, multi-talk group P25 Phase 2 trunked radio system.

Using MCCC's existing UHF radio frequencies and microwave network, additional simulcast transmitters and TAC receivers will be installed at the MCCC tower sites. The existing analog

conventional radio networks will remain active in 'mixed mode' while the new system is brought online.

The implementation of the "Trunking Controllers" will allow the integration of all five P25 systems to be fully integrated and act as a full Countywide P25 National Standard Simulcast Trunked network.

A trunked system of this size would provide for future expansion of additional radio traffic and be able to accommodate more user radio units as our call volumes increase exponentially.

Trunking is not "new" technology by any means. Trunked systems have been utilized for more than twenty-five (25) years. They were first used in metropolitan or even more often statewide radio systems to improve coverage and add capacity to areas where there was no additional available radio frequency spectrum to be granted by the FCC.

It is during this period that all field users should complete their transition to the appropriate P25 radio equipment. Radio equipment will be programmed with both the existing analog conventional channels, and the new P25 channels. This can typically be achieved by grouping channels by zones in the radios. When the time to transition arrives, the users can simply switch to the P25 zone(s) in their radios and commence using the new system.

The "Slow Growth" Rationale:

By taking a slow grow transition process, it would allow our agency as well as our local Police, Fire and EMS partners to transition over as their equipment reached obsolescence and their budgets are established to accommodate these changes.

This transition plan also provides for repurposing and incorporating as much of our existing radio equipment into the new system.

Finally, a transition such as what is being proposed, allows for that during each phase. There is adequate time for testing as each project is energized and before turning it open to all field users. Again, this phase-in methodology allows us to immediately address any issues before moving onto the next phase or spending additional funds.

Even in a "perfect world scenario", I wouldn't recommend a "total systems changeover". One phase at a time, address the issues as they come up, and then only after exhaustive testing of each phase and "acceptance" then and only then, move on to the next step.

Overview:

This transition also takes into consideration that during any phase should the radio technology change, we can adapt accordingly. We wouldn't have to be concerned about a total outright "fork lift replacement" scenario.

As each project milestone is finished, and equipment is installed and deemed "Accepted", it now becomes part and parcel of our "Master Communications Network Upgrade Plan".

Note: Field providers will still be able to keep their own individual radio system networks because, going this route is "backwards compatible" with their own individual systems.

The end goal, a "Trunked network" provides for many advantages of radio network management. Some of

the features that come with this type of system design are:

- Able to inactivate non-authorized or stolen radios from the network remotely.
- Allow for "dynamic regrouping" of the network; add capacity or talk groups "on-the-fly".
- Set network priorities for users. Not every user deserves the highest priority access.
- Allow for the inclusion of incorporating municipal Public Works Departments, local and County Emergency Management officials, Building Codes and Zoning Codes Enforcement Officers.
- Add total radio "interoperability" so that our different agencies and departments can talk directly to each other.

Even though we have a multitude of radio networks, none of these are integrated with each other, nor do they allow us additional "capacity" as radio traffic increases and additional field units are added.

Our data reflects not only the number of calls for service increasing, but what is more alarming is the severity or the degree of the criminal activity.

Radio Equipment Generic Radio Specifications:

These specifications are recommended because there are at least five (5) radio manufacturers who can meet this performance and features. These are not proprietary to any one vendor.

P25 Portable and Mobile Radio Specifications

As previously indicated by MCCC, any agency purchasing two way mobile and portable radios should only purchase devices that are P25 enabled or P25 capable with a software feature upgrade. To be functional on the new system, the specification for the radios must include the following…

- Analog Conventional Software
- P25 Conventional CAI (Common Air Interface) Software
- P25 Phase 1 Software
- P25 Phase 2 Software
- P25 Trunking Software (if listed separately in the manufacturer spec from Phase 1 & Phase 2)
- MDC ID for push to talk ID in the existing MCCC analog radio system. Some manufacturers may list and charge for it as a separate software feature. Until the new system is activated, MDC ID is still required. The new system will use digital signaling for ID transmission, not MDC ID.

The following software features *are not needed or are required* to work in the future MCCC P25 Network because they can add extensive cost to each device and ultimately the end user.

- OTAP and OTAR (Over the Air Programming and Over the Air Rekeying)
- GPS Location Services
- IP Data
- Multi Key AES/DES Encryption
- Link Layer Authentication

Optional:

"Intrinsically Safe Certification":

This is a feature which allows the radio to be used in certain hazardous environments? It's not mandatory and is NOT necessary for operating in the MCCC P25 network, it should be at the discretion of the purchasing agency; but may be desired by certain public safety organizations.

"AES/DES Single Key Encryption":

Is not required for operating on the system, but it is now typically available in P25 radios at no additional cost. You may see this as a separate line item in the manufacturer specification and / or quotation. *If it is offered at no additional cost, add it to your radio.*

Recommended Features for provider's serious consideration:

Visual displays indicating the "Channel/Talk group" name and other status icons are highly recommended.

Batteries:

For portable radios a minimum of a 2200 milliamp hour (MAh) battery is recommended.

Network Setup-Field Users:

As the new system is developed and prior to launch, individual trunking IDs will be provided by MCCC. These identifiers will be necessary for the devices to access the network. All devices must be registered with MCCC in order to receive the required trunking ID and gain access to the network.

Summary:

In closing I would reiterate that "a change" has been discussed openly with our providers over several years.

I've been strongly suggesting to all of our Police, Fire, EMS providers that as they begin to replace their two-way radio equipment that they should be heading in the direction that meets the "P25 Standard".

Our system, as designed, will allow folks, including the Control Center to have equipment options and that is something some of the larger vendors would not normally do because they want to have set the "hook in" so you must come back to them for anything.

I do not believe that is the correct or fair way to expect cooperation with any type of collaborative partnership that we have now with our partners.

As always I welcome any questions or comments.

Gary A. Hoffman, Director of Communications, Monroe County Control Center