

Craig County Radio System Roadmap

Introduction

Craig County's agencies operate disparate radio systems, which include hybrid low-band VHF and UHF analog radio systems. The goal of this project is to design an upgraded radio system which will allow for seamless interoperability for the County's Sheriff, Fire, Rescue, and EMS Department, Emergency Operations Center (EOC), and Public Safety Dispatch Center with considerations to improve interoperability with agencies in the surrounding counties.

To accomplish the goal of this project, the County will need to build out the radio system in stages. Each stage will improve the radio system condition and reliability. The use of this staged approach will allow the County to utilize grants and other funding streams.

This road map will provide recommendations on a technical path the County can use to accomplish the goal of a unified UHF P25 conventional radio system.

Stages

It will take multiple stages to reach the end goal of a unified P25 radio system. Each stage will move the County towards a P25 system using each interim stage to provide independent improvements to the existing communication environment.

Stage 1

This stage will involve an overhaul to the infrastructure that supports all public safety agencies in the County, building the foundation for improvements going forward. These items are not required to be built out in the order list below. Some items will logically come before others, and they will be noted.

Dispatch Consoles

Craig County currently uses two dispatch consoles in the dispatch center and generally only one telecommunicator is on duty at any time. The existing Zetron 4010 consoles are older analog consoles and upgrading to new software-based consoles will provide features that can assist the telecommunicator during busy times when there are multiple radio calls. New consoles will be capable of patching channels together to allow different agencies to communicate. In keep with the goal of a P25 system, the consoles will be capable of being interfaced into a P25 Console Subsystem Interface (CSSI), allowing them to interface into the legacy system in use today.

Currently, there is a third console located at the EOC that also needs to be replaced. The existing grounding at the EOC also needs to be upgrade for more robust lightning protection. Adding electrical surge protection is also recommended, to prevent equipment damage from commercial electrical surges. Upgrading the console at the EOC will need to be consistent with the upgraded consoles in the dispatch center. Using the same consoles will require dispatchers to be trained on one type of console only and facilitate seamless transitioning during emergencies from the dispatch center to the EOC.

Connectivity

The current disparate radio systems rely on RF control links for dispatch to connect to the repeaters at Potts Mountain and Sinking Creek. The current RF links are not capable of providing the higher data rate necessary for an IP based P25 radio system. Connectivity for a P25 system will need either a microwave network, a fiber network, or a combination of both.

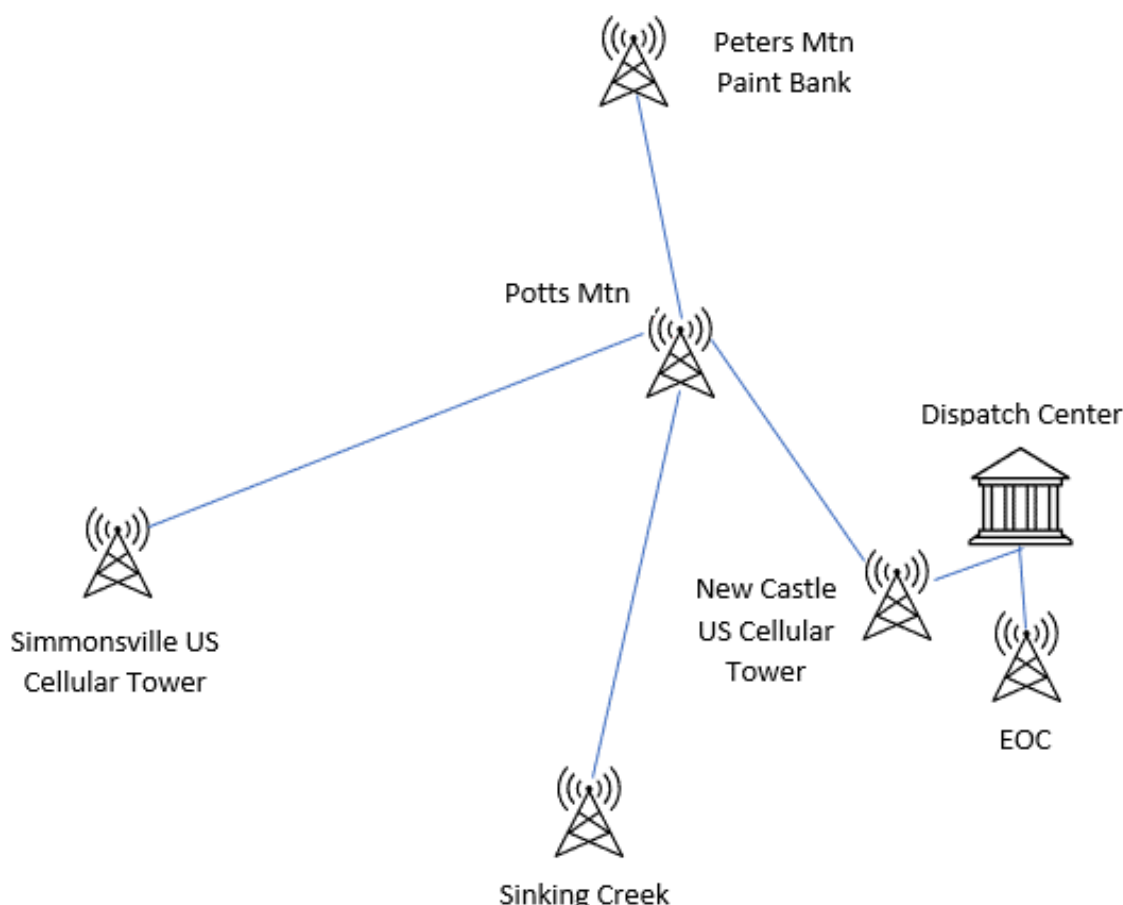


Figure 1 - Microwave System Diagram

Connectivity between the sites is a challenge due to the unique terrain of Craig County limiting line-of-sight. There is tower to tower line-of-sight from Potts Mountain to Sinking Creek and Potts Mountain to Simmonsville US Cellular.

Dispatch does not currently have line-of-sight to any of the existing radio tower sites. For the paths that do not have line-of-sight, an intermediary tower will be required. To provide connectivity between Dispatch and Potts Mountain, the US Cellular New Castle tower will be necessary.

A short Microwave link between Dispatch and EOC will also be necessary to provide connectivity to the EOC so it can operate as a backup Dispatch utilizing the existing Computer-aided Dispatch (CAD).

Commercial grade outdoor microwave radio units that mount to the back of the microwave antenna can be used. This will allow most of the equipment to be tower mounted, only requiring power and a network switch to be at ground level.

Microwave Links will require coordination for licensing of the frequencies. A physical path survey will be needed to verify a reliable line-of-sight. All towers having microwave antennas installed will also require a structural analysis be performed and this analysis may indicate structural strengthening is needed to support the microwave antennas and other equipment. This cost is unknown at this time.

Frequencies

To improve operational efficiencies and radio talk-out coverage four simulcast UHF frequencies are required. We are implementing simulcast technology to allow reusing the same frequencies at all sites. Simulcast technology also benefits the users as they will not be required to change radio channels as they communicate throughout the County.

The frequencies will need to be high power, ERP (Effective Radiated Power) of 200 Watts or greater and have a frequency separation of 250 kHz. Both Potts Mountain and Paint Bank are located in the National Radio Quiet Zone and will have power limitations towards Greenbank, West Virginia. Any frequency used on these sites must be coordinated with the National Radio Astronomy Observatory (NRAO). The future P25 system will not use Potts Mountain as a repeater site mitigating the need to coordinate with the NRAO. However, Paint Bank will be used as a repeater site and his coordination will be necessary.

When licensing these frequencies, the option for an extended buildout will be used, to accommodate the amount of time that may be needed to fully implement all stages.

Paint Bank Coverage/Microwave

With the current UHF systems, radio coverage in the Paint Bank area is limited. A new repeater site is needed to improve radio coverage in this area. A potential radio site has been identified on Peters Mountain, and a short tower will provide line-of-sight to Potts Mountain. The Peters Mountain site should be located near the power line easement, above route 311 on the mountain. This will be a greenfield site; which is a site that does not currently have a tower, shelter, or power. The County will need to negotiate with the landowner to purchase the land or lease the land. An access road will be needed and clearing of the site is required. A guyed tower should be installed to support the LMR and microwave antennas and the height of the tower will be dependent upon the surround tree heights and the necessary spacing for antennas about the tree line.



Figure 2 Proposed Repeater Site In Paint Bank

Initially, the County can provide a single UHF repeater for the Paint Bank Fire & Rescue Squad and a second UHF repeater for the Sheriff's Department. When the repeaters are purchased, they must include all required licenses and modules to operate in the P25 conventional mode. Additional repeaters will be added, in subsequent stages, for the simulcast radio system.

Connectivity will be provided by a microwave link to Potts Mountain. The microwave antenna must be mounted at a height above the treetops, to provide clear line-of-sight to Potts Mountain.

Use of a transmit combiner and a receive multi-coupler with a single Tx and a single Rx antenna, in isolation, will reduce the number of antennas and transmission lines installed on the tower. A tower top amplifier (TTA) will improve the talk-in coverage for portable radios. Much of the coverage in the County is limited by terrain, and the addition of an amplified multi-coupler and a TTA will enhance talk-in coverage.

The use of a telecommunications cabinet is a cost-effective solution to house the radio equipment. The cabinet will air conditioned (HVAC) to provide an appropriate environment for the radio equipment. A UPS and generator will be added for backup power.

Sinking Creek

A structural analysis will be required, and structural strengthening may be required to support the microwave dishes and waveguides, LMR antennas and transmission lines. An assessment of the site will determine any grounding upgrades needed.

Potts Mountain

A structural analysis will be required, and structural strengthening may be required to support the microwave dishes and waveguides. An assessment of the site will determine any grounding upgrades needed.

US Cellular New Castle

Acquisition and leasing of the US Cellular New Castle site will provide connectivity between the Dispatch Center and Potts Mountain. A structural analysis will be required, and structural strengthening may be required to support the microwave dishes and waveguides, LMR antennas and transmission lines. An assessment of the site will determine any grounding upgrades needed.

US Cellular Simmonsville

Acquisition and leasing of the US Cellular Simmonsville site is needed for installation of the Outdoor microwave equipment. Structural analysis and any structural strengthening required to support the microwave dishes and waveguides, LMR antennas and transmission lines. An assessment of the site will determine any upgrades of the site grounding.

Stage Two

Sinking Creek

Improvements are needed to the access road for easier site access. Upgrades to the equipment cabinet with surge protection and HVAC conditioning, will provide proper climate control for the radio equipment. Improvements and extensions to the site fencing will maintain site security.

A UPS may need to be added for backup power; however, it may be possible to use the existing emergency generator.

US Cellular Simmonsville Site

Adding P25 repeaters and the simulcast radios equipment at US Cellular Simmonsville tower site will provide increased coverage to the Simmonsville area and improve coverage in the south. It will also provide coverage to the Johns Creek area.

Connectivity to the US Cellular Simmonsville tower is required for the microwave link to Potts Mountain. The US Cellular Simmonsville site will require an equipment cabinet with HVAC and surge protection.

Two new repeaters will be installed with new antenna equipment, for fire/Rescue and Sheriff's office. When the repeater is purchased, it should include all required licenses and modules to operate in P25 conventional mode. A combiner, multi-coupler, TTA and antenna networks will need to be installed.

A telecommunications cabinet will be needed to house the radio equipment. The cabinet will be conditioned (HVAC) to provide an appropriate environment for the radio equipment. A small UPS and generator will be needed for backup power.

Stage Three

US Cellular New Castle

New P25 repeaters and the simulcast equipment will be installed at the US Cellular New Castle tower site. This will provide improved coverage in the northern part of the County.

Connectivity to the US Cellular New Castle tower will be provided by a microwave link already in place.

A telecommunications cabinet will be needed to house the radio equipment. The cabinet will be conditioned (HVAC) to provide an appropriate environment for the radio equipment and have surge protection. A small UPS and generator will be needed for backup power.

Stage Four

In State 4 we will upgrade the infrastructure to operate in P25 simulcast mode. Additional repeaters purchased in this stage should be of the same make and model, as those purchased in Stages 1 and 2, for ease of maintenance.

Sinking Creek

Four new UHF P25 conventional repeaters will be installed on the Sinking Creek tower and will operate in analog mode until all users have P25 subscribers. When the P25 repeaters are delivered, it will include all required licenses and modules to operate in P25 conventional mode. A combiner, multi-coupler, TTA and antenna networks will need to be installed and the existing equipment will be removed.

US Cellular New Castle

Four new UHF P25 conventional repeaters will be installed on the US Cellular New Castle tower and will operate in analog mode until all users have P25 subscribers. When the P25 repeaters are delivered, it will include all required licenses and modules to operate in P25 conventional mode. A combiner, multi-coupler, TTA and antenna networks will need to be installed and the existing equipment will be removed.

US Cellular Simmonsville

Two new UHF P25 conventional repeaters will be installed on the US Cellular Simmonsville tower and will operate in analog mode until all users have P25 subscribers. This will complement the two UHF P25 conventional repeaters installed in Stage 2. When the P25 repeaters are delivered, it will include all required licenses and modules to operate in P25 conventional mode.

Paint Bank

Two new UHF P25 conventional repeaters will be installed on the Paint Bank tower and will operate in analog mode until all users have P25 subscribers. This will complement the two UHF P25 conventional repeaters installed in Stage 1. When the P25 repeaters are delivered, it will include all required licenses and modules to operate in P25 conventional mode.

Simulcast Equipment

Simulcast equipment, including geo-redundant control points, voters, GPS, and network equipment will be needed dependent upon the specific vendor selected to implement this project.

Dispatch

Upgrading or adding a new logging recorder will be required. The logging recorder will need to be installed and integrated for the P25 system.

Stage Five

Grants and other funding will assist the agencies in upgrading their subscriber radios. These subscribers will be P25 capable and have the needed licenses to operate on a P25 conventional system.

Upgrade equipment for Sheriff Department

- Mobiles: P25 Conventional, single band, AES encryption, program & trunk mount installation, remove 10 existing mobiles
- Portables: P25 Conventional, single band, standard keypad, AES encryption, program, spare battery, belt clip, desk charger, lapel speaker/mic
- Control Station: P25 Conventional, single band, desktop, AES Encryption, desktop microphone, AC power supply, program, installation, antenna

Upgrade equipment for Emergency Management

- Mobiles: P25 Conventional, single band, program & dash mount installation, standard antennas
- Portables: P25 Conventional, single band, standard keypad, program, spare battery, belt clip, desk charger, lapel speaker/mic, and 1 multi-charger unit (6 bays)
- Control Station: P25 Conventional, single band, desktop, desktop microphone, AC power supply, program, installation, antenna

Upgrade equipment for Rescue Squad

- Mobiles: P25 Conventional, single band, program & dash mount installation, standard antennas
- Portables: P25 Conventional, single band, standard keypad, program, spare battery, belt clip, desk charger, lapel speaker/mic

Upgrade equipment for Fire Department

- Mobiles: P25 Conventional, single band, program & dash mount installation, standard antennas
- Portables: P25 Conventional, single band, intrinsically safe radio, standard keypad, program, intrinsically safe spare battery, belt clip, desk charger, intrinsically safe lapel speaker/mic, and 1 multi-charger unit
- Control Stations: P25 Conventional, single band, desktop, desktop microphone, AC power supply, program, installation, antenna
- Digital Tone & Voice Pagers (as necessary): P25 Conventional, single band, program

- Digital Vehicular Repeater (as necessary): P25 Conventional, single band, program & installation

Upgrade equipment for Public Schools

- Mobiles: P25 Conventional, single band, program & installation, standard antennas
- Portables: P25 Conventional, single band, standard keypad, program, spare battery, belt clip, desk charger

Stage Six

This stage can be implemented at any time during the project, once funding is available.

Interoperability

A SHSP grant has been submitted for interoperability radio equipment, with an expected notification date of October 2021. The equipment consists of conventional and all-band P25 Phase 2 base stations including antennas, coax, installation and programming to be installed at the dispatch center. A gateway and interoperability cards will provide connectivity to the dispatch consoles. The grant includes upgrades to the dispatch center grounding and surge protection.

Costs

The following pages provide an Opinion of Probable Costs for each Stage of this project.

Craig County, VA		
Stage 1 Overall Infrastructure Improvements / MW		
	Item	Cost
Sheriff's Office - Dispatch	2 Dispatch Consoles	\$ 27,000
	Upgrade Grounding	\$ 5,000
	Surge Protection	\$ 2,000
EOC - Back-up Dispatch	1 Dispatch Console	\$ 13,500
	Upgrade Grounding	\$ 2,500
	Surge Protection	\$ 2,000
FCC Licensing	4 UHF Channels for all 4 sites	\$ 20,000
Microwave Network	Path Surveys	\$ 14,000
	FCC Licensing (microwave)	\$ 36,600
	1. EOC to Dispatch Center	\$ 45,200
	2. Dispatch to U.S. Cell New Castle	\$ 47,200
	3. U.S. Cell New Castle to Potts Mtn.	\$ 57,900
	4. Potts Mtn. to Paint Bank / Peters Mtn.	\$ 54,000
	5. Potts Mtn. to Sinking Creek	\$ 57,900
	6. Potts Mtn. to U.S. Cell Simmonsville	\$ 57,900
Paint Bank / Peters Mountain	Acquisition Greenfield	\$ 7,500
	Lease or Purchase Property	Unknown
	Clear/Grade	\$ 19,500
	Access / Parking	\$ 13,500
	GeoTech Survey	\$ 15,750
	Foundation Pads	\$ 6,000
	160 ft Guyed Tower (Rohn 45)	\$ 84,000
	Utilities (Prime Power)	\$ 5,000
	UPS System (Small - 4 to 12 kVA)	\$ 8,000
	Telecom Cabinet (HVAC, UPS,...)	\$ 50,000
	Generator & Fuel Tank	\$ 8,000
	Fencing	\$ 14,000
	Site Grounding	\$ 12,850
	Surge Protection	\$ 3,000
	2 UHF P25C Repeaters	\$ 54,000
	Combiner, Tx antenna & installation	\$ 28,600
	Rx Antenna, TTA, multicoupler, install	\$ 27,400
Sinking Creek	Tower Structural Inspect & Analysis	\$ 7,000
	Upgrade Tower "construction"	\$ 25,000
	Site Grounding (only microwave now)	\$ 2,000
Potts Mountain	Tower Structural Inspect & Analysis	\$ 7,000
	Upgrade Tower "construction"	\$ 25,000
	Site Grounding (only microwave)	\$ 2,000
U.S. Cellular New Castle	Acquisition site	\$ 5,000
	Lease	Unknown
	Tower Structural Inspect & Analysis	\$ 7,000
	Upgrade Tower "construction"	\$ 8,500
	Site Grounding (only microwave now)	\$ 2,000
U.S. Cellular Simmonsville	Acquisition site	\$ 5,000
	Lease	Unknown
	Tower Structural Inspect & Analysis	\$ 7,000
	Upgrade Tower "construction"	\$ 16,800
	Site Grounding (only microwave now)	\$ 2,000
Contingency		\$ 69,100
Project Management	Consulting Services	\$ 92,110
Total Stage 1		\$ 1,082,310

Craig County, VA		
Stage 2 Add Additional Site / Site Improvements		
	Item	Cost
Sinking Creek	Clear/Grade (improve site area)	\$ 5,000
	Upgrade / Improve Access Road & Parking	\$ 10,000
	Foundation Pad	\$ 3,000
	Telecom Cabinet (HVAC, UPS,...)	\$ 50,000
	Generator & Fuel Tank	\$ 8,000
	UPS System (Small - 4 to 12 kVA)	\$ 8,000
	Upgrade / Improve Fencing	\$ 5,000
	Site Grounding	\$ 5,000
	Surge Protection	\$ 3,000
U.S. Cellular Simmonsville	Clear/Grade	\$ 5,000
	Foundation Pads	\$ 3,000
	Utilities (Prime Power)	\$ 2,500
	UPS System (Small - 4 to 12 kVA)	\$ 8,000
	Telecom Cabinet (HVAC, UPS,...)	\$ 50,000
	Generator & Fuel Tank	\$ 8,000
	Extend / Upgrade Fencing	\$ 8,000
	Site Grounding	\$ 5,000
	Surge Protection	\$ 3,000
	Install 2 New UHF P25C Repeaters*	\$ 54,000
	Combiner, Tx antenna & installation	\$ 28,600
	Rx Antenna, TTA, multicoupler, install	\$ 27,400
Contingency		\$ 22,500
Project Management	Consulting Services	\$ 29,950
Total Stage 2		\$ 351,950

Craig County, VA		
Stage 3 Add Additional Site		
	Item	Cost
U.S. Cellular New Castle	Clear/Grade	\$ 5,000
	Foundation Pads	\$ 3,000
	Utilities (Prime Power)	\$ 2,500
	UPS System (Small - 4 to 12 kVA)	\$ 8,000
	Telecom Cabinet (HVAC, UPS,...)	\$ 50,000
	Generator & Fuel Tank	\$ 8,000
	Extend / Upgrade Fencing	\$ 8,000
	Site Grounding	\$ 5,000
	Surge Protection	\$ 3,000
Contingency		\$ 7,000
Project Management	Consulting Services	\$ 9,250
Total Stage 3		\$ 108,750

Craig County, VA		
Stage 4 Upgrade Radio Equipment		
	Item	Cost
Dispatch / EOC	Audio Logging Recorder System	\$ 85,000
Sinking Creek	4 New UHF P25C Repeaters*	\$ 108,000
	Combiner, Tx antenna & installation	\$ 28,600
	Rx Antenna, TTA, multicoupler, install	\$ 27,400
	remove old equipment, lines, antennas, etc.	\$ 16,600
U.S. Cellular New Castle	4 New UHF P25C Repeaters*	\$ 108,000
	Combiner, Tx antenna & installation	\$ 28,600
	Rx Antenna, TTA, multicoupler, install	\$ 27,400
	remove old equipment, lines, antennas, etc.	\$ 16,600
U.S. Cellular Simmonsville	Add 2 New UHF P25C Repeaters*	\$ 54,000
Paint Bank / Peters Mountain	Add 2 New UHF P25C Repeaters*	\$ 54,000
Simulcast - Geo Redundant	Control Point, Voters, GPS, Network Equip	\$ 111,500
Contingency		\$ 43,600
Project Management	Consulting Services	\$ 58,070
Total Stage 4		\$ 767,370

Craig County, VA			
Stage 5 Upgrade Subscriber Equipment			
Agency	Qty	Item	Cost
Sheriff's Office	10	Trunk Mount Mobiles	\$ 34,389
	14	Portables	\$ 34,064
	1	Control Station	\$ 4,696
	Total Sheriff's Office		\$ 73,149
Emergency Management	7	Dash Mount Mobiles	\$ 19,804
	26	Portable	\$ 52,816
	2	Control Station	\$ 8,683
	Total Emergency Management Services		\$ 81,303
Volunteer Rescue Squad	2	Dash Mount Mobiles	\$ 5,710
	15	Portable	\$ 30,114
	Total Volunteer Rescue Squad		\$ 35,824
New Castle Volunteer Fire Dept.	5	Dash Mount Mobiles	\$ 13,869
	30	Portable	\$ 71,406
	Total New Castle Volunteer Fire Dept.		\$ 85,275
Paint Bank Volunteer Fire Dept.	10	Dash Mount Mobiles	\$ 27,374
	30	Portable	\$ 71,406
	1	Control Station	\$ 4,251
	14	Digital Tone & Voice Pagers	\$ 7,902
	Total Paint Bank Volunteer Fire Dept.		\$ 110,933
Simmons ville Volunteer Fire Dept.	10	Dash Mount Mobiles	\$ 27,738
	25	Portable	\$ 59,608
	25	Digital Tone & Voice Pagers	\$ 14,110
	Total Paint Bank Volunteer Fire Dept.		\$ 101,456
John Creek's Volunteer Fire Dept.	5	Dash Mount Mobiles	\$ 13,687
	3	DVR (Digital Vehicular Repeater) in-ba	\$ 45,000
	20	Portable	\$ 47,810
	1	Control Station	\$ 4,251
	Total John Creek's Volunteer Fire Dept.		\$ 110,748
Upper Craig's Creek Vol. Fire Dept.	7	Dash Mount Mobiles	\$ 19,053
	25	Portable	\$ 59,608
	Total Upper Craig's Volunteer Fire Dept.		\$ 78,661
Craig County Public Schools	18	Dash Mount Mobiles	\$ 51,392
	3	Portable	\$ 3,683
	Total Craig County Public Schools		\$ 55,075
TOTAL STAGE 5			\$ 732,424

Craig County, VA		
Stage 6 Interoperability Equipment		
	Item	Cost
Interoperability Equipment	Conventional base station, installation, antenna, and programming	\$ 10,000
	All-band P25 Phase 2 base station, installation, antenna, and programming	\$ 19,000
	programming	\$ 39,000
	Interoperability gateway cards	\$ 15,000
	Upgrade Grounding in the Dispatch Center	\$ 5,000
	Surge Protection	\$ 2,000
Project Management	Consulting Services	\$ 20,000
Total Stage 6		\$ 110,000

Craig County, VA	
Roadmap Summary of Costs	
Stage 1 Overall Infrastructure Improvements / MW	\$ 1,082,310.00
Stage 2 Add Additional Site / Site Improvements	\$ 351,950.00
Stage 3 Add Additional Site	\$ 108,750.00
Stage 4 Upgrade Radio Equipment	\$ 767,370.00
Stage 5 Upgrade Subscriber Equipment	\$ 732,424.00
Stage 6 Interoperability Equipment	\$ 110,000.00
GRAND TOTAL	\$ 3,152,804.00