



Law Enforcement, Public Safety, Health & Welfare Committee

Interagency Radio Discussion

December 13, 2016



OCONEE COUNTY SHERIFF'S OFFICE

Emergency Communications / E-911

415 South Pine Street
Walhalla, South Carolina 29691
Mike Crenshaw, Sheriff

December 13, 2016

Law Enforcement, Public Safety, Health & Welfare Committee
Oconee County Council
415 S. Pine Street
Walhalla, SC 29691

Dear Committee Members:

I am pleased to offer for your consideration the following discussion regarding interagency radio issues in Oconee County. Sheriff Crenshaw and Chief King have asked me to provide the following information regarding the current state of communications for all agencies operating radios in Oconee County.

At the heart of the discussion is the need for all disciplines, regardless of agency or function, to be able to communicate without regard for equipment, band, or radio type in an emergency. The primary goal is to achieve interoperable communications during a school emergency. However, various disciplines in public safety, county services, and education operate with each other every day. We have the opportunity to discuss a system whereby communications between agencies can be improved at automobile collisions, structure fires, special events, hostage situations, etc.

I would like to recognize Lt. Mike Holmes for his thorough research of this data for the committee.

Thank you for your consideration of the material that follows. I, along with my staff, remain available to this committee and to council to answer any questions that you may have.

Sincerely,

A handwritten signature in black ink, appearing to read "Travis C. Tilson".

Capt. Travis C. Tilson
Director

SDOC

We have provided you with diagrams and charts which depict the current radio systems for all county agencies. In the case of the School District of Oconee County, we do not maintain their radio system. However we have researched their current equipment and are able to briefly describe their system.

The SDOC currently utilizes a variety of radio systems:

Logic Trunked Radio (LTR) – Primarily school bus radio traffic and administration

Capacity Plus – Newer high schools and middle schools

Conventional Repeater – Older high schools and middle schools

Radio to Radio – Older middle schools and most elementary schools

Overall Pros:

LTR handles high volume radio traffic efficiently, Conventional Repeaters provide adequate coverage on school campuses and radio to radio systems are low cost, but they comes with a price... coverage.

Capacity Plus is the most advance system in the school district. It is very similar to the LTR in operation; however, it is much more efficient in managing radio traffic. This efficiency results in lower system costs.

Capacity Plus also provides features that none of the other systems can provide. For example, crystal clear voice communications, extended range of coverage, text messaging, GPS data, privacy calls between radio users, remote monitoring, remote disabling and most importantly an emergency alert function in the event of a campus emergency.

Overall Cons:

The LTR system is aging and its coverage has been severely reduced since narrow banding. LTR isn't alone in reduced coverage, Conventional Repeaters also suffered when narrow banding was implemented. Radio to radio systems have never been a good option when trying to cover a school campus. These types of systems simply lack the transmitting power to properly penetrate the concrete and steel structure that makeup school facilities. Capacity Plus systems do come with a cost. These type systems require the purchasing of new radios and repeaters.

The most significant problem with the School District's radio system is interoperability between campuses, the district office, school buses, emergency services and law enforcement. Under the current system, the only way to communicate between schools and other agencies is by telephone.

One lesson learned at the Townville Elementary school shooting was that the telephone system isn't adequate to support the massive number of telephone calls placed. Officers reported numerous "all circuits are busy" messages when they attempted to make a cellular call.

RADIO COVERAGE DATA

One tool considered in the installation of radio transmitters/receivers is a propagation map. Propagation or coverage maps show **general** coverage for large regions and therefore any boundary indicated should not be interpreted as a rigid limit. The quality of transmission can be very different at places only short distances apart. Inevitably small pockets of poor transmissions will exist within the main service area that cannot be shown on the map due to scale issues.

Very mountainous terrain will also affect transmission signals. If you're on a mountain, you may be able to transmit a much clearer signal than indicated on the maps. Likewise, if you're in a valley, you may have trouble transmitting any usable signal.

The Received Signal Strength Indicator (RSSI) is measured in decibels (dB). The higher the dB, the weaker the transmitted signal. Propagation maps "plot" the projected coverage using different shades of color. These colors are determined by using topographic maps, which have elevation readings and other data.

While working on the Sheriff's analog radio system, we have learned that when a radio's "talk-in" signal reaches -90dB the transmission starts to become unusable. Conversely, we found that a digital radio's "talk-in" signal doesn't become unusable until it reaches -115dB. That's a 27% increase in "talk-in" coverage.

One option that has been discussed is increasing the number of analog voter sites within the current system. One consideration that should be taken into account is the age of the current Raytheon SNV-12 voter. This system was installed in 1999 and is approaching 20 years old. It is inevitable that modules of this system will begin to fail and need to be repaired or replaced. In January of 2016, Raytheon ceased production of the SNV-12 and all replacement parts. A "start-up" company has purchased the rights to manufacture replacement parts; however, it is unclear when these new parts will become available.

Second, a propagation map showing the projected "talk-in" coverage was produced for the additional four sites: Salem's new water tower, the OLEC, the Cleveland Fire Station and the Oconee Airport. Although there is an increase in "talk-in" ability for portable radios, the dB level for much of the county still remains at or near -90dB. Given what was observed with the Sheriff's analog system, -90db "talk-in" signals start to become unusable.

Finally, cost. Each new voter site is projected to cost approximately \$30,000. This would be a \$120,000 investment for the four new sites on a 20 year old system that still leaves a large portion of the county at a -90dB "talk-in" projection.

How does the Sheriff's new digital radio network compare? The first step that we performed was to determine where the calls for service (CFS) were occurring. Using the computer aided dispatch system (CAD) we ran a report for the location of each call dispatched. This information was "raw" data which included calls for not only law enforcement, but also fire and rescue.

This data was then sorted using fire districts. What we discovered was that the Seneca area generated thirty-two (32%) percent of the CFS followed by the Walhalla area with twenty-one (21%) percent and finally the Westminster area with seventeen (17%) percent. The tri-city area, Seneca, Walhalla and Westminster) account for seventy (70%) percent of all the CFS dispatched.

The next step was to review the radio system's infrastructure and determine transmitter/receiver options. Our first priority was the Seneca area, which accounts for one-third of the calls. Units in the Seneca area had only

two "talk-in" options in the analog voter system: Oakway and Long Mountain. This meant the distance to a receiver was anywhere between nine (9) miles and twenty-five (25) miles, depending on the unit's location. The decision was made to install a repeater transmitter in the Seneca area and with the cooperation of the City of Seneca the location chosen was the water tower located on the campus of Oconee Medical Center. This reduced the "talk-in" distance from a receiver transmitter to between five (5) and (6) miles. Another repeater transmitter site was installed at Oakway, which not only enhanced the Seneca area coverage but provided coverage to the southern area of the county and the "talk-in" distance to that receiver transmitter is between five (5) and seven (7) miles.

The Sheriff's digital system also has a repeater transmitter atop Long Mountain, which provides coverage to Mountain Rest, Tamassee, Salem and most of Walhalla area. We did discover that the Walhalla area had "pockets" of low "talk-in" coverage so an additional repeater transmitter was installed at the Oconee Law Enforcement Center.

The Sheriff's digital radio network is currently about sixty (60%) complete with three additional repeater transmitter sites to be completed. The first repeater transmitter site scheduled is atop Round Mountain, to enhance "talk-in" coverage in the Long Creek area as well as the area between Westminster and Long Creek and the Cleveland Madison areas near the Georgia state line. The second site is Westminster, which will provide additional "talk-in" coverage to the Cleveland/Madison area as well as Foxwood Hills, Chickasaw Point and areas surrounding the City of Westminster. Finally, a repeater transmitter will be placed near Keowee Key which will provide additional "talk-in" coverage for that area as well as Oconee Nuclear Station, Salem and Jocassee.

How does our "talk-in" coverage with digital compare to analog? With the analog system, users reported that only about twenty to twenty-five percent (20%-25%) of their handheld radio transmissions were successful. The current digital system's "talk-in" success rate for handheld radios is reported to be seventy to seventy-five (70%-75%) and the mobile success rate is reported to be greater than ninety (90%) percent. This is a significant increase in "talk-in" success from handheld radios, and the system is only sixty percent (60%) complete. We attribute this increased handheld "talk-in" ability to a couple of factors. First is digital radio's ability to operate at signals near -115dB verses analog's -90dB. From the start the digital radio has a twenty-seven (27%) percent greater chance of producing a usable transmission. Second is the placement of repeater transmitter sites. By spreading the system out over a wide area, the ability for the system to send and receive radio transmissions is greatly increased. This is in stark contrast to the analog system which has only one repeater transmitter location.



Emergency Communications

Oconee County Communications Overview

VHF Low Band:

Roads and Bridges

Solid Waste

Vehicle Maintenance

VHF High Band:

Emergency Services

UHF:

Rock Quarry

South Cove County Park

High Falls County Park

Chau Ram County Park

Coroner's Office

School District of Oconee County

Sheriff's Office

Animal Control

Detention Center

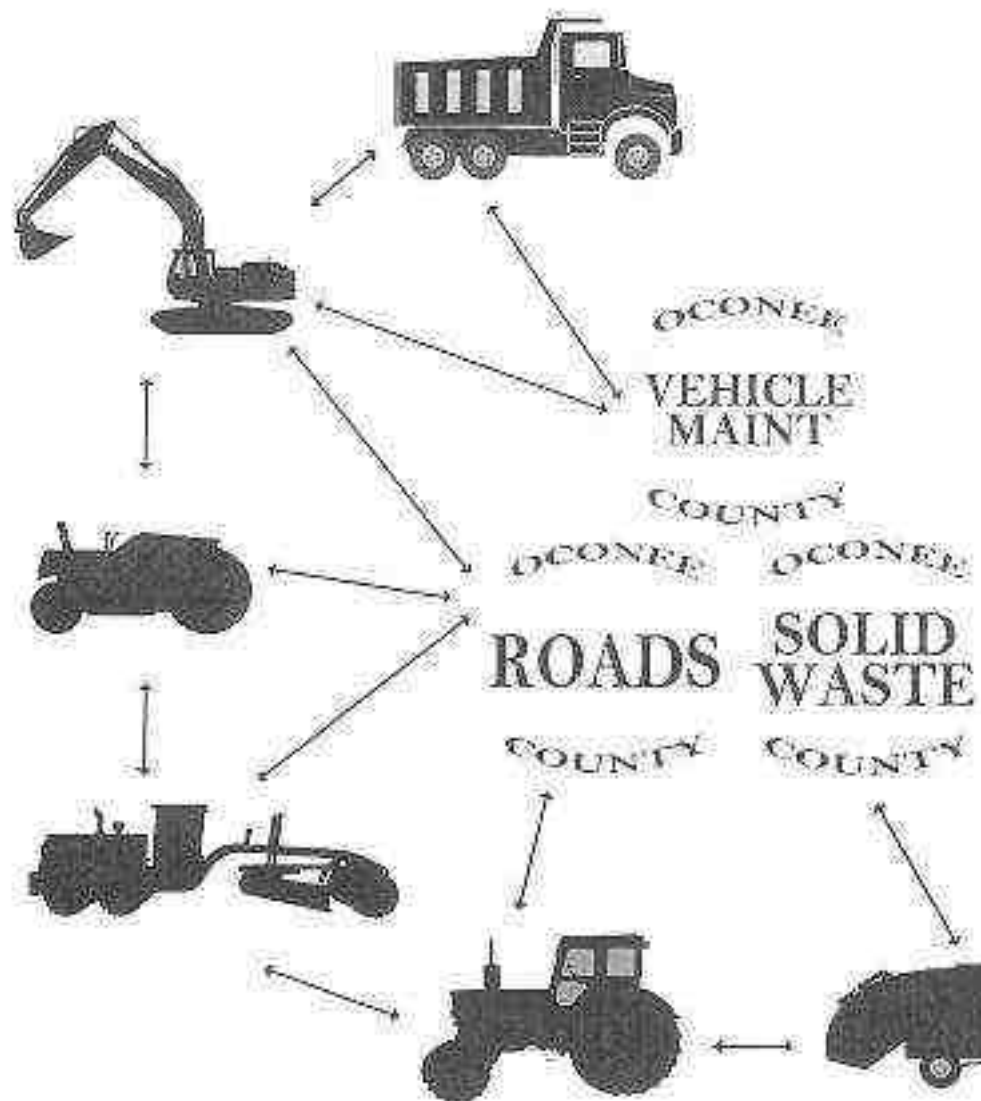
Courthouse Security

Local Law Enforcement



Emergency Communications Current Communications

Roads/ Solid Waste/ Vehicle Maint



VHF LOW BAND SYSTEM

This radio system operates just above the Citizens Band radio frequency spectrum and utilizes high power radio transmitters to communicate. This system does not employ a radio repeater and relies on radio to radio transmissions to communicate.

Pros

This system does not fall under the FCC's "Narrowband" requirement

Cons

This system requires the use of "high-power" radio transmitters, 100 to 500 watts. Because of the transmitting power requirement, these radios are much more expensive to purchase.

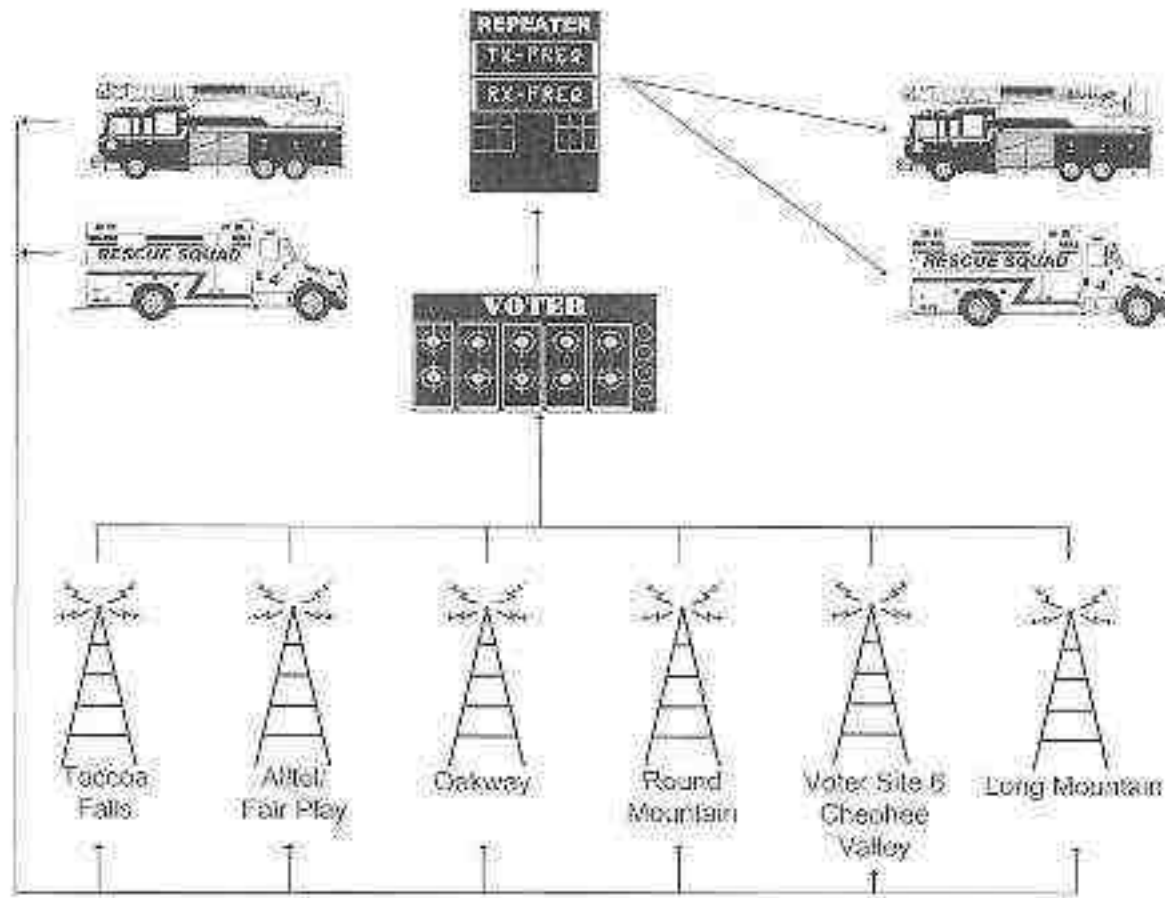
Coverage. All three Departments using this system have employee safety concerns about the lack of radio coverage. Each Department has resorted to using employee owned cellular telephones to communicate. One Department has completely abandoned this radio system due to these concerns.

Interoperability. These Departments have no way to communicate with other county Departments (ie. Sheriff or Fire/Rescue) and are often called to remove debris, such as downed trees, or scrape roadways during inclement weather.



Emergency Communications Current Communications

Emergency Services (Fire and Rescue)



VHF Radio Repeater System

This system utilizes a Raytheon SNV12 voter module and two high-power radio transmitters, one for Fire and one for Rescue. These transmitters are located atop Long Mountain, which is above the Oconee State Park in Mountain Rest.

What is an SNV12 voter? A voter system simply utilizes receiving radios, known as site voter modules, which are placed throughout the county to receive radio transmissions on a specific frequency. Once a radio signal is received, the voter modules send their signal to a Control Processor, located on Long Mountain. The processor evaluates each signal and then sends the clearest one to the radio repeater for transmission.



Emergency Communications Current Communications

Emergency Services (Fire and Rescue)

Pros

This system allows users to utilize a much lower power transmitter to communicate. Mobile radios are generally in the 100 watt range and portables are in the 5 watt range.

Cost per radio is much lower than the VHF Low-Band radios because of the lower power transmitters.

This system has a high-power radio repeater connected to the SNV-12 voter which provides much better radio coverage than the old radio to radio VHF Low-Band system.

VHF Radio Repeater System

Cons

This radio system falls under the mandatory FCC narrowband requirement.

Post narrowband, some areas of the county experienced a 35% to 40% reduction in coverage.

Channel congestion.

Fire only has one channel for dispatching. During periods of high radio traffic, users often transmit over the top of each other. An example of this would be the afternoon "rush-hour" period when you have three or four traffic accidents, a grass fire and a couple of fire alarms. Fire does have another repeater channel; however, it is located in Westminster and is not connected to the voter system, which makes its effective use limited.

Rescue has the same trouble as fire... only one channel for dispatching and operations.

Voter Considerations. The system's Raytheon SNV-12 was installed in 1999.

Since installation, Raytheon has not only ceased parts production, but completely closed the JPS Communications Unit (Jan 2016).

As discussed above, fire and rescue both only have one repeater for communications. If either repeater fails, Oconee County's ability to properly dispatch Emergency Services will be severely handicapped.

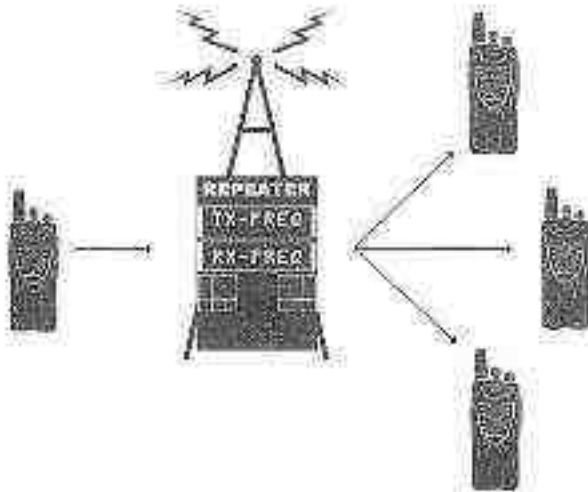


Emergency Communications Current Communications

County Recreation Parks



South Cove
High Falls
Chau Ram



UHF Radio Repeater System

Each of the County's three recreational parks utilizes an independent UHF radio repeater system. The repeater is located on-site and transmits a low power signal to cover the recreation area.

Pros

By using a radio repeater, employees are able to carry a portable radio to communicate, thus eliminating the need for mobile car radios.

Improved safety for employees. As discussed above, the employee has the ability contact a co-worker in the event of a disturbance or a need for assistance without having to return to his vehicle or try to make a cellular telephone call.

Cost. In this localized radio repeater system, employees only need a portable radio to communicate... eliminating the need for a more powerful radio transmitter in a vehicle.

Cons

Park employees area limited in their ability to communicate with other agencies, such as the Sheriff's Office and Emergency Services. From time to time there are incidents where law enforcement is needed in the park or someone has a medical emergency requiring immediate attention.

Age of the system is becoming a concern and the repeaters could be replaced, which would provide even greater coverage and more reliable service.



Emergency Communications Current Communications

Rock Quarry

UHF Radio Repeater System

The Rock Quarry's radio system is the same type as the county parks... a local UHF radio repeater system. The repeater is located on-site at the quarry and transmits a low power radio signal for use at the complex.

Pros

By using a radio repeater, employees are able to carry a portable radio to communicate, thus eliminating the need for mobile car radios.

Improved performance of employees. As discussed above, the employee has the ability to contact a co-worker in the event of any situation requiring attention. This is very useful in running the day to day operations at the quarry.

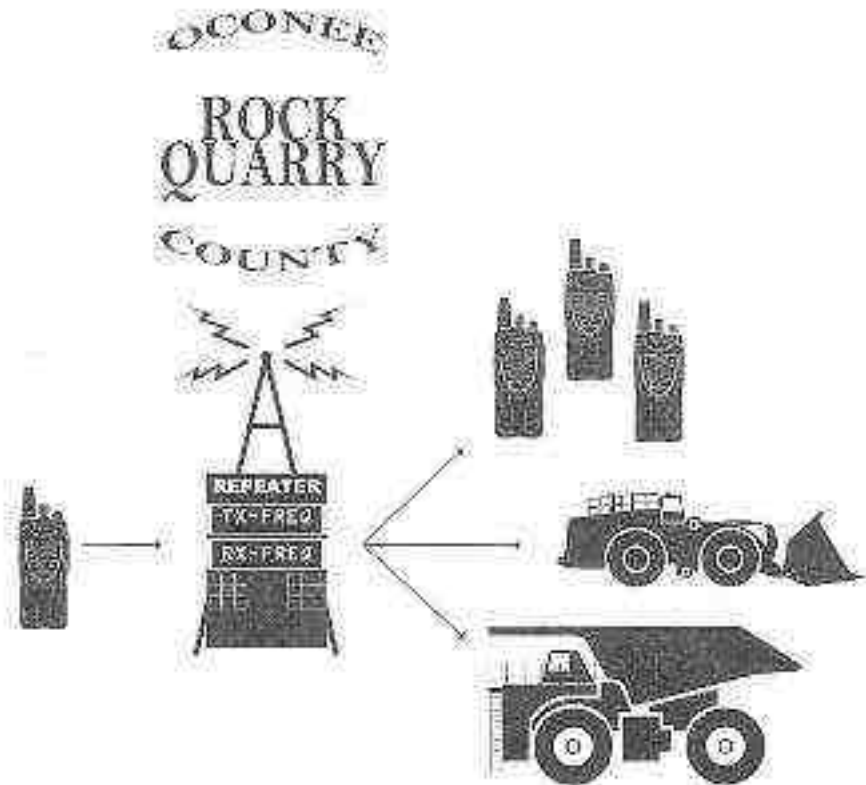
Safety. The quarry from time to time needs to blast rock using explosives. **EMPLOYEE SAFETY IS THE MOST IMPORTANT THING DURING THESE EVENTS.** The repeater system allows everyone to be in constant radio contact with each other during the blast, thus improving safety.

Cost. In this localized radio repeater system, employees only need a portable radio to communicate... eliminating the need for a more powerful radio transmitter in a vehicle.

Cons

Coverage. Although most of the quarry complex is covered by the repeater, there are some areas of the pit that have poor reception.

Age of the system is becoming a concern and the repeaters could be replaced, which would provide even greater coverage and more reliable service.





Emergency Communications Current Communications

Sheriff' Office Law Enforcement Network

UHF Analog Radio Repeater System

UHF Digital Radio Repeater System



The Sheriff's Office law enforcement radio network currently operates two different systems, analog and digital. This radio network encompasses several different departments including:

Sheriff Office

Coroner's Office

Detention Center

Animal Control

Four Additional Law Enforcement Agencies

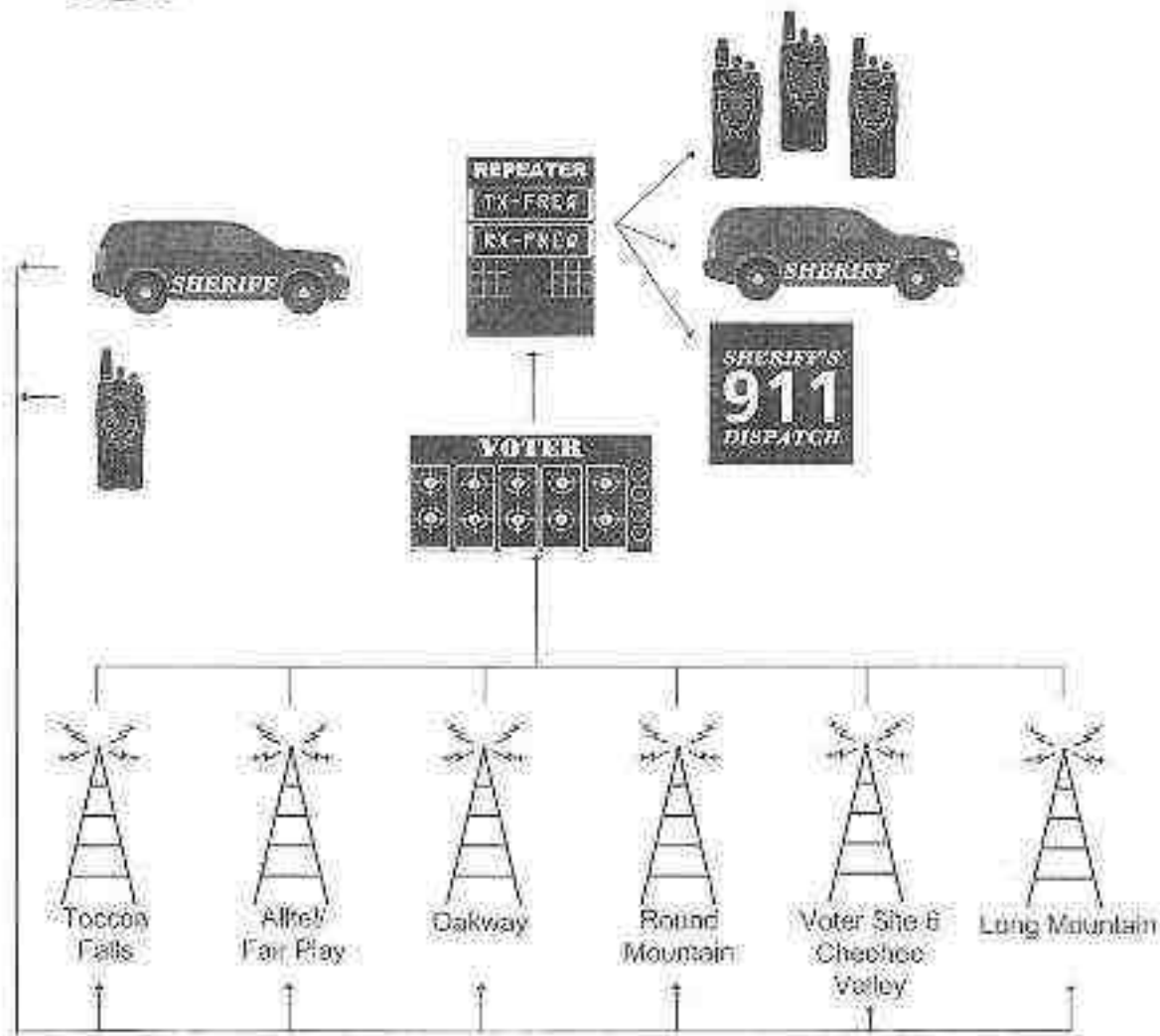
The analog radio repeater system was originally installed in the late 1970's and was upgraded in the late 1990's to utilize the Raytheon SNV-12 voter. The voter system is shared with Emergency Services (Fire and Rescue) and the Sheriff's Emergency Communications Division maintains the network's infrastructure.

The digital radio repeater system was first installed during the fall of 2010 in preparation for the FCC's mandatory narrowband requirement effective on or before January 1, 2013. This began a migration period where new vehicles were equipped with digital radios. This migration continued over the next six years and the system became operational in March of 2016. The Sheriff's Office is currently about sixty (60%) complete with installing the necessary infrastructure for the digital network. The network currently serves the Sheriff's Office, Coroner's Office, Detention Center and two additional Law Enforcement agencies.



Emergency Communications Current Communications

Sheriff' Office Law Enforcement Network



Pros

This system allows users to utilize a much lower power transmitter to communicate. Mobile radios are generally in the 100 watt range and portables are in the 4 watt range.

Equipment costs per unit are generally lower than VHF Low-Band radios because the system can operate with lower power transmitters.

This system has a high-power radio repeater connected to the SNV-12 voter which provides much better radio coverage than the old radio to radio VHF Low-Band system.

Signal penetration into buildings is generally much better using a UHF signal when compared to a VHF Low or VHF Hi frequency.

The Sheriff's Office maintains two repeater channels to reduce communications congestion and provide a redundant "back-up" in case one repeater falls.

Cons

This radio system falls under the mandatory FCC narrowband requirement.

Post narrowband, some areas of the county experienced a 35% to 40% reduction in coverage.

Cost. This system utilized a 100 watt UHF mobile transmitter, for each vehicle, costing around \$2,000 per radio.

Voter Considerations. The system's Raytheon SNV-12 was installed in 1999.

Since installation, Raytheon has not only ceased parts production, but completely closed the JPS Communications Unit (Jan 2016).

The voter system is expensive to operate and maintain.

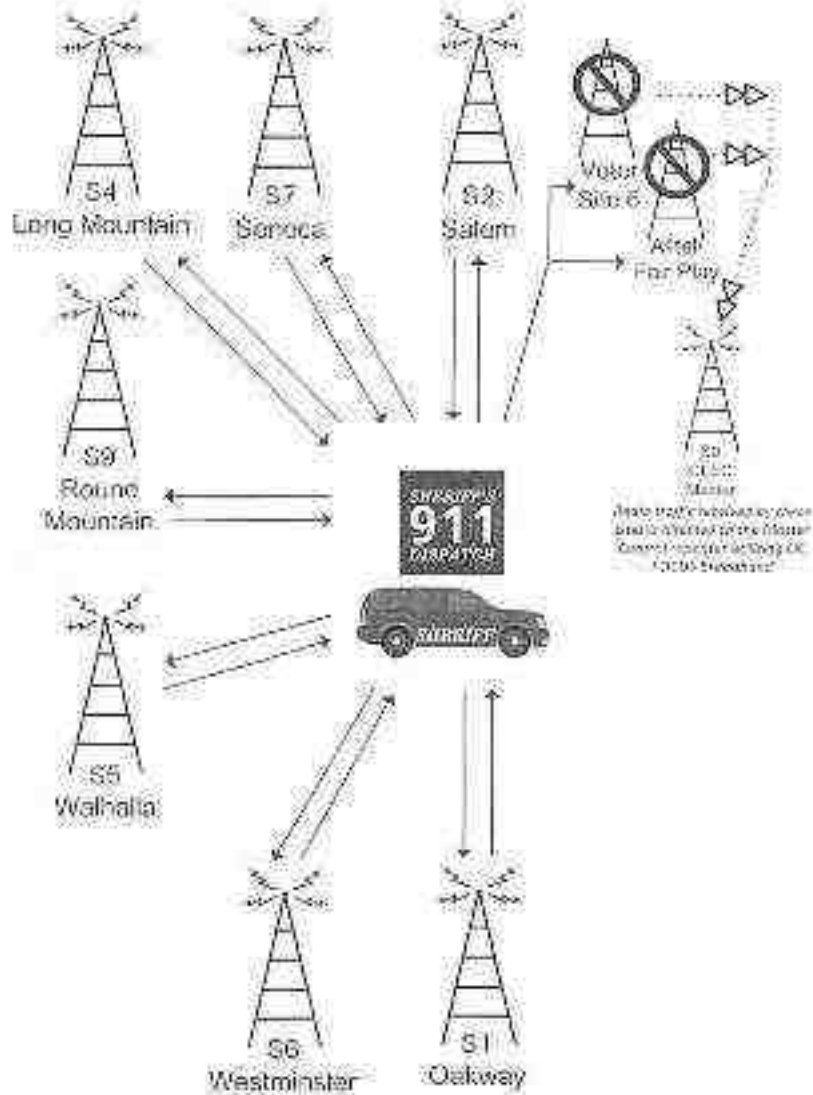


Emergency Communications Law Enforcement Digital Radio Network Overview

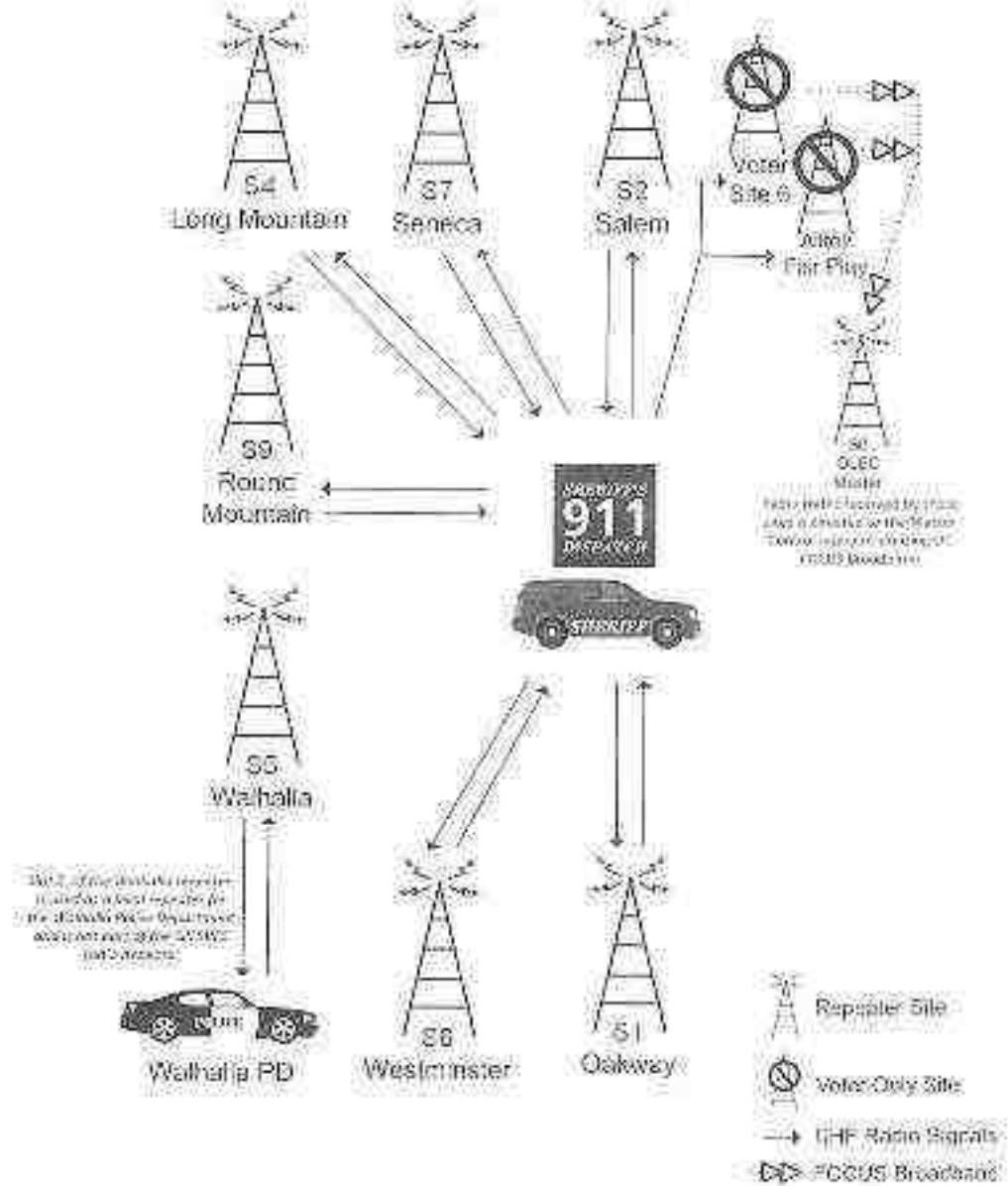


All PATRO and SPLSVCS radio traffic must pass through the Master Control repeater which is located at the OLEC

Patrol Radio Network



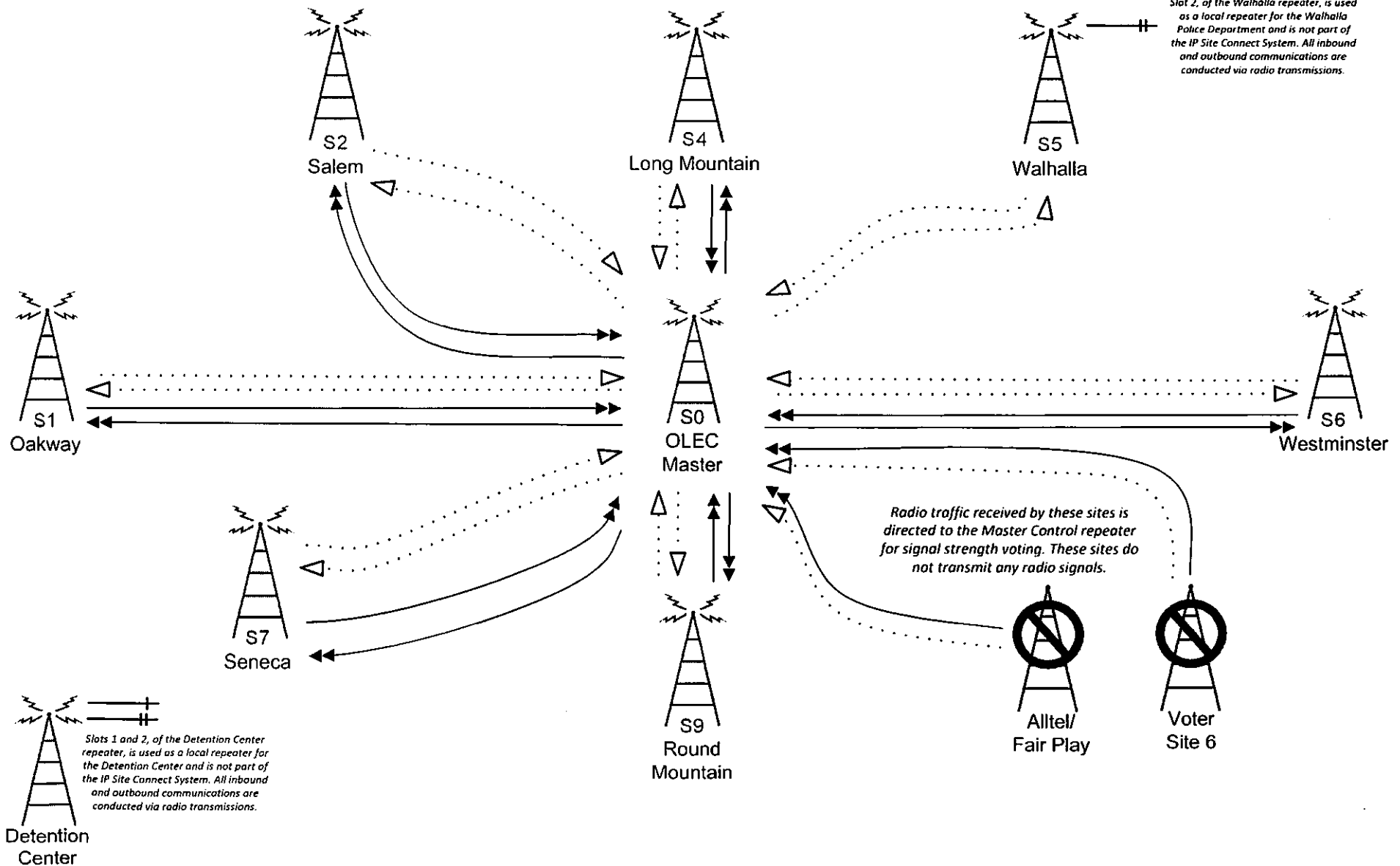
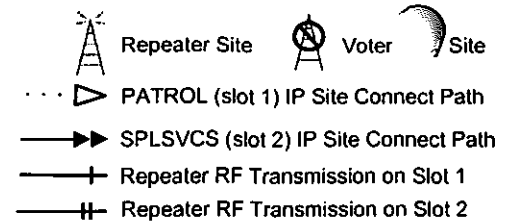
SPLSVCS Radio Network





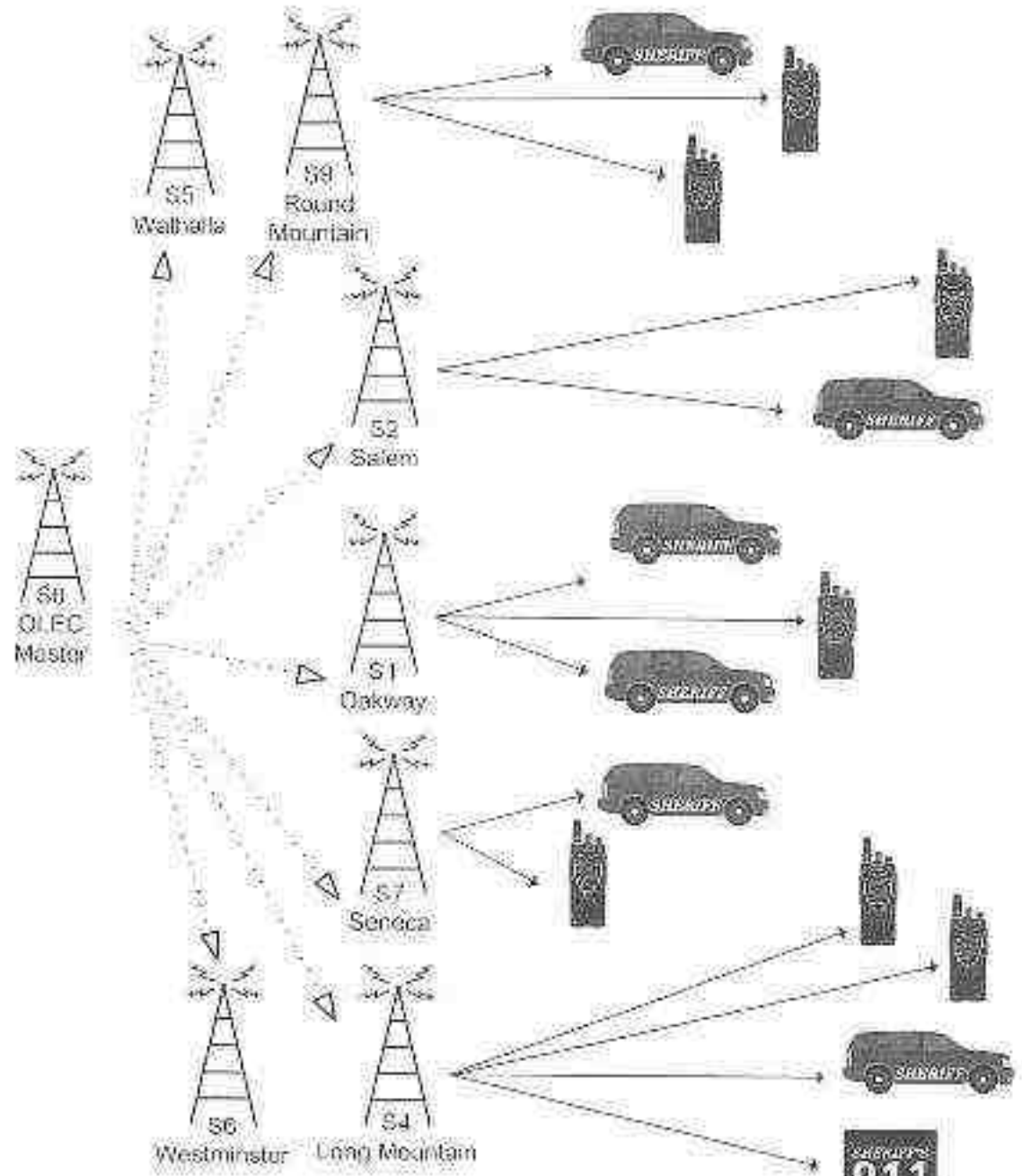
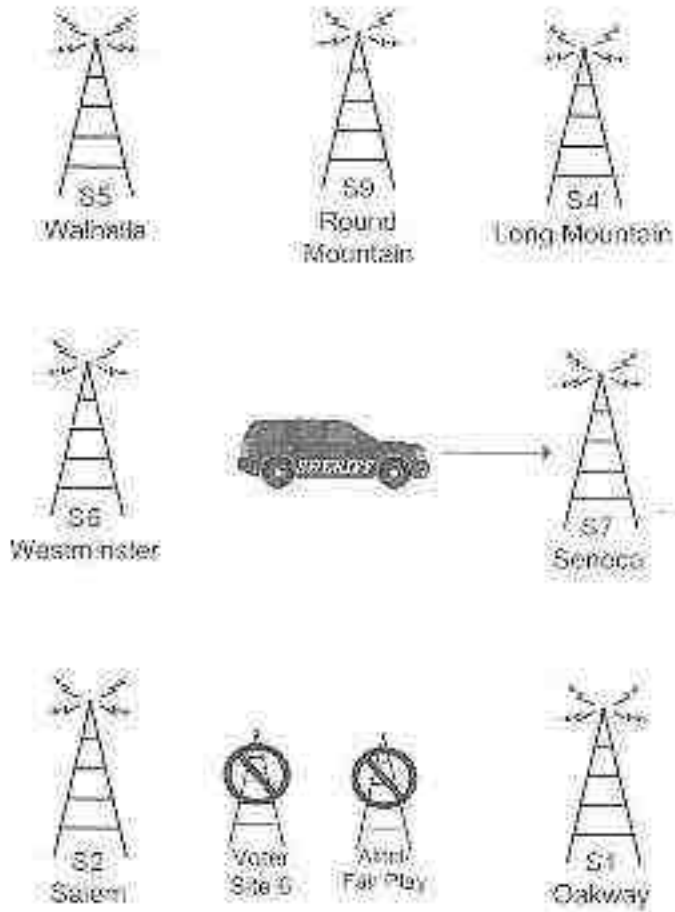
Emergency Communications Law Enforcement Digital Repeater Overview

IP Site Connect uses a Metro E Loop on the Oconee Broadband FOCUS network to connect a series of repeaters together, forming a wide area radio system. A received radio transmission, except S5 (slot 2) and the Detention Center (slot 1 and 2), is routed through the Master Control repeater, via the Broadband Metro E Loop. The Master Control repeater then sends that transmission out to all of the repeaters for rebroadcast via the same Metro E Loop.





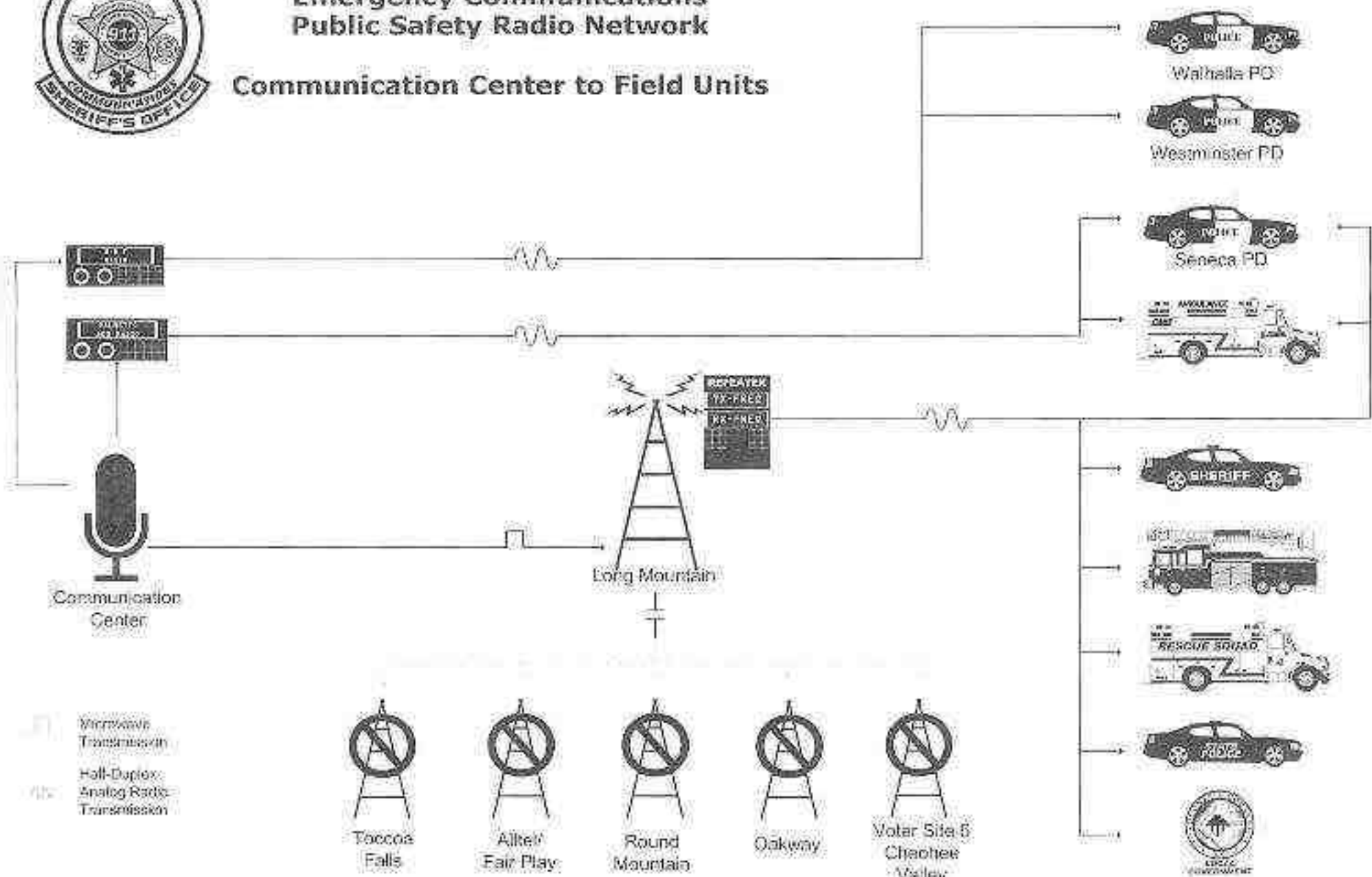
Emergency Communications Law Enforcement Typical Radio Transmission Path





Emergency Communications Public Safety Radio Network

Communication Center to Field Units



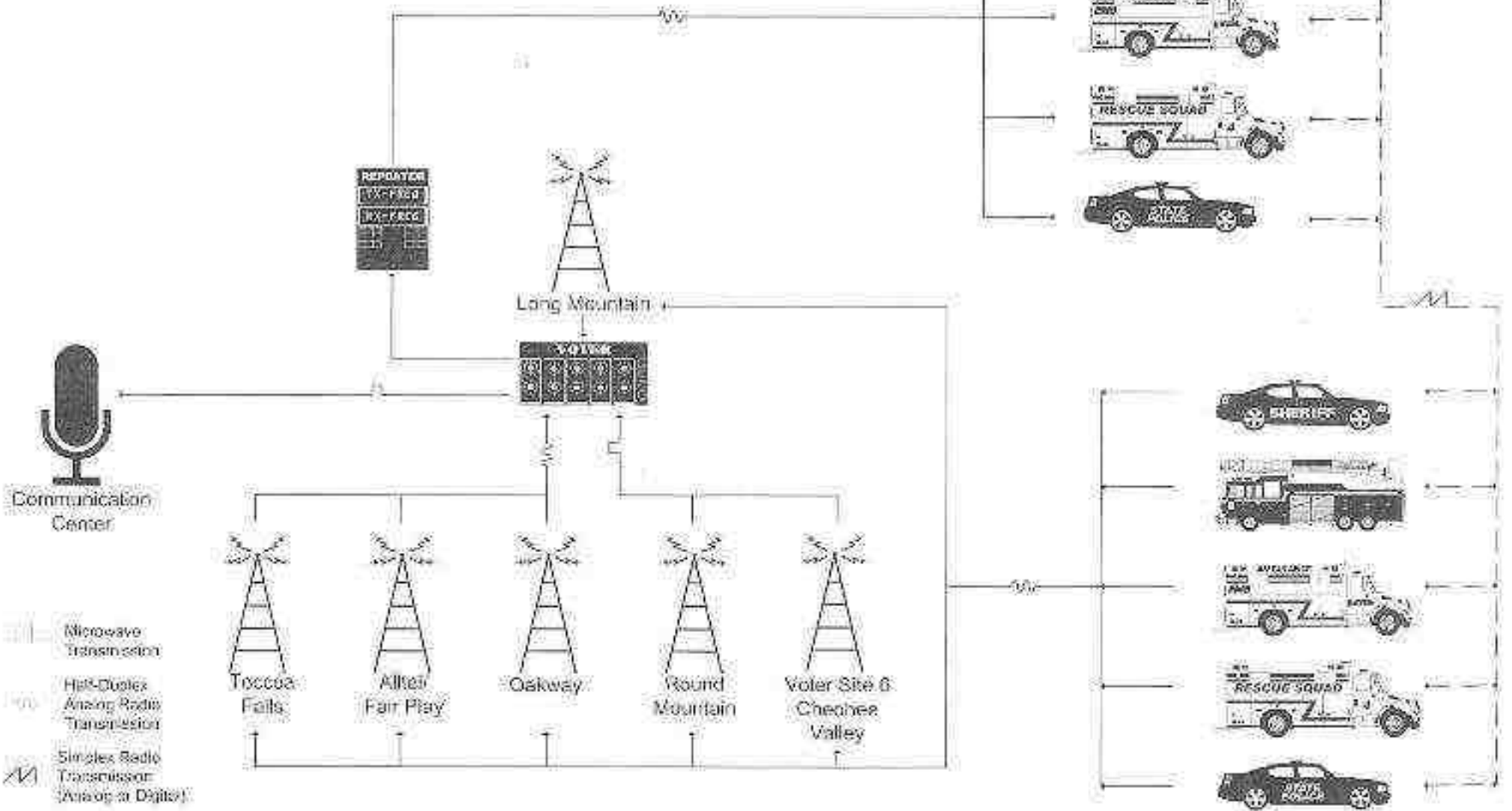
Microwave Transmission
 Half-Duplex Analog Radio Transmission

These Radio Towers Do Not Transmit to the Network



Emergency Communications Public Safety Radio Network

Field Units to Communication Center and Simplex Transmissions



- Microwave Transmission
- Half-Duplex Analog Radio Transmission
- Simplex Radio Transmitter (Analog or Digital)

