Can the Project P-25 System Solve the Problem of Radio Interoperability for Florida Public Safety Agencies?

Kevin Kirkpatrick

Abstract

In the aftermath of the 9/11 attacks, the federal government quickly realized that first responder agencies often could not communicate to each other over their radio systems and developed the Project 25 standard. The goal of the project was to set a standard for companies and first responder agencies to move towards and to limit the impediments of land mobile radio communication. This paper looked at the public safety radio system and the hindrances of communication between agencies within the State of Florida. Public safety agencies in the sixty-seven counties of Florida were surveyed to determine the status of Florida's radio systems and their interoperable status.

Introduction

Public safety agency personnel must be able to communicate and share vital information with other groups of first responders. Interoperability means that communication is absent from the impediments of interagency operations. Radio communication is a critical part of the daily function of the duties and responsibilities associated with protecting lives and keeping people safe. First responders must not only be able to communicate with their dispatch center and other responders in their agency, but they must also be able to communicate with other agencies that respond to multi-agency emergencies. It does not mean law enforcement can simply talk to other law enforcement agencies in their region or fire agency to fire agencies. Having "interoperability" means that police, fire, and emergency medical services in a jurisdiction can communicate with each other on-demand without impediment. They must also be capable of communicating with other agencies in the next region, including federal agencies, if necessary.

Interoperability on a macro scale does not merely apply to radio communications. Interoperability also includes the flow of information through other technology such as internet accessibility, wired and wireless networks, and additional accesses that allow communication sharing, including social media.

Radio communication systems are a costly and significant endeavor for public safety agencies to invest. Any purchaser of technology equipment expects a return on their investment, but often the financial hurdles to purchase communications systems must be balanced against technological advancements and features. Unfortunately, technology frequently advances at such a rate that a radio system is antiquated before the acquisition cycle completes.

All too often first responder agencies (police, fire, EMS) in the same jurisdiction are unable to talk to each other on their two-way radios. The problem worsens as agencies bordering each other cannot communicate either.

In coordination and collaboration with various federal agencies, Project 25 was designed and implemented to fill the needs of public safety now and into the future concerning the interoperability of communications. The objectives of Project 25 are to maximize spectrum efficiency; ensure competition in life cycle procurements; allow effective and efficient inter- and intra-agency communications; and provide "user-friendly" equipment and operation.

The purpose of this research paper is to determine whether first responder agencies can collaborate to solve radio communication disconnects and explore how the Project P-25 system might solve the problem of radio interoperability for public safety agencies.

Literature Review

Public safety agencies (police, fire, emergency medical services, etc.) have procured and used land mobile radio (LMR) systems in their dispatch centers and command posts during emergencies since the 1930s. These LMR systems used for public safety are wireless systems, which typically consist of handheld portable radios, mobile radios, base stations, networks, and repeaters (Safecom, 2016).

The first licensed police agency to use a radio system was the Detroit Police Department in 1922. An AM broadcast station sent out one-way all-points bulletins and administrative messages to their officers. The radio car became an active part of Detroit's policing culture by 1928. Today's radios do not merely allow the passing of voice communication like the early days in Detroit; they can enable first responders to send text messages, make phone calls, and give the GPS location of the person using the device (Hawkins, 2013).

Radio systems play a critical role in transmitting signals across great distances and must exchange information correctly and effectively. Communication interoperability means emergency responders communicate between both agencies and throughout field operations effectively over a variety of wired and wireless networks without any special effort. The ability for all first responders to talk to one another by radio communication is essential during the day to day activities and throughout the worse emergencies (Huyck, 2015).

First responder radio communication problems existed before the September 11, 2001, terrorist attacks but, the 9/11 attack and its aftermath brought attention to the importance public safety wireless communications have, as well as increased governmental focus on the role of first responders and their capabilities. First responders capacity to respond to emergencies, including terrorist incidents, was scrutinized and raised concern within the Federal Government. A primary focus was the reexamination of public safety wireless communications, public safety spectrum issues, and communications interoperability issues. Testimony in the matters of interoperable communications was taken before the subcommittee of the Government Reform Committee, House of Representatives. William Jenkins, Director for Homeland Security

and Justice Issues stated "One key barrier to development of a national interoperability strategy is the lack of a statement of national mission requirements for public safety—what set of communications capabilities should be built or acquired - and a strategy to get there" (U.S. General Accounting Office, 2003).

Whether talking with members of one's agency or with other departments, emergency responders must receive information timely and without incident. This information will include the location, what is taking place, what resources needed to respond, and tactical plans. Environmental factors, including tall buildings, mountain ranges, and shopping malls, can further hinder a responder's ability to talk. Combining the environmental elements with outdated or antiquated equipment and communication can be almost impossible (Hawkins, 2013).

Communications interoperability has diminished over time as technology has advanced. For many years, agencies establishing radio systems had very few options, and the likelihood of agencies having compatible technology was very high. As technology has advanced, more manufacturers have entered the market, creating new radio systems. Agencies began installing systems with different radio technologies to meet requirements for varying agency needs. Incompatible equipment increases the interoperability void (Hawkins, 2013).

Not all LMR systems are compatible for many reasons, and many public safety agencies frequently cannot directly communicate with other public safety entities around them (National task force on interoperability, 2003). Interoperability challenges facing agencies include incompatible frequencies, incompatible equipment, and a lack of common language. (U.S Department of Justice, 2007).

Beginning in the 1930s, the Federal Communications Commission (FCC) assigned radio spectrum to public safety agencies as agencies demonstrated a need. These initial systems were designed to provide extensive coverage areas by placing the radio sites at high elevation. Due to the design, high altitude, and broad coverage, these sites limited the proximity to reuse of radio spectrum geographically as not to overlap coverage. This resulted in an additional radio spectrum being necessary to fulfill the needs. Each time a spectrum was added, the band would be at a higher spectrum resulting in today's public safety entities operating in ten separate and incompatible spectrum bands (National task force on interoperability, 2003).

Radio spectrum is limited; the part of the electromagnetic spectrum ranges from 1 Hz to 3000 GHz (U.S. Department of Transportation, 2017). Not all public safety agencies operate on the same radio spectrum. The most common public safety radio spectrums are VHF low (30-40 MHz), VHF high (152-162 MHz), UHF (406-512MHz), and 700 or 800 MHz (U.S Department of Justice, 2007).

As agencies upgraded their radio communication systems, they would sometimes move their systems from one spectrum to another. There are ways to fix this gap of frequency incompatibility. The different equipment can combine on the same frequency with the use of a bridging or gateway device. Users can also solve issues by swapping radios so that one group can hear or talk to the other group, but this requires carrying a second radio (U.S. Department of Justice, 2007). A gateway is a system using software that allows agencies to transmit radio transmissions and/or location services data between equipment from different manufacturers. Radio gateways can play a significant role in linking separate networks but have disadvantages. By linking two radio channels,

the communication back and forth on both channels are now on one. Combining two channels into one can create too much chatter on a radio channel and can inhibit effective communication (Hawkins, 2013).

Radio infrastructure traditionally has long a life span, sometimes exceeding 20 to 30 years. Portable and mobile radios have an expected service life of 8 to 10 years, yet more than one-half of the agencies polled by SAFECOM had exceeded that service life. Many agencies are now upgrading their radio systems for multiple reasons, including the increasing cost to support old equipment, manufacturers dropping older technologies, and mandates like narrow banding. Radio upgrading led to a rise in regional incompatibility as technologies were changing, such as the implementation of higher frequency bands, digital channels, and trunked systems. These changes created a broader gap in capabilities between systems (Hawkins, 2013).

Trunking radio systems first became available in the 1980s, and it allowed for more efficient use of radio spectrum. Trunked radio systems have advantages as they allow multiple agencies in an area to share a radio system. A trunked system is computer controlled and uses all the available frequencies and allocates an open frequency each time someone uses the push to talk (National task force on interoperability, 2003). This technology change presented new problems and opportunities for achieving and maintaining effective interoperable communications as three different proprietary radio systems were designed with trunking capability. This lead to systems being less compatible than before (U.S General Accountability Office, 2007).

As technology evolved, public service agencies began purchasing two significant types of radio systems that do not necessarily work together: analog and digital. Analog transmissions can carry sound, video, or data. These transmissions vary based on the strength of the signal wave. Digital transmissions convert analog input into a digital format of numbers, which is sent as electronic pulses. The signals are then converted back from a digital signal to analog. Digital signals have advantages that include greater accuracy, noise reduction, and higher capacity for sending information (National Aeronautics and Space Administration, 2018).

Without consideration or coordination with their neighbors, each public safety entity designed and constructed their radio systems (National task force on interoperability, 2003). Many of these systems were designed to meet specific agency goals and were sold equipment that is proprietary and not compatible with other manufacturers. These non-standards-based systems meant that they might not be compatible with neighboring agencies (SAFECOM, 2016).

The issue of multiple radio spectrums amongst public safety entities is not an easy solution to solve. Each of the ten spectrum bands is best suited for different purposes, and the geographical location will influence which spectrum to use (Hawkins, 2013). Generally, the lower the frequency, the better the coverage for a given power level. VHF low band has several advantages as it has the best area coverage but it can be prone to issues such as skipping off the ionosphere, experiences the highest amount of noise interference, and requires a large antenna. By contrast, UHF frequencies have a shorter wavelength but have better building penetration and less noise interference (Imel & Hart, 2003)

The 700MHz spectrum has been identified to travel longer distances similar to other typical cellular bands and is known to penetrate buildings well. It is an appealing

band for both commercial and public safety networks to build their communications networks and are inherently interoperable. Wide-area agencies are using the 800MHz public safety spectrum for state and local governments. Still, there has been a growing problem of interference in the bandwidth from high-density commercial wireless systems (National task force on interoperability, 2003).

The different spectrums have different benefits, and there is no one size fits all. Many forestry and state police agencies have needs for a radio system that covers a vast area where foliage can cause problems for higher frequency systems. Whereas, a metropolitan police department may need a system that provides highly reliable in-building coverage (U.S. General Accounting Office, 2007).

After the terrorist attacks of 9/11, SAFECOM was formed as part of the Presidential E-Government Initiative to improve public safety interoperability, allowing emergency responders to communicate effectively before, during, and after emergencies and disasters. SAFECOM's mission is to "improve designated emergency response providers' inter-jurisdictional and inter-disciplinary emergency communications interoperability through collaboration with emergency responders across Federal, State, local, tribal, and territorial governments, and international borders" (About SAFECOM, 2015). Originally SAFECOM began under the umbrella of the Department of Justice and then was transferred to the Federal Emergency Management Agency (FEMA). SAFECOM now falls under the Department of Homeland Security and assists by guiding funding, technology, governance, and planning of public safety radio systems (U.S. Department of Homeland Security / SAFECOM, 2019).

The SAFECOM lays out five critical success factors necessary to interoperability communications, including governance, standard operating procedures, technology, training and exercises, and usage (Krauss, 2012).

In joint efforts with the Telecommunications Industry Association (TIA), selected Federal Agencies and the National Communications System (NCS) and the Association of Public Safety Communications Officials International, Project 25 was developed as a set of standards for Land Mobile Radios (LMR) to meet the needs of public safety and government organizations. P25 is an open architecture, a user-driven suite of system standards that define digital radio communications. Open architecture is a standard that is designed to make adding, upgrading, or swapping of components easy. The open system standards define the interfaces, operation, and capabilities of any P25 compliant radio system. They exist in the public domain, which allows any manufacturer to produce a P25 compliant radio product (Daniels Electric, 2004).

Compliance with the P25 standard is a vague understanding of what the standard is. Project 25 is a combination of over 80 documents that cover multiple interfaces, multiple services, and various features associated with each interface or service. P25 is more accurately referred to as the P25 Suite of Standards, which is determined by a steering committee. The suite of standards is designed to enable interoperability between the implementations and the multiple venders. The open design allows venders to implement the P25 services or features needed to suit their customer's needs (Davis, n.d.).

P25 systems include a complete suite of technical standards for its wired networks, unlike most LMR standards. This most essential standard for the wired network, Inter-RF Subsystem Interface (ISSI), impacts radio interoperability by connecting P25 networks

creating greater coverage. ISSI, which is open source, not manufacturer-specific, allows users to roam from one network to another and permit roamers to talk back to their home system. Additional wired interfaces are the Console System Interface (SCCI) and the Fixed Station Interface (FSI). These interfaces provide for interoperability between dispatch vendors for consoles and system infrastructure manufacturers. The P25 standards further include interoperability for Over-the-Air-Rekeying (OTAR), which allows system operators to quickly and securely change encryption keys regularly without ever physically touching a radio. By using open-source standards, different brands can be used together as pieces of the radio network or even allow different two-way radio brands to combine on the same frequency (Project 25 technology interest group, 2016).

P25 compliant technology was developed into three stages. The first, Phase 1, operates in 12.5 kHz analog, digital or mixed-mode and is compatible and interoperable with legacy systems. Phase 2 began availability in 2012 defines FDMA (Frequency Division Multiple Access) and TDMA (Time Division Multiple Access) standards to achieve one voice channel and one data channel at 6.25 kHz bandwidth efficiency. The goal of FDMA and TDMA is to improve spectrum efficiency, which gives agencies the ability to have two channels for every 12.5 kHz spectrum. Phase 3 has yet to be implemented but will address the need for high-speed data for public safety use in conjunction with broadband networks (Daniels Electric, 2004).

A P25 system can have a variety of configurations to address an array of geography coverage requirements. The system can be configured in direct mode, repeated, single site, multi-site, voting, multicast, and simulcast operation. The P25 can also be set up in the frequency best suited for an agency, which includes VHF, UHF, 700, 800, and 900 MHz frequency bands. The P25 system is frequency-band compatible, but it does not guarantee radios can talk to each other if they are operating on different bands. Necessary collective planning to implement a P25 radio system is paramount. A P25 system can operate in a conventional or trunked mode based on an agency's needs. The system can also have encryption capability for communications for both voice and data (Project 25 Technology Interest Group, 2016).

P25 sets a standard for a vocoder. A voice encoder or vocoder is a process that allows voice communication to be captured and turned into a digital signal. Not all vocoders are equal, forcing a set standard for P25 compliance. A vocoder standard ensures a radio eliminates as much background noise as possible, and radio transmissions are as clear as possible without significant distortion levels. Analog and digital radios use many of the same components but, microphones in radios were not created equally. (Hawkins, 2013).

There are newer radio technology systems available that are not P25 compliant and have been coming into the public market. These systems are attractive because the cost can be significantly less than a P25 system. These technologies include TETRA (common in Europe), DMR (Digital Mobile Radio), and dPMR (digital Private Mobile Radio). These systems are available in the United States but were designed for business, industrial, and transportation needs. These new technologies, if utilized as public safety communication systems, bring concerns because they are not set up to be interoperable with P25 they can have manufacturer-specific coding. A system that has manufacturer-specific coding will not be able to talk with other radio manufacturer systems (U.S. Department of Homeland Security / SAFECOM, 2016).

Methods

The purpose of this research was to determine whether regional first responder agencies can collaborate to solve radio communication disconnects and explore how the Project P-25 system might solve the problem of radio interoperability for public safety agencies.

Agencies across the state were asked about their radio systems and if they are P25 compliant. If not, does their current radio system have interoperability deficiencies or does it meet their needs? For this research, data was collected from surveys sent to one agency from each of the 67 counties. If one agency did not respond, another agency in the same county was contacted.

The questions captured the participant's base knowledge of a P25 radio system and asked if there were current or future plans within their organization to implement the system in their county. Challenges facing implementation such as newer technologies were addressed, as well as cost of ownership and maintenance sustainability.

The survey consisted of twenty-four questions about the land mobile radio systems in Florida counties. The respondents were told the purpose of the survey was to obtain an assessment Land Mobile Radio systems in place around the state. The study was designed to determine whether regional first responder agencies have radio interoperability barriers or if their current systems are meeting their regional needs. The survey assessed individual Land Mobile Radio needs, capabilities, and challenges achieving LMR interoperability for a county. For the survey, LMR interoperability means that all first responder agencies within a county jurisdiction can communicate with each other on-demand without impediment.

The survey questions were designed using best practices to maximize participation, clarity and focus. One concern is the possibility of a participant skewing the data out of embarrassment of lack of knowledge of radio systems. The survey answers will be kept anonymous to hopefully alleviate this concern, especially among managers/administrators.

Results

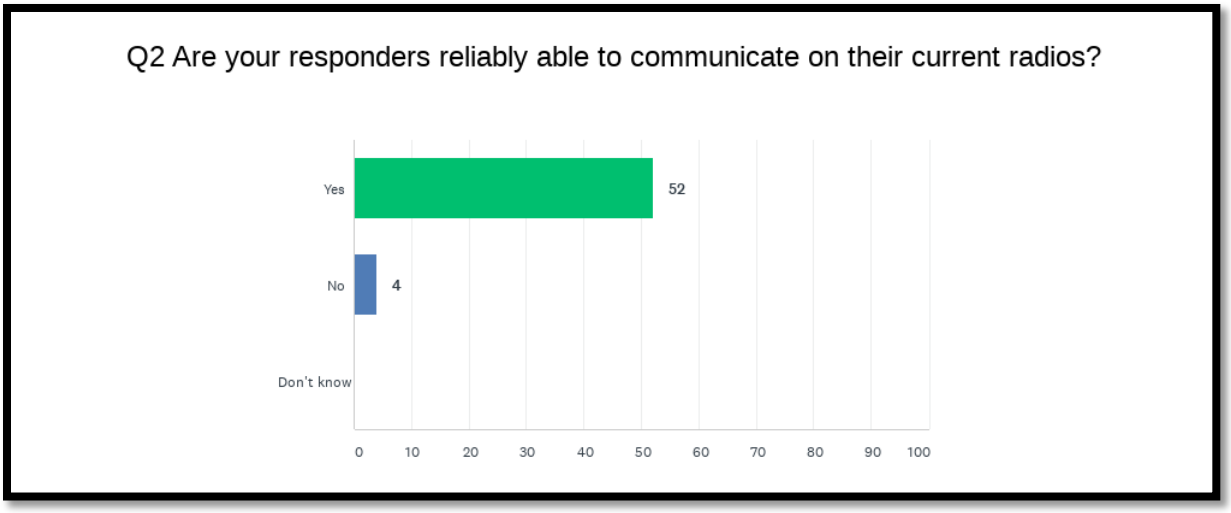
Contact was made with one representative from a public safety agency in each of the 67 counties. This method was to ensure the survey response to one response per county. Most responses were from Sheriff's Departments but also included Fire Departments and the offices of the Board of County Commissioners. Fifty-six responses were received with a response rate of 84%.

The first question of the survey was a fill-in-the-blank question. The question asked the participants which agency they represented. This question was to safeguard the results to ensure only one response from each county was received. The response list was verified to ensure data was not skewed by receiving multiple responses for any of the 67 counties.

The second question asked if their responders are reliably able to communicate with their current radios. There were three available responses; yes, no, and don't know.

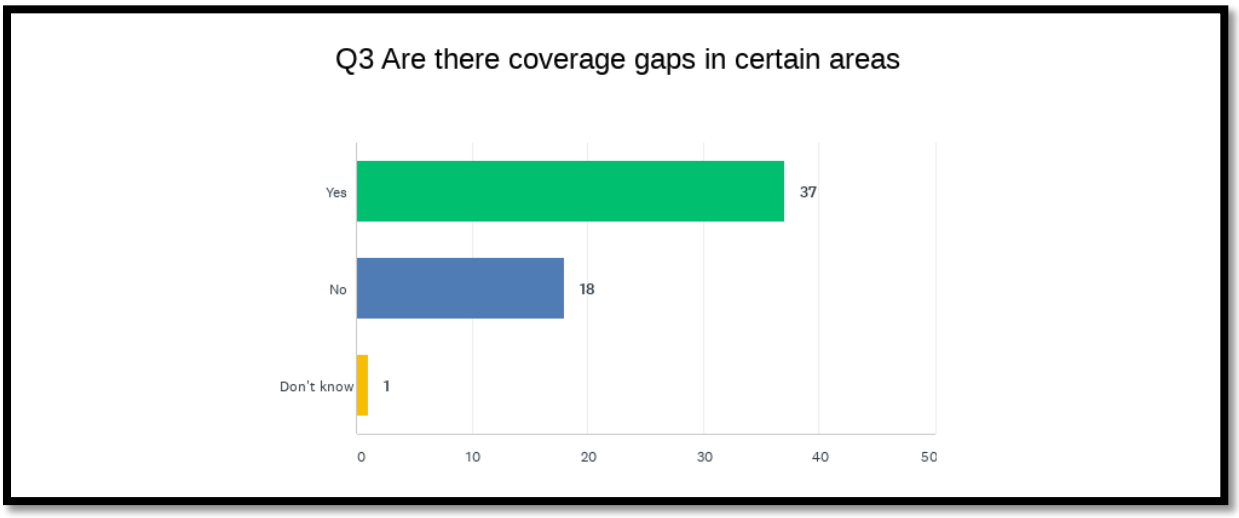
Fifty-two responses received a yes (92.9%), 4 answered no (7.1%), and zero don't know responses were given.

Question 2 Chart: Radio Communication Reliability



Question three asked if there are coverage gaps in certain areas. There were three available responses; yes, no, and don't know. 37 responded yes (66.1%), 18 answered no (32.1%), and 1 responded don't know (1.8%).

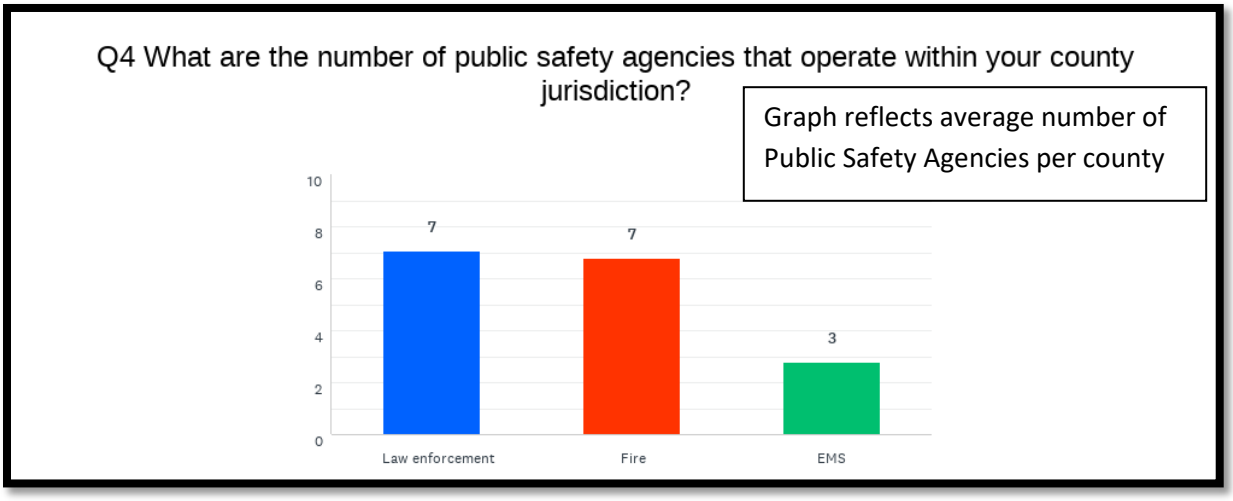
Question 3 Chart: Radio Coverage Gaps



Question four requested the number of public safety agencies (law enforcement, fire, and EMS) operating within their county jurisdiction. There were 56 responses to the number of law enforcement agencies in their county and a total number of 396 (average number of 7 agencies per county). For Fire, there were 56 responses with a total number

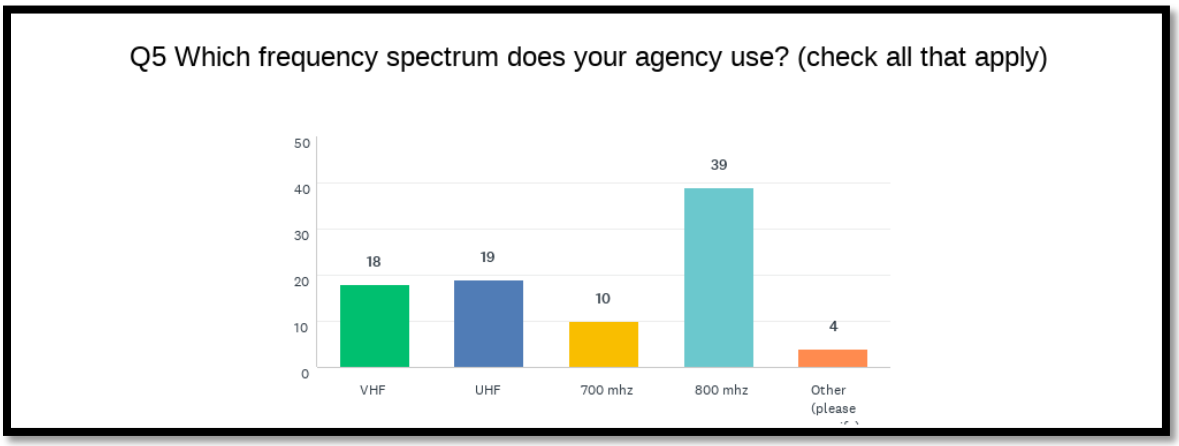
381 agencies (average of 7 agencies per county). There were 54 responses for EMS with a total of 151 agencies (average of 3 per county).

Question 4 Chart: Representing the average number of agencies per county jurisdiction



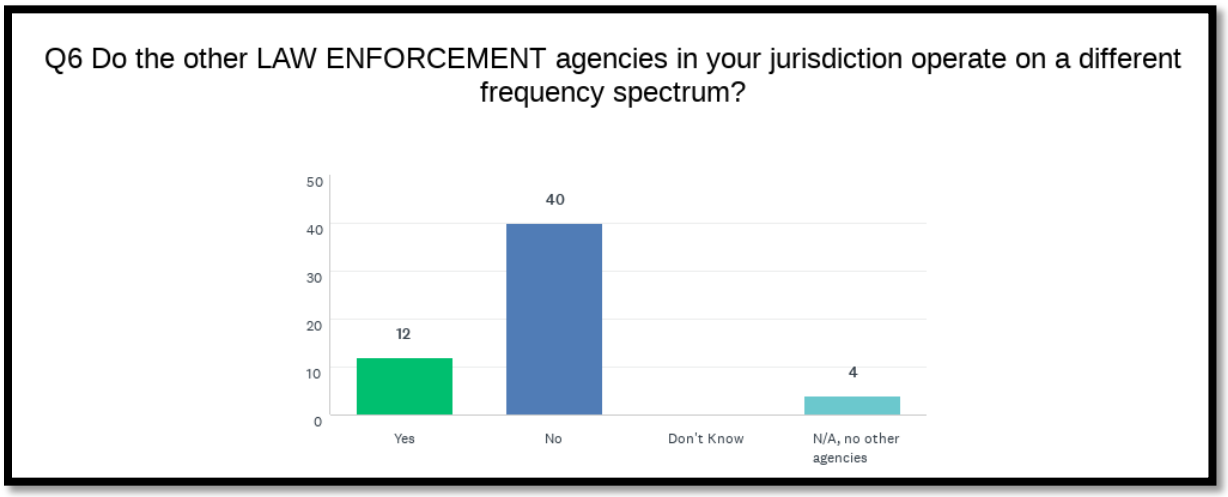
Participants were asked which frequency spectrum their agency uses for radio communication in question five. The participants could make multiple selections for this question and had the options of VHF, UHF, 700 Mhz, 800 Mhz, and other. If other was selected, the participant was requested to fill in an answer to specify their answer. There were 18 selections for VHF, 19 for UHF, 10 for 700 Mhz, 39 for 800 Mhz, and 4 for other. Of the four responses for other, two replied SLERS, one replied P25, and one selected VHF (Fire/EMS) & UHF (LE). Each of these four responses are part of the selected spectrums offered as options, and the selection of other was not an appropriate response.

Question 5 Chart: Spectrum Usage



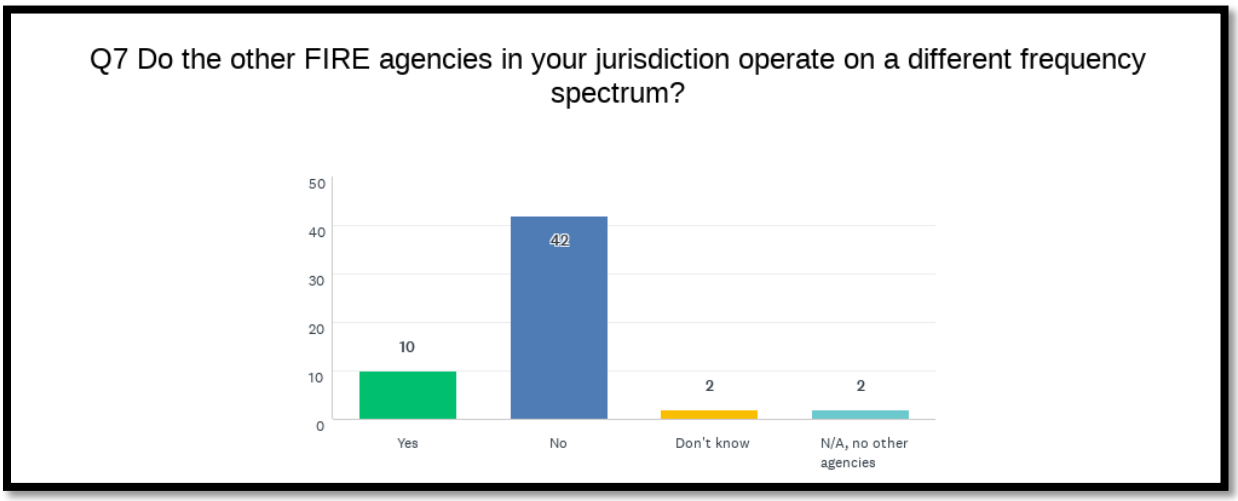
Question six asked if the other law enforcement agencies in their jurisdiction operate on a different frequency spectrum. The selectable answers included yes, no, don't know, and not applicable (no other agencies). 12 participants selected yes (21.4%), 40 participants chose no (71.4%), no participant selected don't know, and 4 chose not applicable (7.2%).

Question 6 Chart: Law Enforcement Agencies Using Different Spectrums



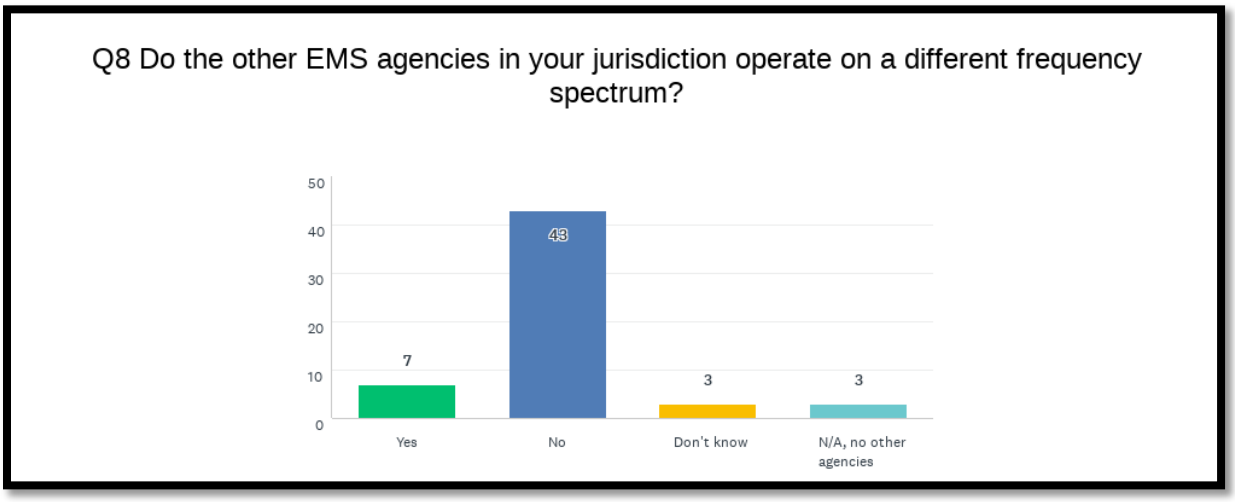
Question seven asked if the other fire agencies in their jurisdiction operate on a different frequency spectrum. The selectable answers included yes, no, don't know, and not applicable (no other agencies). 10 participants selected yes (17.8%), 42 participants chose no (75%), 2 participants selected don't know (3.6%), and 2 chose not applicable (3.6%).

Question 7 Chart: Fire Agencies Using Different Spectrums



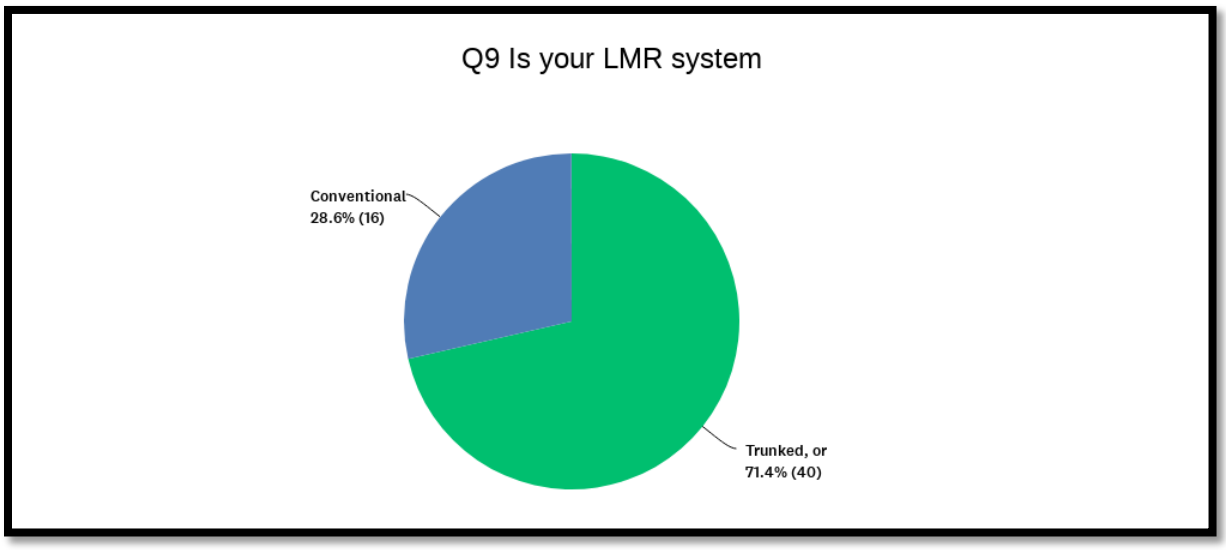
Question eight asked if the other EMS agencies in their jurisdiction operate on a different frequency spectrum. The selectable answers included yes, no, don't know, and not applicable (no other agencies). 7 participants selected yes (12.5%), 43 participants selected no (76.7%), 3 participants selected don't know (5.4%), and 3 selected not applicable (5.4%).

Question 8 Chart: EMS Agencies Using Different Spectrums



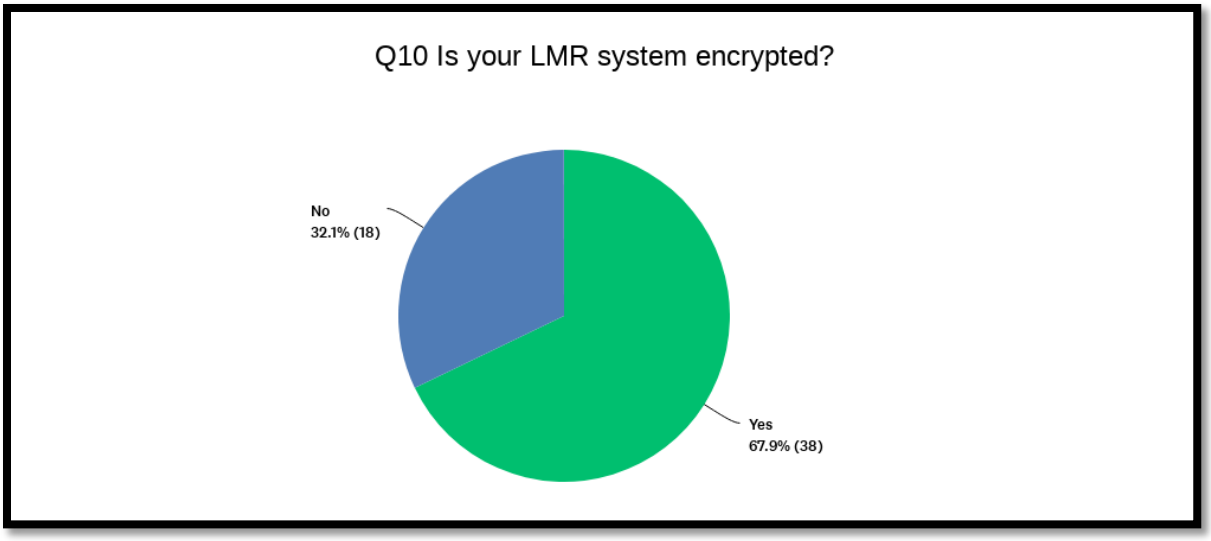
Question nine asks if the participant's LMR radio system is trunked or conventional. Fourty participants answered trunked (71.4%), and 16 answered conventional (28.6%).

Question 9 Chart: Trunked or Conventional



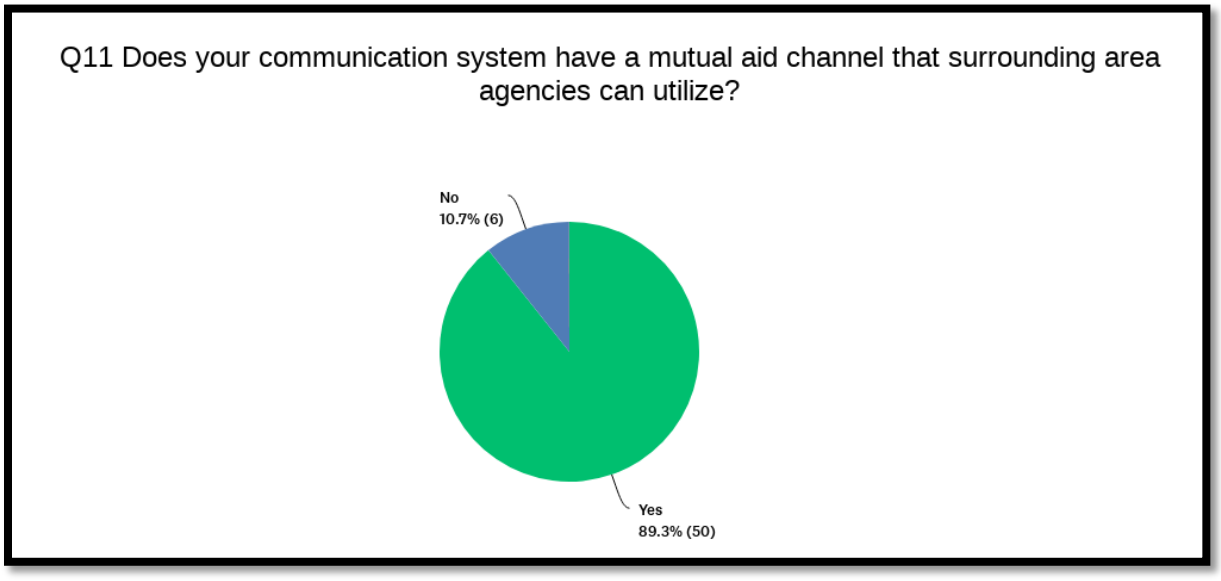
Question ten asks if the participant's LMR radio system is encrypted. 38 participants answered yes (67.9%), and 18 answered no (32.1%).

Question 10 Chart: LMR Encryption



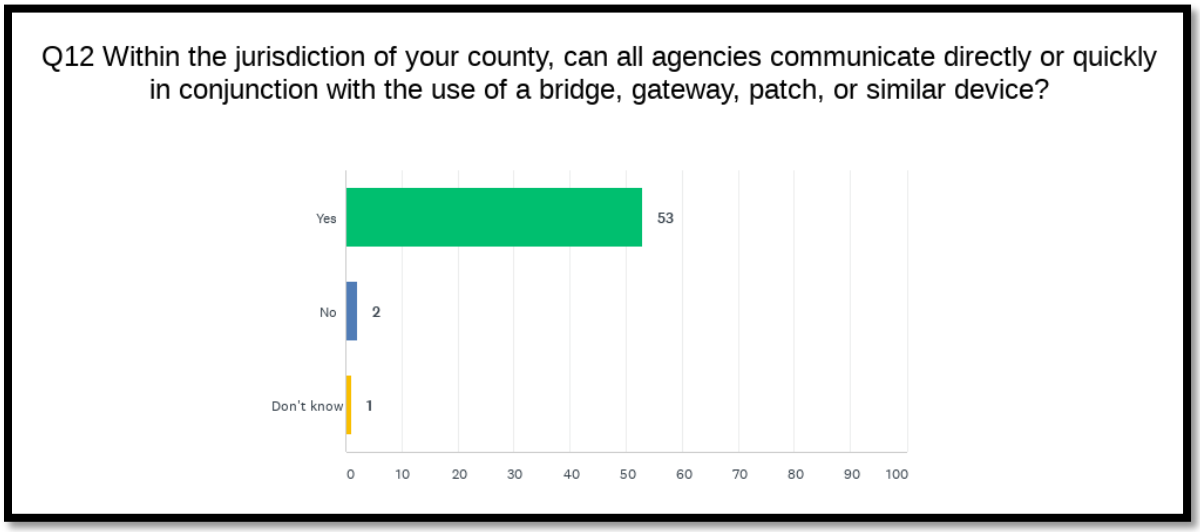
The next question asked if their communication system has a mutual aid channel utilized by surrounding agencies. Fifty participants replied yes (89.3%), and 6 replied no (10.7%).

Question 11 Chart: Mutual Aid



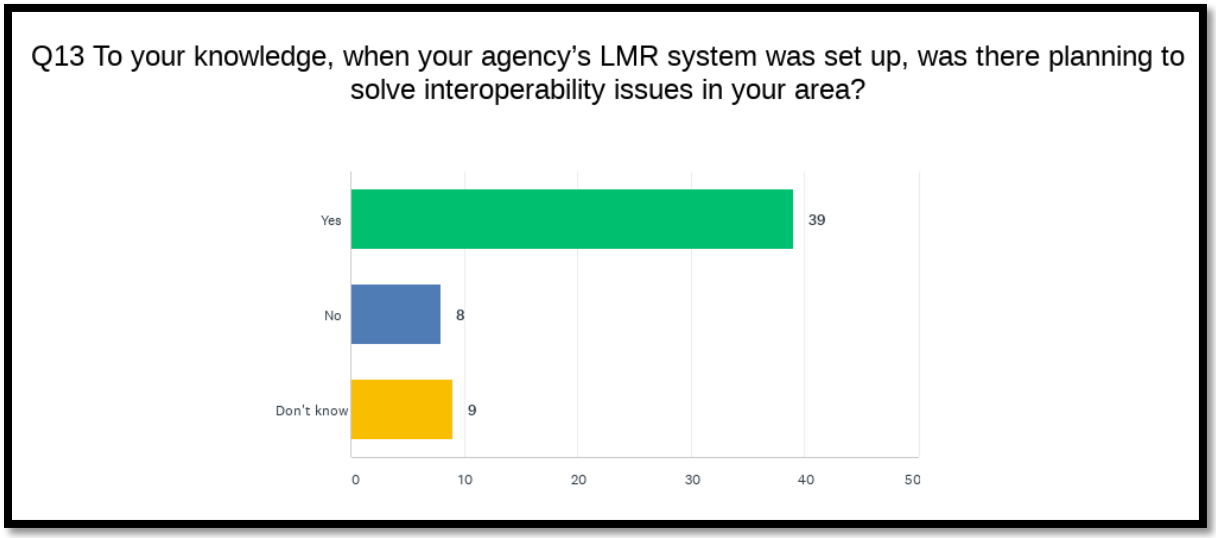
Question twelve asked if within their county, all agencies can communicate directly or quickly in conjunction with the use of a bridge, gateway, patch, or similar device. There were three possible answers of yes, no, and don't know. 53 participants replied yes (94.6%), 2 selected no (3.6%), and 1 chose don't know (1.8%).

Question 12 Chart: Direct Communication



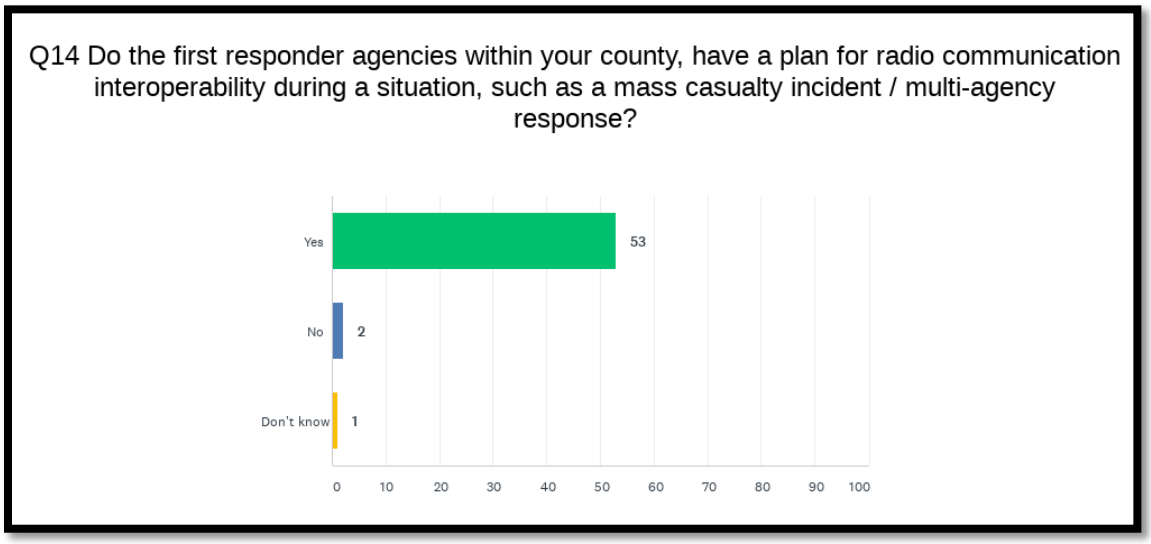
Question thirteen asked if when their agency LMR system was set up, was there a plan to solve interoperability issues in their area. There were three possible answers of yes, no, and don't know. Thirty-nine participants replied yes (69.7%), 8 selected no (14.3%), and 9 replied don't know (16.0%).

Question 13 Chart: Interoperability Planning



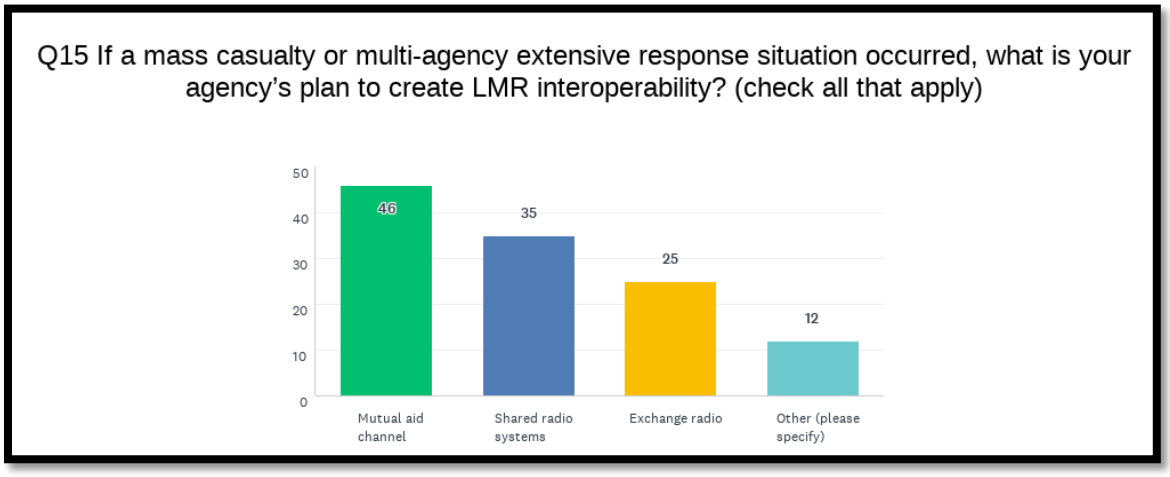
The next question requested to know if the first responder agencies within their county have a plan for radio communication interoperability during a situation such as a mass casualty incident or a multi-agency response. There were three possible answers of yes, no, and don't know. Fifty-three participants replied yes (94.6%), 2 selected no (3.6%), and 1 selected don't know (1.8%).

Question 14 Chart: Mass Casualty Radio Interoperability Plan



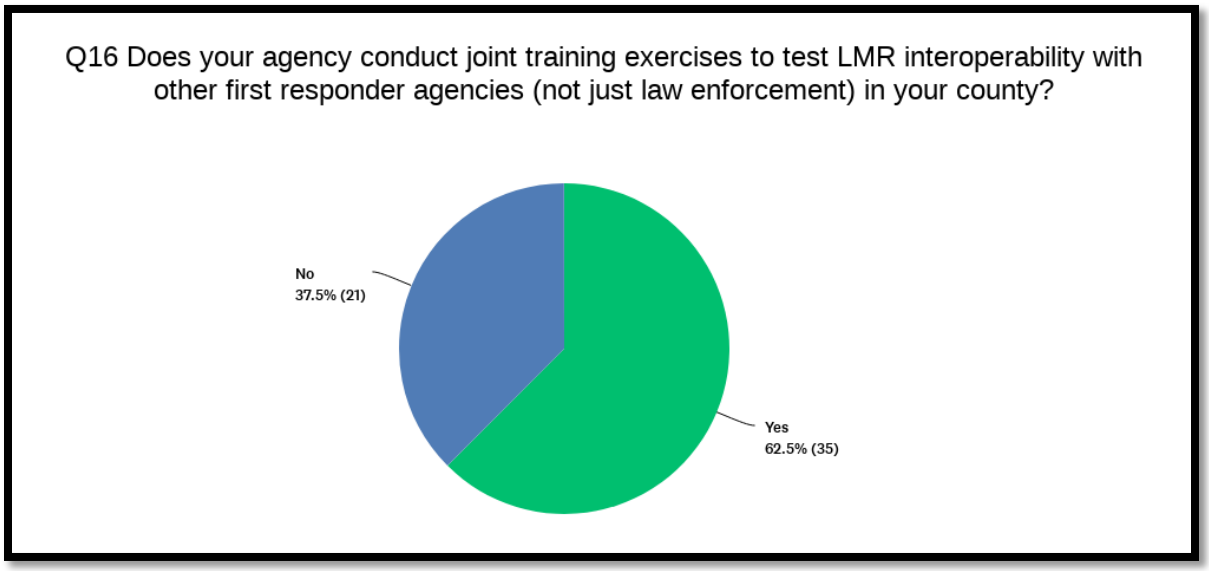
Question fifteen asks if a mass casualty or multi-agency extensive response situation occurred, what is your agency's plan to create LMR interoperability. Four choices were provided in which the participant could select all appropriate choice selections which included mutual aid channel, shared radio systems, exchange radios, and other. If other was selected, the participant was requested to type out a response. There were 46 responses for mutual aid channel, 35 responses for shared radio systems, 25 responses for exchange radios, and 12 responses for other. The 12 other responses are listed in Appendix B.

Question 15 Chart: Radio Interoperability Options



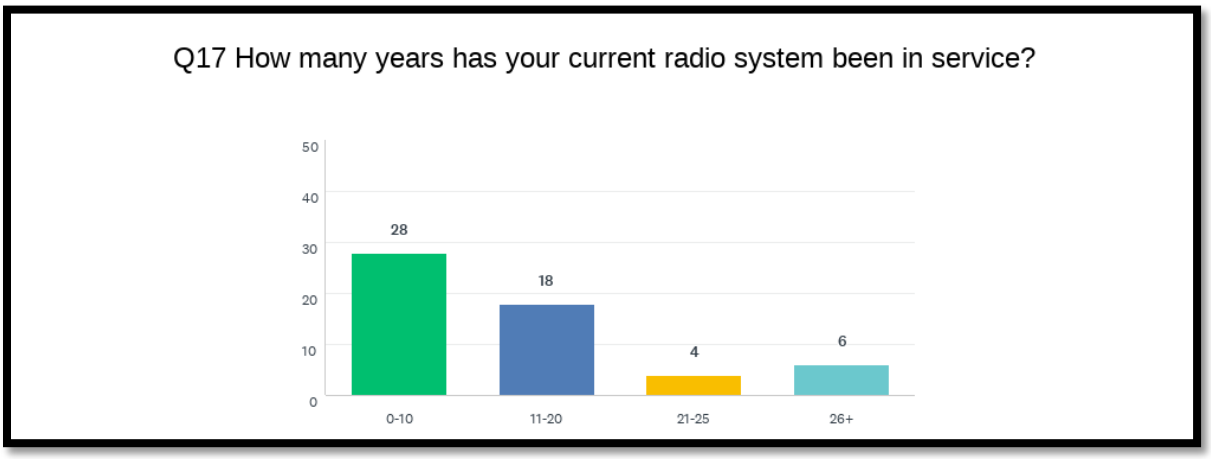
Agencies were asked if they conduct joint training exercises to test LMR interoperability for question sixteen. Participants were asked if they test their system with the other first responder agencies in their county. There were 35 responses for yes (62.5%) and 21 responses for no (37.5%).

Question 16 Chart: Exercises to test LMR Interoperability



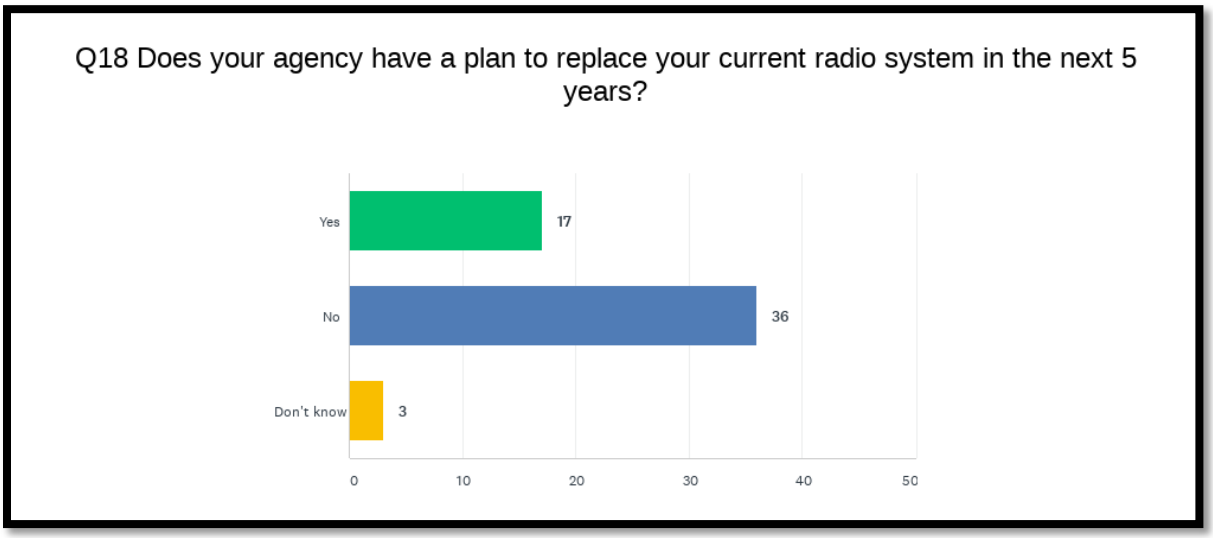
Question seventeen asks participants how many years their current radio system has been in service. The answers in years were grouped at 0-10, 11-20, 21-25, and 26+ years. There were 28 responses for 0-10 (50.0%), 18 responses for 11-20 (32.2%), 4 responses for 21-25 (7.1%) and 6 for 26+ years (10.7%).

Question 17 Chart: Radio System Years of Service



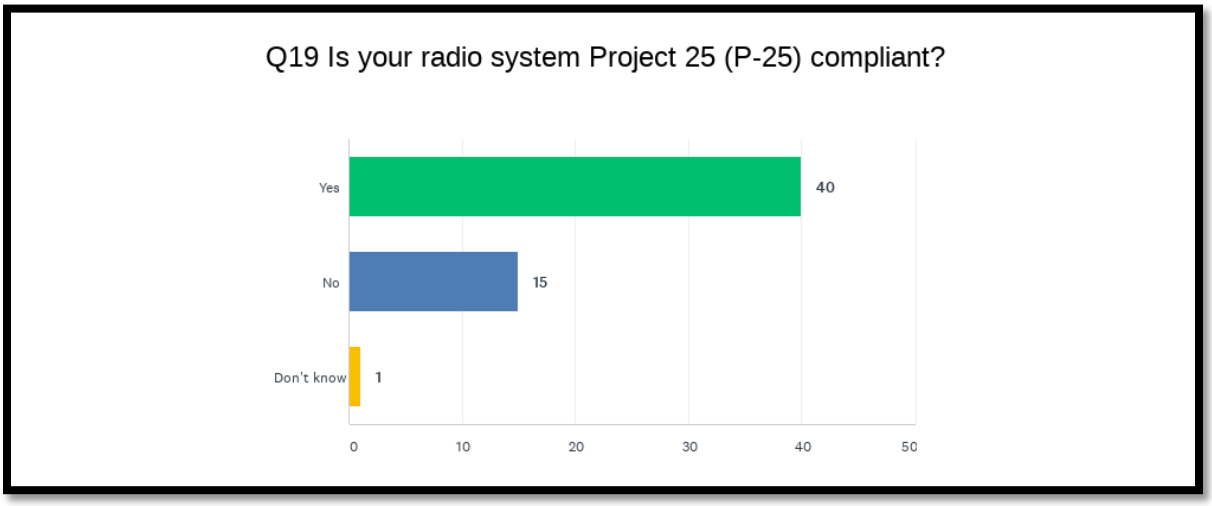
Question eighteen asks if their agency has plans to replace their radio system in the next five years. Seventeen participants stated yes (30.4%), 36 responded no (64.3%), and 3 responded don't know (5.4%).

Question 18 Chart: Radio System Replacement in Next 5 Years



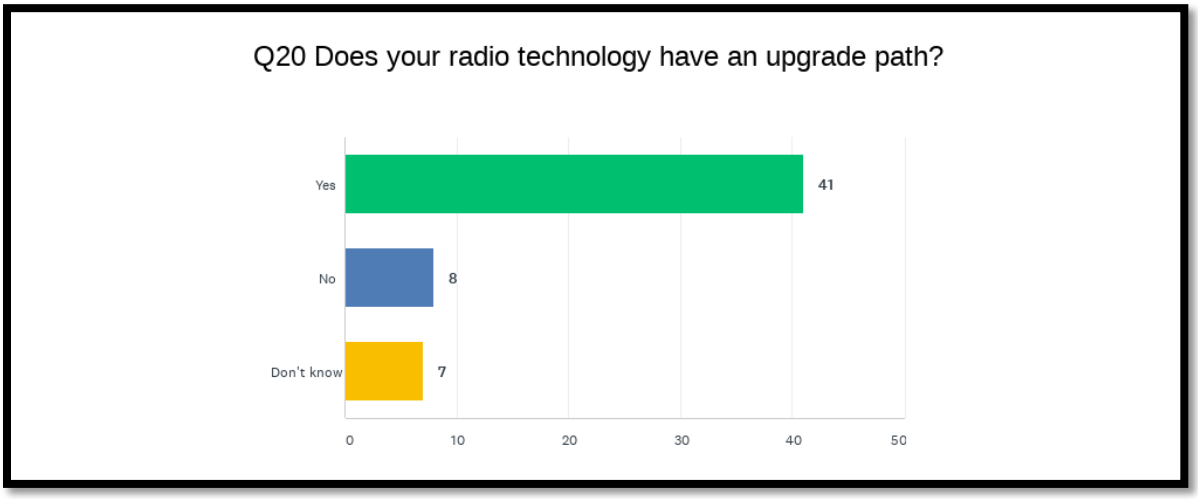
The participants were asked if their radio system is Project 25 compliant for question nineteen. Forty participants answered their system is with yes (71.4%), 15 replied no (26.8%), and 1 responded don't know (1.8%).

Question 19 Chart: P-25 Compliant



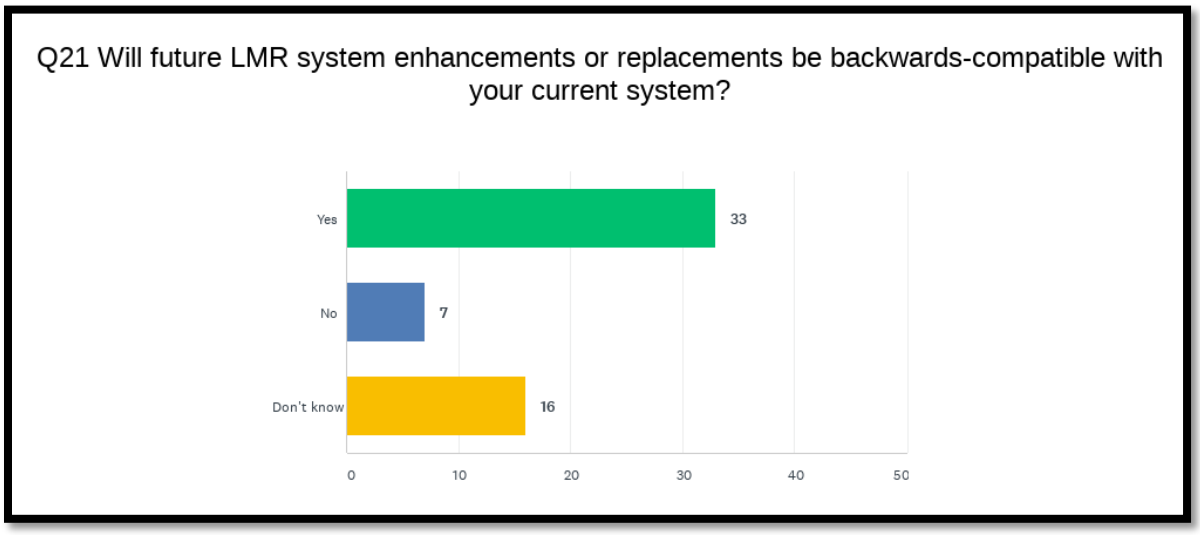
Question twenty asks if their agency's radio technology has an upgrade path. Forty-one participants answered yes (73.2%), 8 replied no (14.3%), and 7 responded don't know (12.5%).

Question 20 Chart: Radio Upgrade Path



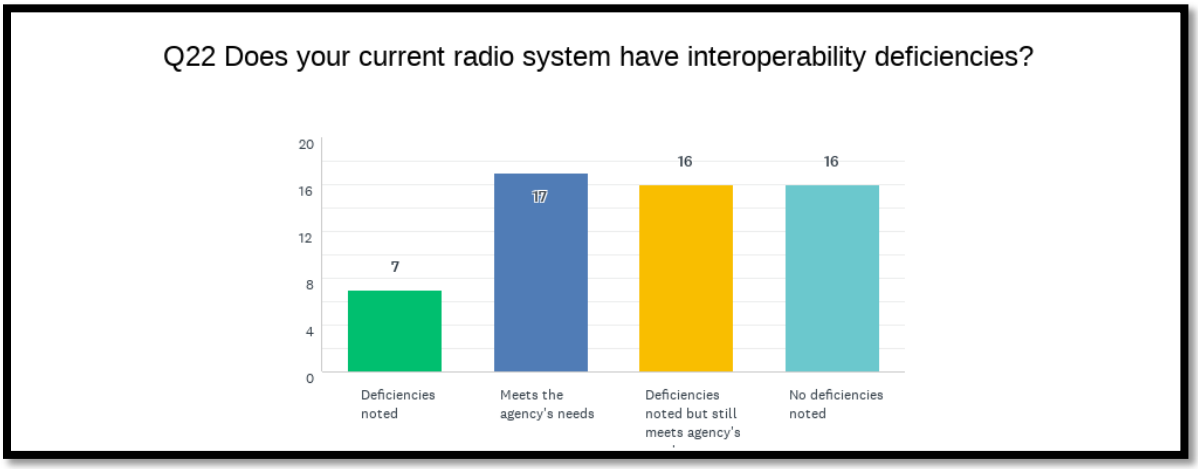
Question twenty-one asks if future LMR system enhancements or replacements will be backward-compatible with their current system. Thirty-three participants answered yes (58.9%), 7 replied no (12.5%), and 16 replied don't know (28.6%).

Question 21 Chart: Backwards-Compatibility



Participants were asked if their current radio systems have interoperability deficiencies for question twenty-two. Four answers were possible to the question, including deficiencies noted, meets the agency's needs, deficiencies noted but still meets the agency's needs, and no deficiencies noted. Seven participants checked deficiencies noted (12.5%), 17 checked meets agency's needs (30.3%), 16 checked deficiencies noted but still meets agency's needs (28.6%), and 16 checked no deficiencies noted (28.6%).

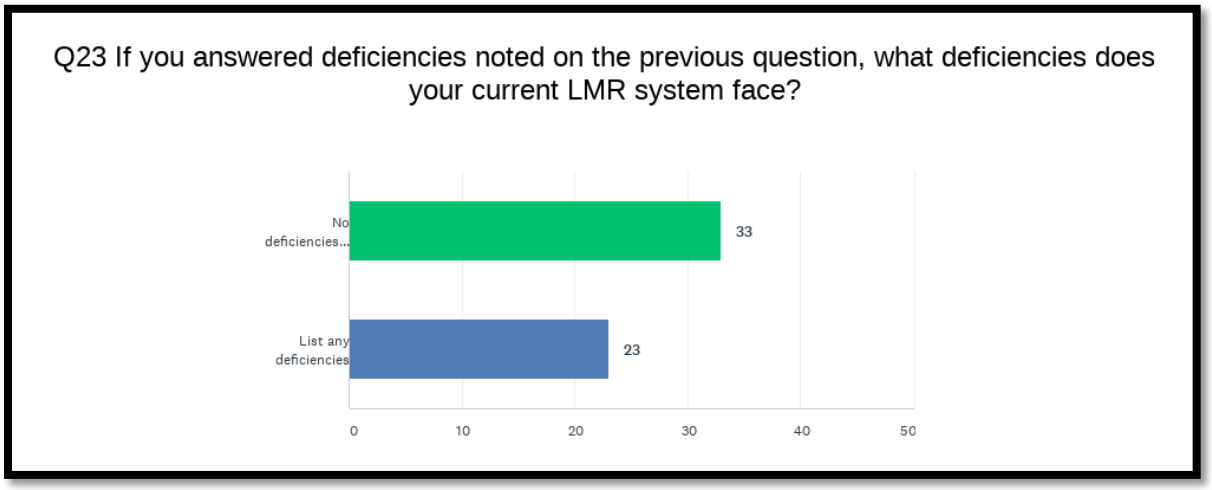
Question 22 chart: Interoperability Deficiencies



Question twenty-three asked if deficiencies were noted in question twenty-two, what deficiencies does you current LMR system face. There were two possible answers; no deficiencies and list any deficiencies with a fill in the blank response. Thirty-three participants marked no deficiencies and 23 marked list any deficiencies and left the remarks that are detailed in Appendix B. The responses in question twenty-three are

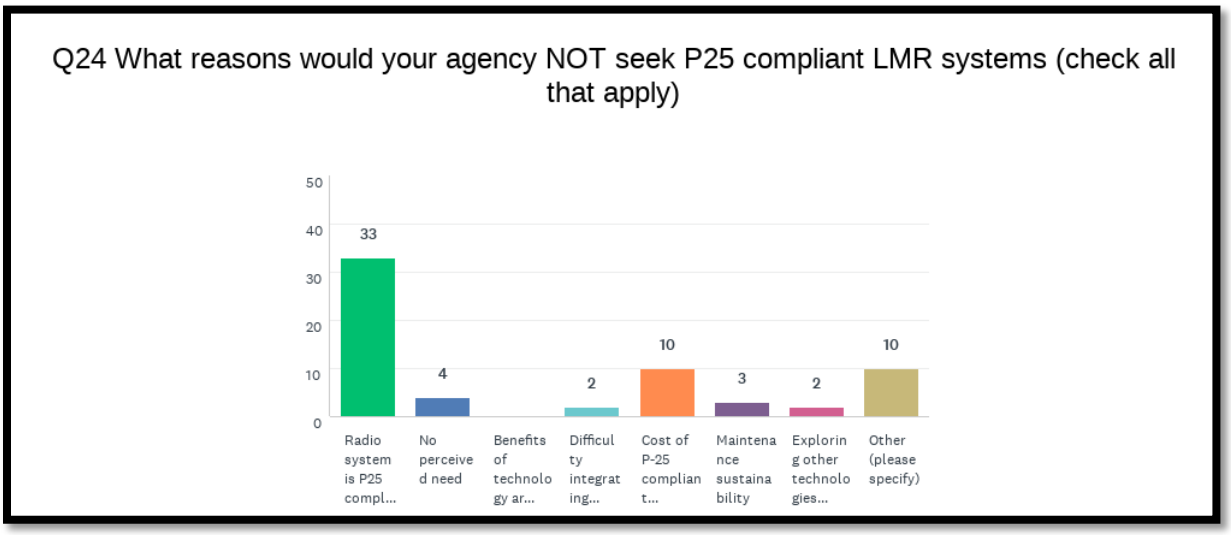
slightly contradicted to question twenty-two. For question twenty-two there were 16 responses no deficiencies noted but for question twenty-three, there were 33 responses for no deficiencies.

Question 23 Chart: LMR noted Deficiencies



The last question asks what reasons would their agency not seek P25 compliant LMR systems. The participant could choose as many answers as applicable but eight possible answers were available. The possible answers include: radio system is P25 compliant, no perceived need, benefits of technology are unclear, difficulty integrating technology with the current system, cost of P-25 compliant devices too high, maintenance sustainability, exploring other technologies (i.e. FirstNET) as LMR substitute, and other to include a fill in the blank response. There were 33 responses for radio system is P25 compliant, 4 responses for no perceived need, no responses for benefits of technology are unclear, 2 responses for difficulty integrating technology with the current system, 10 responses for cost of P-25 compliant devices too high, 3 responses for maintenance sustainability, 2 responses for exploring other technologies as LMR substitute, and 10 other responses. The other responses provided are detailed in Appendix B, but many of the other responses state their system is P-25 compliant or their agency is in the process of becoming P-25 compliant.

Question 24 Chart: Reasons to not seek P25 LMR Systems



Discussion

This survey revealed most agencies have very few impediments with radio communication within their individual organization as 92.9% of the responses stated they are reliably able to communicate on their radios. However, first responders must not only be able to communicate with their dispatch center and other responders in their agency, but they must also be able to communicate with other agencies that respond to multi-agency emergencies.

The survey revealed there are a vast number of public safety organizations throughout the state. On average, seven law enforcement, 7 Fire, and 3 EMS agencies per county were identified. With this large number of first responder agencies, was an interoperability problem identified in Florida? According to the survey, the answer overwhelmingly is no but there were still issues identified.

Florida agencies were found to still be using different radio spectrums of VHF, UHF, 700 Mhz, and 800Mhz, but when asked, 89.3% indicated they have a mutual aid channel that the surrounding agencies utilize. When asked if their agency has a plan to further create interoperability, 94.6% stated they are able of utilize a bridge, gateway, patch, or similar device to achieve interoperability.

Many agencies replied to being proactive when setting up the LMR to have solve interoperability issues. Sixty-nine and seven tenths percent of the survey responders stated there was planning on part of their agencies to solve interoperability prior to setting up their LMR system. Ninety-four and six tenths percent stated their agencies have plans in place to ensure radio interoperability occurs during a mass casualty/multi agency responses.

The purpose of this research was to determine whether first responder agencies can collaborate to solve radio communication disconnects and explore how Project 25 might solve the problem of radio interoperability for public safety agencies. Most of the

agencies responding to the survey (71.4%) stated their radio system are Project 25 compliant and overwhelmingly stated their systems have upgrade paths and are backwards compatible. The survey suggests that many agencies have implemented Project-25 to solve radio interoperability. Surprisingly, 30.4% of the participants stated their agencies are looking to replace their current radio systems in the next five years. In a follow up question, at least five agencies are in the process of or moving towards their LMR systems being P-25 compliant.

The survey results reveal agencies are working to solve LMR interoperability issues, at least within their counties, between all first responder agencies. However, there will always be some impediments to communication, specifically agency interoperability.

Question 5 asked which spectrums their agencies utilize. The responders were permitted to check as many responses as applied. The largest collective of answers selected was 800 MHz with 43.3% of the answers. This means 56.7% operate on other spectrums (UHF, VHF, 700 MHz). This does not mean that agencies cannot talk directly, it means those communication centers must utilize the use of bridges, gateways, and patches to solve the radio interoperability problems. Overwhelmingly (94.6%) agencies have plans in place to solve this problem.

Interestingly the research revealed that radio infrastructures can last 20 to 30 years. Of the survey results, 50% of the responses answered their systems are 0-10 years old and 32.2% are 11-20 years old. There are additional questions not answered by the survey that would be intriguing as it relates to P-25 standards. First, what percentage of these newer systems (0-10) are P-25 compliant? Also, 30.4% stated their agency is looking to replace their system in the next five years. Of that group, how many are looking to maintain or obtain P-25 compliance, or are looking at new and emerging technologies? There were not follow-up questions specifically to those agencies looking to replace their systems. The survey responders were asked what reasons their agency would not seek to be P25 compliant with the cost of a P25 system being the most prevalent just as the research for the paper revealed. The survey does not answer of agencies that cannot afford P-25 and are replacing their LMR systems, what systems are they looking to use.

Recommendations

After researching radio systems and in surveying agencies across the state, it was revealed many Florida public service agencies have implemented or are implementing P-25 radio systems.

There are still many barriers to creating and implementing new radio systems. This was discovered to be true in both the research and survey. The first recommendation is there must planning of a system and how one agencies' system will work with another's. The research showed 69.7% did plan to solve interoperability problems before implementation however that leaves 30.3% who either did not plan or do not know if their agency planned how to solve interoperability issues.

The second recommendation is to implement spectrum mandates within county jurisdictions. Overall, the largest group of agencies within the state utilizing the 800 Mhz as outlined in question five, but more than 55% percent of those that responded used

other spectrums. For each county, between 12% and 21% stated other agencies (law enforcement, Fire, and EMS) use other spectrums just within their own counties (see questions six, seven, and eight).

The third recommendation is for agencies to look at radio systems regionally. This topic was covered in the survey but agencies must begin planning for regional responses within the state. For question twenty-three in other responses listed in Appendix B, many of the responses listed interoperability issues with neighboring jurisdictions outside of their county.

Can the P-25 system solve radio interoperability issues in Florida? Yes it can, but there are budget issues that prevent some jurisdictions from participating. Radio interoperability is a continuing work in progress and will likely affect the state for years to come.

Captain Kevin Kirkpatrick began his law enforcement career in 1997 with the Valparaiso Police Department. Two years later, he joined the Okaloosa County Sheriff's Office serving as a Deputy Sheriff in patrol and community policing before being promoted to Corporal. He was promoted to Sergeant supervising the Street Crimes Unit before being transferred back to patrol when he was promoted to Lieutenant. Kevin joined the Special Response Team in 2000 and is the Team Commander. Since 2002, Kevin has instructed various topics at the local police academy including various high liability topics. Kevin currently supervises the Special Operations Division which includes the Communications section, Marine Unit, Beach and Dive Unit, Part-time deputies, POSSE, UAS, THI and SRT. Kevin graduated from the Florida Leadership Academy, Class 36. Captain Kirkpatrick has a Bachelor's degree in Criminal Justice from Troy University and is working on his Master's degree in Criminal Justice from Liberty University.

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Appendix A -Survey Questions

This survey is in conjunction with the Florida Department of Law Enforcement Senior Leadership Program class 23.

This purpose of this survey is to obtain an assessment of Land Mobile Radio (LMR) systems in place around the state. This study is designed to determine whether regional first responder agencies have radio interoperability barriers or if their current systems have met their region's needs. This survey will provide an assessment of Land Mobile Radio (LMR) needs, capabilities, and challenges achieving LMR interoperability.

For this survey, LMR interoperability means that all first responder agencies within a jurisdiction can communicate with each other on-demand without impediment.

This survey is 24 questions.

1. Which agency do you represent? _____
2. Are your responders reliably able to communicate on their current radios?
    a. Yes
    b. No
    c. Don't know
3. Are there coverage gaps in certain areas
    a. Yes
    b. No
    c. Don't know
4. What are the number of public safety agencies that operate within your county jurisdiction?
    a. Law enforcement ____
    b. Fire _____
    c. EMS _____
5. Which frequency spectrum does your agency use?
    a. VHF
    b. UHF
    c. 700 mhz
    d. 800 mhz
    e. Other _____
6. Do the other Law Enforcement agencies in your jurisdiction operate on a different frequency spectrum?
    a. Yes
    b. No
    c. Don't know

7. Do the other Fire agencies in your jurisdiction operate on a different frequency spectrum?
    a. Yes
    b. No
    c. Don't know

8. Do the other EMS agencies in your jurisdiction operate on a different frequency spectrum?
    a. Yes
    b. No
    c. Don't know

9. Is your LMR system:
    a. Trunked or
    b. Conventional

10. Is your LMR system encrypted?
    a. Yes
    b. No
    c. Don't know

11. Does your communication system have a mutual aid channel that surrounding area agencies can utilize?
    a. Yes
    b. No
    c. Don't know

12. Within the jurisdiction of your county, can all agencies communicate directly or quickly in conjunction with the use of a bridge, gateway, patch, or similar device?
    a. Yes
    b. No
    c. Don't know

13. To your knowledge, when your agency's LMR system was set up, was there planning to solve interoperability issues in your area?
    a. Yes
    b. No
    c. Don't know

14. Do the first responder agencies within your county, have a plan for radio communication interoperability during a situation, such as a mass casualty incident / multi-agency response?
    a. Yes
    b. No
    c. Don't know

15. If a mass casualty or multi-agency extensive response situation occurred, what is your agency's plan to create LMR interoperability?
    a. Mutual aid channel
    b. Shared radio systems
    c. Exchange radios
    d. Other _____

16. Does your agency conduct joint training exercises to test LMR interoperability with other first responder agencies (not just law enforcement) in your county?
    a. Yes
    b. No

17. How many years has your current radio system been in service?
    a. 0-10
    b. 11-20
    c. 21-25
    d. 26+

18. Does your agency have a plan to replace your current radio system in the next 5 years?
    a. Yes
    b. No
    c. Don't know

19. Is your radio system Project 25 (P-25) compliant?
    a. Yes
    b. No
    c. Don't know

20. Does your radio technology have an upgrade path?
    a. Yes
    b. No
    c. Don't know

21. Will future LMR system enhancements or replacements be backwards-compatible?
    a. Yes
    b. No
    c. Don't know

22. Does your current radio system have interoperability deficiencies?
    a. Deficiencies noted
    b. Meets our needs
    c. Deficiencies noted but still meets agencies' needs
    d. No deficiencies noted

23. If you answered deficiencies noted on the previous question, what deficiencies does your current LMR system face?
    a. No deficiencies noted
    b. List any deficiencies _____

24. What reasons would your agency NOT seek P25 compliant LMR systems (check all that apply)
    a. Radio system is P25 compliant
    b. No perceived need
    c. Benefits of technology are unclear
    d. Difficulty integrating technology with current system
    e. Cost of P-25 compliant devices too high
    f. Maintenance sustainability
    g. Exploring other technologies (i.e FirstNet) as LMR substitute
    h. Other _____

Appendix B – Detailed Responses

Question 15: Radio Interoperability Options

- FIN (Florida Interoperability Network) connection to SLERS
- All agencies in JaCo can interoperate either directly through console patching. No “direct” interop with state agencies as they are on SLERS and limited mutual aid channels existing in the counties since funding for state interop sites is limited
- Channel patch
- Depending on the situation may use any of these and FIN or patching
- Cashe radios
- FIN
- Sharing interoperable talk group zones
- Control stations programmed for surrounding counties are connected by gateways to the dispatch consoles
- Communications Unit Leader (COML) will be deployed to make a decision of the available tools above depending on the exact situation and requirements of the incident commander
- FIN radio
- Raytheon ACU-1000 Interconnect system
- Deployable repeaters.

Question 23: LMR noted Deficiencies – “List any deficiencies” responses

- Lack of proper training for the use of mutual aid groups
- Unable to communicate with surrounding county agencies or state agencies.
- Antiquated and major coverage gaps
- JaCo agencies operate DMR digital, multi-site I.P. site connect in both UHF (LE) & FWH (Fire/EMS) and cannot interop with state assets other than through mutual aid channels which are very limited. JaCo borders AL and GA and nine counties with some being same DMR and majority of others being different.
- Interop with neighboring jurisdictions who are on antiquated systems (VHF/UHF). There is sometimes a learning curve when a patch has to be made
- Can’t patch SLERS to SLERS.
- No dedicated interoperable channel at this time for agencies outside of county
- Coverage, interoperability, expansion, end of life equipment.
- Dead areas.
- Older encryption – need to update
- Radios 10 years old and are starting to show their age. Vender does not support the older system with new radios hitting the market, so current systems do have a shelf life despite being P25 compliant. Upkeep for the older radios is also more costly
- Mutual aid with vender specific radio systems
- Encryption

- We are surrounded by P25 800 systems on all sides, FIN is not always the best solution but for now it's all we have until we can upgrade our system. Other agencies don't have to use Fin as we do, so their lack of knowledge adds to the deficiencies
- Coverage issues mostly, the system is older and upgrades are needed
- Funding for replacement of support infrastructures such as generators, battery backup systems, and microwave backhaul is noted as a current challenge. Interoperability with state law enforcement is also a challenge as they are not P25 capable and the statewide radio system (SLERS) is not P25 capable and is vendor-specific/proprietary
- FHP, Brevard, and Volusia are not P25 systems currently and present a challenge for events where interop is needed
- Outdated equipment, no inherent upgrade path
- Incompatibility with agencies not on the four-county area covered by our/their system
- We're currently a proprietary EDACS system so we're limited when communicating with Motorola systems until we upgrade to P25
- The state's radio system is none P25 Phase 2 compliant so we can't talk; EDACS encryption, non-P25
- Awaiting surrounding counties to go to P25 for easier ISSI interop, instead of gateway patches.

Question 24: Reasons to not seek P25 LMR Systems – "Other" responses

- Migrating to P25 phase 2 now and should be complete by 2026
- N/A – we use P25
- Most counties in the area cannot afford P25 system. Cannot sustain maintenance cost. Most counties explored current SLERS but no coverage for portables in rural areas. JaCo alone is approx. 1000 sq. miles. I designed our system to operate multi-site, multi-case but are independent of each other if microwave fails, as was the case in Hurricane Michael, which allowed localized comms to continue independently. Our system capable of dual analog/digital
- Currently migrating to P25 TDMA
- We have a P25 system
- We want our future LMR to be P-25 compliant
- We do utilize P25 countywide for all agencies. All public safety and law enforcement agencies in Lake County utilize the countywide system. Our main challenge today in inter operation with state law enforcement agencies who utilize SLRS and are not directly compatible
- N/A
- We are in the process of upgrading our system to P25 now
- New system is P25 phase 2, we are state SLERS users.