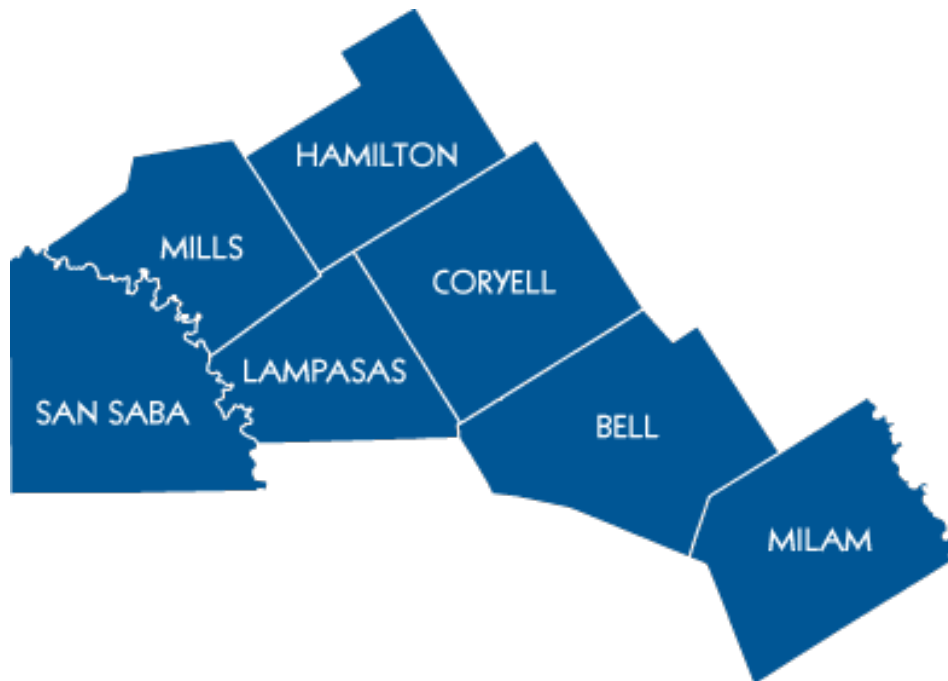


Central Texas Council of Governments
Radio Communications Interoperability
2017 Assessment Report



September 2017

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EXECUTIVE SUMMARY

The Texas Statewide Communications Interoperability Plan (SCIP) describes the State of Texas plan to develop a system of 24 regional Project 25 (P25) voice communications systems by 2015. Few regions have attained this goal. The Regional Interoperable Communications Plan (RICP) describes the goal of developing a regional system that would be comprised of interconnected independent systems operated by local jurisdictions. The regional system would provide the interoperability necessary to address daily operations and large-scale incidents.

The Central Texas Council of Governments (CTCOG) contracted with Mission Critical Partners, Inc. (MCP) to assess the interoperability needs and conduct an inventory of radio assets within the counties of Coryell, Hamilton, Lampasas, and San Saba. The results of the assessment and inventory would describe the current state of radio systems within the four subject counties necessary to update the RICP.

The assessment process began with a project kickoff meeting that involved emergency management coordinators from the counties of Coryell, Lampasas, and San Saba. The coordinators provided baseline information on each county's radio systems. They also provided information on the public safety agencies within each county, including a point of contact.

The MCP team attempted to schedule meetings with all the public safety officials who represent county, municipal, and volunteer agencies within each county. The meetings were intended to gather data on interoperability needs and radio system assets. Unfortunately, many of the volunteer fire departments (VFDs) declined requests to participate in the project. However, MCP consultants felt that the data that was made available by county and municipal officials was sufficient to develop an accurate assessment of systems within each county.

The results of the assessment revealed that voice radio interoperability remains an important concern of public safety officials. However, officials expressed a greater concern regarding the state of the radio equipment presently in use by first responders. Departments have implemented various work arounds to provide interoperability using the existing equipment. The CTCOG, working in conjunction with several fire departments and Bell County, have pre-positioned mobile radio resources to enhance interoperability during large-scale incidents.

Much of the radio system infrastructure and radios used by first responders have exceeded their technological life expectancy, i.e., the equipment is no longer supported by the original manufacturer. In short, first responders are using obsolete radio equipment to carry out day-to-day operations. This also indicates that radio interoperability would be a critical problem if a large-scale, multidiscipline, multijurisdictional incident were to occur.

MCP consultants analyzed the data that was made available and developed recommendations to improve radio system in the four counties. The recommendations are presented in Section 5 using a tiered approach that includes incremental improvements and increasing costs.

1. INTRODUCTION

The CTCOG seven-county region includes the counties of Bell, Coryell, Milam, Hamilton, Lampasas, Mills, and San Saba. The four counties involved in the MCP assessment participated in the development of the RICP that was adopted in 2011. The assessment process and outcomes described in this report reflect the current state of voice radio systems within the four subject counties.

The 2011 RICP included a section that described the future needs of public safety radio systems. The plan, as stated in 2011, was to connect all agencies within the region to the P25 network switch in Belton (Bell County) to create a regionwide, shared P25 communications system. The description of critical shortcomings included:

- Inadequate mobile, portable, and in-building coverage across the counties
- Insufficient channel capacity for day-to-day, emergency, and planned-event operations and interoperability

The proposed improvements spanning a ten-year period include:

- Increased mobile, portable, and in-building coverage
- Adding channels to increase radio system capacity

The State's target goal stated in the SCIP was to realize a statewide system of systems by 2015. The RICP set a more realistic target of 2020 to obtain a regional P25 system.

The plan was based upon the assumption that grant funding would continue to be provided through the State's Homeland Security Grant Program (HSGP). Federal preparedness grant funding largely was reallocated to the Urban Area Security Initiative (UASI) entities across the country. CTCOG does not fall within a UASI.

1.1. CTCOG Point of Contact

The primary point of contact (POC) for questions regarding the CTCOG RICP is:

Region:	Region 23 - Central Texas Council of Governments
Name:	Jesse Hennage
Title:	Homeland Security/Criminal Justice Planner
Address:	2180 North Main Street Belton, TX 76513
Phone:	254.770.2365
E-mail:	jesse.hennage@ctcog.org

1.2. Summary of Findings

Many of the recommendations and planned enhancements described in the 2011 RICP have not been accomplished. The public safety officials who participated in the project are more concerned with replacing the obsolete radio equipment than achieving a greater level of

interoperability. First responders are using radios that have exceeded their expected technological life expectancy. Interoperability needs, while important, are secondary to maintaining primary daily public safety operations.

Radio systems and radios used in the field have changed little since being placed into service in 2003-2004. Much of the infrastructure—including towers, repeaters, switches, and network backhaul—is outdated. Some systems need immediate maintenance. Many of the radios in use by first responders are no longer serviceable and in need of replacement.

The primary challenge to resolving the problems associated with aged equipment is identifying funding to replace system components and user radios.

2. PROJECT OVERVIEW

2.1. Project Overview

The last comprehensive assessment of radio systems and inventory of radio assets was conducted in conjunction with the preparation of the 2011 RICP. The project described in this report was undertaken with the goal of identifying current interoperability needs and inventory of radio assets.

2.2. Scope of Work

The scope of work defined for this assessment project included:

- Conducting a project kickoff meeting
- Reviewing existing data and reports
- Gathering data from the public safety community
- Analyzing the data
- Developing recommendations to improve interoperability with the subject counties
- Presenting findings and recommendations in report form and in-person

3. PROJECT METHODOLOGY

3.1. Methodology Overview

The methodology employed by MCP to gather data and conduct the analysis involved a combination of stakeholders meeting, site visits, and follow-up communication. MCP reviewed the RICP that was adopted in 2011, information concerning Federal Communication Commission (FCC) licensing, information concerning tower sites, and other publicly available data that was accessed via online sources.

3.2. Project Initiation

The project formally began with a kickoff meeting that was held on June 1, 2017. The meeting provided the opportunity for MCP consultants to meet with representatives of the counties, including the emergency management coordinators from the counties of Coryell, Lampasas, and San Saba. The local officials were selected to support the project by providing the following:

- Present the historical context of radio system operations
- Identify existing sources of information (e.g., public safety executives)
- Describe known gaps in radio system data
- Assist in arranging site visits within each county

The county coordinators provided lists of public safety agencies within each county, including contact information for chief executives. Table 3-1 below presents a list of kickoff meeting participants.

Table 3-1: Kickoff Meeting Participants

Name	Agency
Marsha Hardy, Coordinator	San Saba Office of Emergency Management (OEM)
Bob Harrell, Coordinator	Coryell County OEM
Angela Rainwater, Coordinator	Lampasas County OEM
Mark Collier	CTCOG
Stacey Alley	CTCOG
Jesse Hennage	CTCOG
Richard Gaston, Project Manager	MCP
Darek Wiczorek	MCP
Todd Johnson	MCP

3.3. Stakeholder Meetings and Site Assessment

The initial phase of the project involved the collection of data from public safety officials representing agencies at the county and municipal level. MCP consultants utilized information provided by the county coordinators to attempt to contact representatives of county, municipal and volunteer public safety agencies. Unfortunately, many of the VFDs are not represented in

this report. MCP made numerous attempts to contact local officials by telephone and email. The county coordinators also encouraged officials to respond to MCP's request for information.

MCP consultants were successful in scheduling and conducting site visits in each county. The purpose of the site visits was to identify the radio equipment in use and to assess the condition and age of system components. Site visits were conducted at public safety communication centers and tower sites in each county. Section 4 describes the radio systems in each county.

4. CAPABILITIES AND REQUIREMENTS

4.1. Overview

CTCOG's current RICP was adopted in 2011. That plan presented the state of regional interoperability that existed at the time the plan was under development. The plan also provided a path for each county, municipality, and region to enhance interoperability. This assessment determined that advancements in interoperability capabilities have been slow. Few changes have occurred in the four counties since the 2011 RICP was adopted. This section will present the current state of public safety interoperability that exists within the four counties.

4.2. Regional Demographics

Many counties within Central Texas have experienced rapid population growth since the 2010 census was conducted. Improved transportation infrastructure has encouraged residential development in areas that were considered too distant for commuting into the Austin area.

Increased demand for public safety services typically accompanies the addition of new residents. Law enforcement and fire/emergency medical services (EMS) agencies must plan to enhance their capabilities by adding personnel, vehicles, equipment, and communications resources.

Within CTCOG, Bell County has led the growth by adding 26,148 residents, representing an increase of 8.4 percent since 2010. Between 2010 and 2016, the population of neighboring Williamson County increased by an estimated 19.5 percent, or 82,571 people. In the same period, Travis County/Austin has gained 165,920 new residents, representing an increase of 16.2 percent.

Analysis revealed that of the seven counties in CTCOG's region, Hamilton and Mills counties experienced slight decreases in population. The other five counties had increases that range from 2.6 to 8.4 percent. Table 4-1 on the following page presents the demographic composition within CTCOG's footprint.

Table 4-1: County Population Estimates

County	2010 Census Results	2016 Estimated Population	Population Change	Percent Change
Coryell County	75,388	78,137	2,749	3.6
Hamilton County	8,517	8,449	-68	-0.8
Lampasas County	19,677	20,540	863	4.3
San Saba County	6,131	6,283	203	3.3
Bell County	310,235	336,383	26,148	8.4
Milam County	24,757	24,167	-590	-2.4
Mills County	4,936	5,064	128	2.6

Data Source: Texas Demographic Center

4.3. Deployable Mobile Interoperability Resources

Deployable mobile resources are available to enhance interoperability during large-scale or planned events. Resources have been pre-positioned within CTCOG’s region. Mobile command units and site-on-wheels (SOW) trailers are located at Bell County Communications, the Harker Heights Fire Department (FD), the Copperas Cove FD, and Gatesville Fire/Rescue. The deployable assets provide enhanced coverage on 700/800 megahertz (MHz) and UHF/VHF to serve the full spectrum of interoperability needs during a large-scale, multi-discipline, multi-jurisdiction incident.

4.3.1. Allied Emergency Services

The fire and EMS providers in the region interact with hospital emergency departments. EMS providers and hospital emergency departments partner to assure a continuum of care to patients. EMS providers depend upon interoperable communications with each hospital to provide vital patient information. Table 4-2 on the following page presents the hospitals that serve CTCOG’s region.

Table 4-2: Hospitals Within CTCOG's Region

Hospitals	
Baylor Scott and White Medical Center	Carl R. Darnall Army Medical Center
Baylor Scott and White McLane Children's Medical Center	Central Texas Veterans Hospital
Metroplex Adventist Hospital	Rollins Brook Community Hospital
Seton Medical Center Harker Heights	Coryell Memorial Healthcare System

The following sections describe the current radio communications infrastructure and the status of interoperability capacity within the four counties included in this assessment report.

4.4. Coryell County

Coryell County spans 1,057 square miles and shares borders with Bell, Burnet, Lampasas, Hamilton, Bosque, and McClennan counties. Coryell County is the second most populated county in CTCOG’s region with an estimated population of 78,137. The county is home to Fort Hood, which occupies a large area of the county. Figure 4-1 below depicts a map of Coryell County.

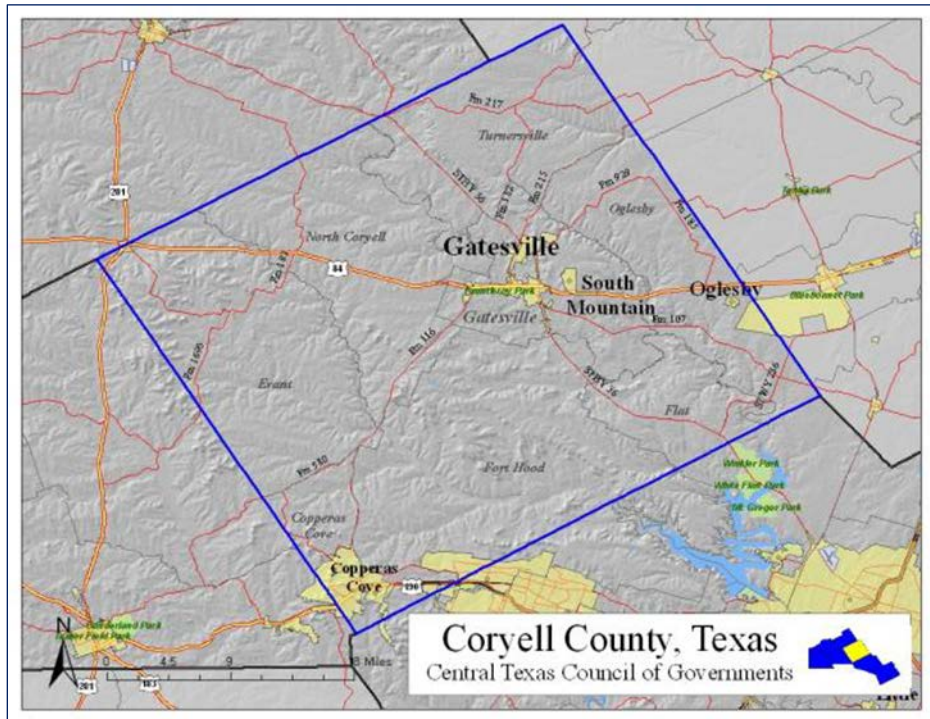


Figure 4-1: Coryell County Map

Coryell County is home to the largest number of first responder communications systems of the four counties addressed in this report. Coryell County government, the City of Copperas Cove, and the City of Gatesville operate separate radio systems that serve public safety and other local government agencies. Seven VFDs serve the large unincorporated areas of the county. The southern part of the county is covered by a Harris Enhanced Digital Access Communication System (EDACS)[®] system that is managed by the City of Copperas Cove. The City of Gatesville operates a legacy VHF conventional system that covers the northern portion of the county. A significant portion of the county falls within the boundaries of Fort Hood. Local public safety agencies are not responsible for initial emergency response operations within Fort Hood. However, agencies may be called upon to support emergency operations and require the ability to interoperate with Department of Defense resources.

The Texas Department of Criminal Justice (TDCJ) operates seven correctional units within Coryell County. Though infrequent, the need exists for local public safety agencies to interoperate with prison security staff. State law enforcement agencies—including the Texas

Department of Public Safety (DPS) Highway Patrol Division and Texas Parks and Wildlife Game Wardens— have a presence in the county. Officers with both agencies interact with local law enforcement officials daily. Table 4-3 below provides a list of the public safety agencies serving Coryell County.

Table 4-3: Coryell County Public Safety Agencies

Agencies	
Coryell County SO	Coryell City – Osage VFD
Coryell County OEM	Evant VFD
Coryell County Constable Offices (3)	Flat VFD
City of Copperas Cove Police Department (PD)	Gatesville VFD
City of Copperas Cove Fire Department (FD)	Levita VFD
City of Gatesville PD	Oglesby VFD
Texas DPS	Turnersville VFD
Texas Parks and Wildlife/Game Wardens	Acadian EMS, Coryell EMS, and Hospitals
TDCJ	Fort Hood

4.4.1. Data Gathering

MCP consultants met with Deputy Fire Chief Gary Young of the Copperas Cove FD. Chief Young provided a thorough briefing on the city’s EDACS® system and the capabilities of the mobile interoperability trailer, e.g., the site on wheels. Gatesville Fire Chief Billy Vaden demonstrated his knowledge of radio systems in both the City of Gatesville and Coryell County. Chief Vaden also serves as the Coryell County Fire Marshal. Coryell County public safety agencies are fortunate to have the support of these two individuals who possess knowledge and experience involving the management of public safety radio systems.

The City of Copperas Cove operates an 800 MHz EDACS® analog trunked radio system. The system serves police, fire/EMS, and public service agencies within the city. While the system is undergoing progressive upgrades, budget limitations have delayed full P25 operation to 2020. Most of the public safety subscriber units are capable of P25 operation. However, as of 2017, Harris no longer provides support for EDACS®. All maintenance work is based upon the availability of parts that are either in stock or available through secondary sources, including second-hand components. The system has interoperability with the Bell County radio system.

The City of Gatesville manages a conventional VHF radio system from a single tower site. All but two of the VHF conventional channels dispatched from Gatesville operate in P25 mode.

Chief Vaden reported that the site provides good mobile radio coverage across the northern portion of the county. The S.O. utilizes range extenders to enhance portable radio coverage.

Bell County operates a Harris 700/800 trunked radio system. The 2011 RICP called for the installation of a network switch at Copperas Cove and the full migration to P25. That plan has not yet been implemented.

Interoperability needs are greater in the areas of the county that are adjacent to Bell County. Copperas Cove and neighboring City of Killeen would benefit from the proposed upgrades that were presented in the 2011 RICP.

Copperas Cove maintains and manages the deployable SOW, which can provide temporary site coverage at a large-scale incident or event. The resource is available to support incidents within CTCOG's region and other areas of the state upon request of the Texas Division of Emergency Management (TDEM). Table 4-4 below provides a summary of the radio system infrastructure that exists in Coryell County.

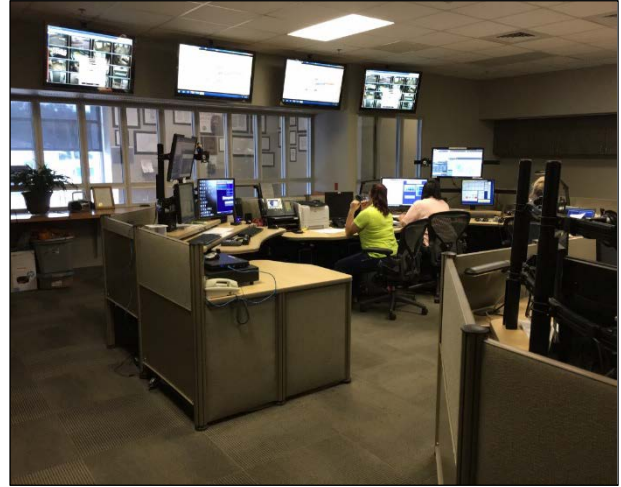


Figure 4-2: Copperas Cove Communications Center

Table 4-4: Coryell County Radio Systems Overview

Category	Quantity	Comments
First Responder Agencies	16	14 VHF; two 800 MHz (Copperas Cove); not included: Copperas Cove Public Works, statewide or federal agencies; includes 8 VFDs.
Radio Tower Sites	4	One outside Copperas Cove; one outside Gatesville; not included: building tops or small towers for local control stations
Communication Centers/Public Safety Answering Points (PSAPs)	4	The main dispatch centers with advanced positions are located at Copperas Cove PD and Gatesville PD. Some dispatch operations are performed at the S.O. using desktop control stations. Gatesville FD also has similar capability
Radio Channels in Use	5 (trunked) 10 (conventional)	Trunked (all 800 MHz) Conventional (mostly VHF, some 800 MHz)
P25-Capable Channels (repeaters)	8	All VHF. While the Harris MASTR III 800 MHz repeaters theoretically are upgradeable to P25, they are at end of life and need to be replaced soon.

4.4.2. Findings

Interoperability was not found to be a major issue with public safety officials in the county. The key concerns identified include:

- Equipment obsolescence
 - Most of the equipment in use dates to the original post-9/11 Department of Homeland Security (DHS) grants and was purchased and installed in 2003-2004.
- Portable coverage (for the VHF system only) in the north, east and west sections of the county; the 800 MHz system provides good coverage in and around Copperas Cove).
- Coryell County has not established, and does not have ready access, to a cache of radios to support large-scale emergency incidents.

4.5. Hamilton County

Hamilton County encompasses 836 square miles and includes the municipalities of Hamilton and Hico. The county shares borders with Coryell, Lampasas, Mills, Comanche, Somerville, and Bosque counties. The county’s population decreased slightly since 2010. The 2016 estimated population was 8,449 that represented a 0.8 percentage decrease.

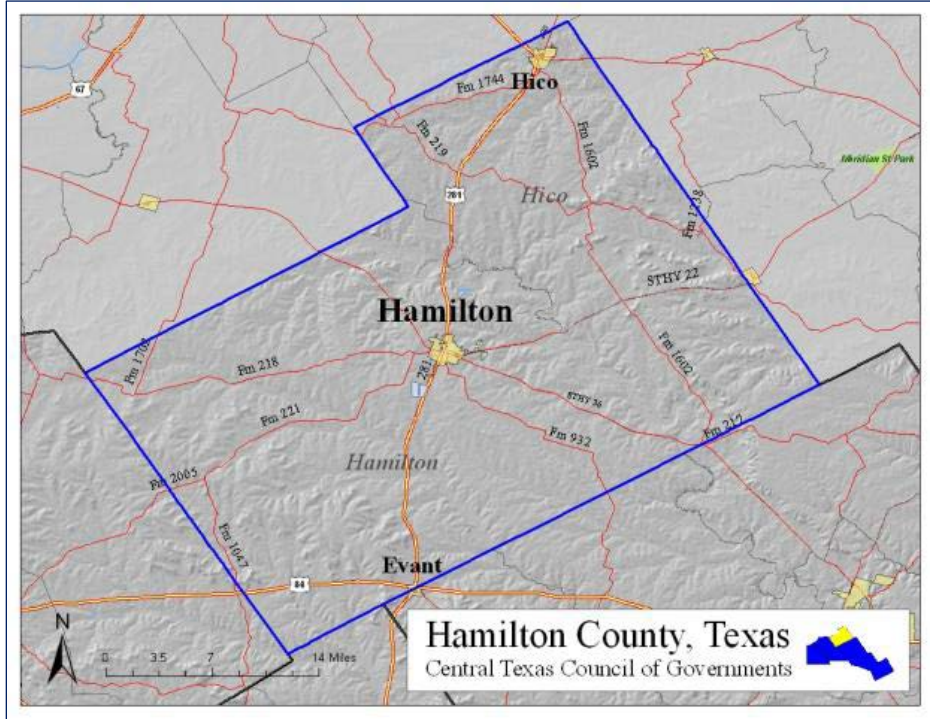


Figure 4-3: Hamilton County Map

The Hamilton County S.O. manages the county’s only PSAP. The S.O. communications office provides dispatch services to all public safety agencies in the county. Table 4-5 below provides a list of the public safety agencies serve Hamilton County.

Table 4-5: Public Safety Agencies in Hamilton County

Agencies	
Hamilton County SO	Carlton VFD
Hamilton County Constable	Cransfills Gap VFD
Hamilton County OEM	Hamilton VFD
City of Hico, Town Marshal’s Office	Jonesboro VFD
City of Hamilton PD	Pottsville VFD
Texas DPS	Shire VFD

Agencies	
Texas Parks and Wildlife/Game Wardens	Star VFD
Coryell Memorial EMS and Hospitals	

The SO manages the county's Harris radio system. The P25 system utilizes analog conventional VHF channels and is served by a single repeater site.

The radio system components and a majority of the subscriber equipment is considered technically obsolete. The equipment has exceeded projected life expectancy and no longer is supported by the manufacturer. In terms of technical expertise, the County depends on contractors to provide system maintenance. Table 4-6 below provides a summary of the radio system infrastructure in Hamilton County.



Figure 4-4: Hamilton County Sheriff's Office Control Stations

Table 4-6: Hamilton County Communications System Overview

Category	Quantity	Comments
First Responder Agencies	9	Including 4 VF's; not included: statewide or federal agencies
Radio Tower Sites	1	Not included: building tops or small towers for local control stations
Communication Centers/PSAPs	1	All agencies dispatched from SO dispatch located at the County Jail
Radio Channels in Use	9	All agencies use VHF; 800 MHz used only for interoperability purposes
P25-Capable Channels (repeaters)	0	The SO operates P25-capable desktop control stations. While the MASTR III repeaters theoretically are upgradeable to P25, they are at end of life and need to be replaced soon

4.5.1. Findings

The agencies within Hamilton County did not report any issues regarding voice interoperability. Interoperability is not a major concern for the agencies. The most important issues that officials feel to be addressed are:

- Equipment obsolescence
- Coverage gaps in the southwest, north and southeast areas of the county

4.6. Lampasas County

Lampasas County covers 714 square miles and shares borders with San Saba, Milles, Hamilton, Coryell, Bell, and Burnet counties. The 2016 estimated population is 20,540. This represents an increase of 4.4 percent since 2010. A map of the county appears in Figure 4-5 below.

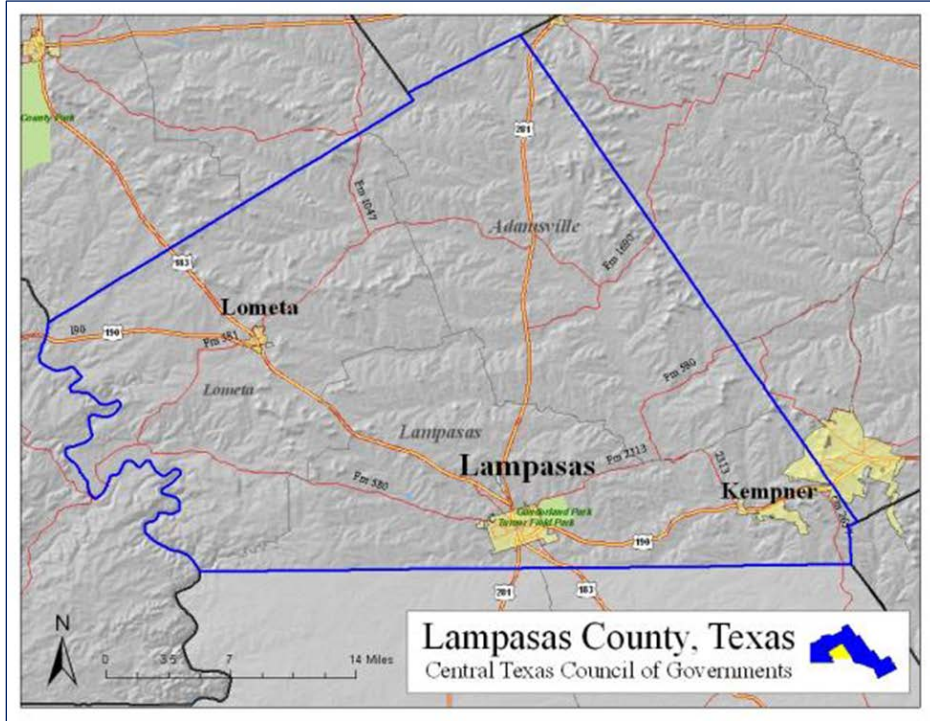


Figure 4-5: Lampasas County Map

All the public safety agencies in Lampasas County operate on VHF conventional analog frequencies. The S.O. provides dispatch services most agencies in the county. The City of Lampasas police and fire departments are dispatched from the City PSAP. Table 4-7 below provides a list of the public safety agencies serve Lampasas County.

Table 4-7: Public Safety Agencies in Lampasas County

Agencies	
Lampasas County S.O.	City of Kempner PD
Lampasas County Constable Offices (3)	Kempner VFD
Lampasas County OEM	Adamsville VFD
City of Lampasas PD	Lometa VFD
City of Lampasas FD	Acadian EMS and Hospitals

Agencies	
Texas DPS	Texas Parks and Wildlife/Game Wardens

MCP was not able to identify an individual with direct responsibility for maintaining the county’s radio system. Research revealed that a 900 MHz microwave link previously connected the SO dispatch office to the single radio site. The link was considered unreliable and eventually was disconnected and replaced with a combination VHF link and local repeater. It is suspected that at least some of the reported coverage problems (e.g., Lampasas FD, poor indoor coverage in the City) may be caused by a less-than-optimal system configuration.

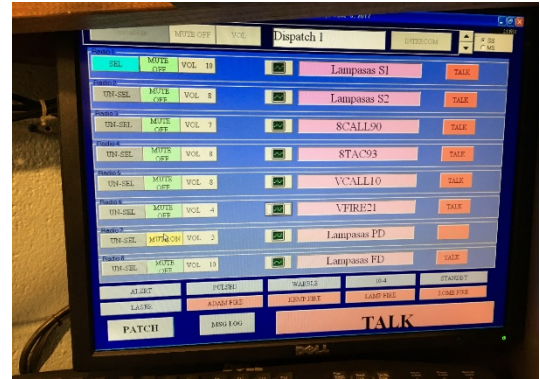


Figure 4-6: Lampasas County Sheriff’s Dispatch Radio Console

The City of Lampasas has executed an agreement with neighboring Burnet County to permit the installation of a P25 VHF trunked radio site on city property. The Burnet County radio system is affiliated with the Greater Austin/Travis Regional Radio System (GATRRS). The system is based in the Combined Transportation, Emergency, and Communications Center (CTECC) in Austin, Texas. In exchange for site placement, the City of Lampasas public safety agencies will have access to the Burnet County radio system at no cost. The new site is expected to provide excellent coverage in the City of Lampasas. Table 4-8 below provides a summary of radio system infrastructure in Lampasas County.

Table 4-8: Lampasas County Communications System Overview

Category	Quantity	Comments
First Responder Agencies	9	Including 3 VFDs; not included: statewide or federal agencies
Radio Tower Sites	2	One outside City of Lampasas, the second one halfway to Lometa; not included: building tops or small towers for local control stations
Communication Centers/PSAPs	2	All countywide dispatching is conducted from the SO; all dispatching for the City of Lampasas is provided by the PD; the FD has its own desktop control station, but is dispatched from the PD under normal circumstances
Radio Channels in Use	8 (VHF) 5 (800 MHz)	All agencies use VHF; 800 MHz used only for interoperability purposes

Category	Quantity	Comments
P25-Capable Channels (repeaters)	2	While the MASTR III repeaters theoretically are upgradeable to P25, they are at end of life and need to be replaced soon

4.6.1. Findings

Interoperability is not a major concern for the agencies in the County. The individuals interviewed by MCP in Lampasas County did not report any deficiencies in interoperability. The most important issues that were identified are:

- Equipment obsolescence
- Mobile and portable coverage gaps in the north, east and west areas of the county

4.7. San Saba County

San Saba County encompasses 1,138 square miles and shares borders with Lampasas, Mills, Brown, McCulloch, Mason, Llano and Burnet counties. The 2016 estimated population was 6,283, which represents a 3.3 percent increase from the 2010 census. The western area of the county is rural and sparsely populated. A map of San Saba County appears in Figure 4-7 below.

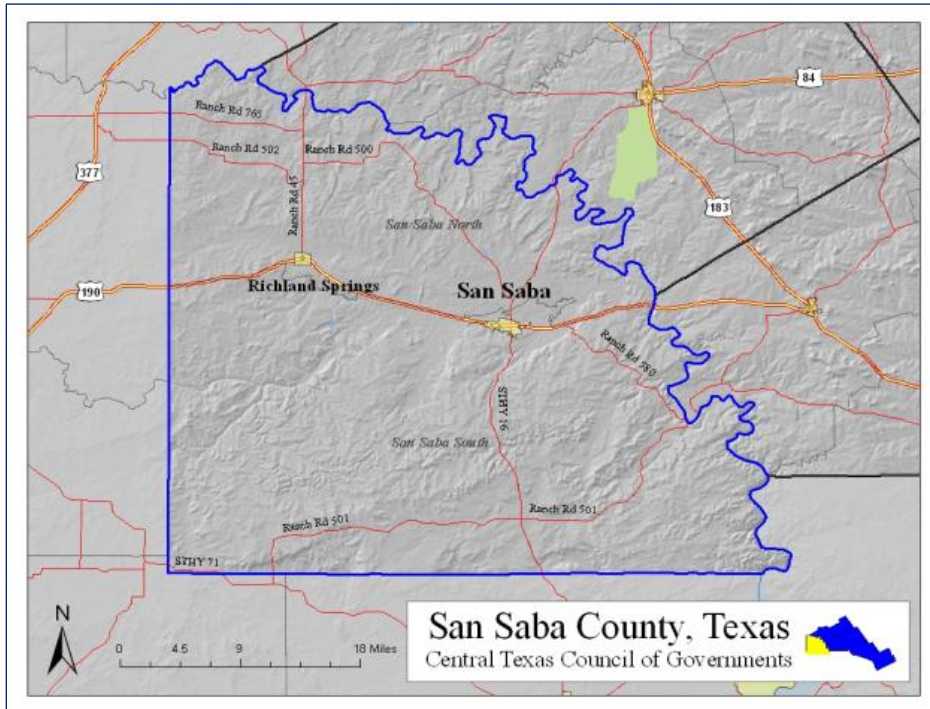


Figure 4-7: San Saba County Map

The San Saba County SO provides dispatch services to all local public safety agencies in the county. The County’s emergency services operate using a P25 conventional system. The other agencies in the county operate on VHF conventional analog channels. Table 4-9 below provides a list of the public safety agencies serving San Saba County, while Table 4-10 below provides a summary of the radio infrastructure in San Saba County.

Table 4-9: Public Safety Agencies in San Saba County

Agencies	
San Saba County S.O.	San Saba VFD
San Saba County OEM	Richland Springs VFD
City of San Saba PD	Cherokee VFD
Texas DPS	Elm Grove VFD
Texas Parks and Wildlife/Game Wardens	EMS/Hospitals

Table 4-10: San Saba County Communication System Overview

Category	Quantity	Comments
First Responder Agencies	7	Including 4 VFDs; not included: statewide or federal agencies
Radio Tower Sites	2	Main site is approximately five miles east of San Saba; a backup site is in town: not included: building tops or small towers for local control stations
Communication Centers/PSAPs	1	The SO dispatch is in the County facility
Radio Channels in Use	7	All agencies use VHF; 800 MHz used only for interoperability purposes
P25 Capable Channels (repeaters)	0	While the MASTR III repeaters theoretically are upgradeable to P25, they are at end of life and need to be replaced soon

4.7.1. Findings

Public safety officials interviewed reported that radio coverage is lacking in all areas of the county. Interoperability was not identified as a key concern of officials in the County. The most important issue to be addressed is equipment obsolescence.

5. RECOMMENDATIONS

Radio voice interoperability was not a key concern of the public safety officials who were interviewed during the preparation of this report. Officials are more concerned about the ability of radio systems and radios to serve day-to-day needs. Officials expressed their concerns regarding equipment obsolescence, deficient system coverage, and the availability of maintenance for existing equipment before considering interoperability needs. Lack of funding was identified as the most challenging barrier to enhancing radio systems and subscriber equipment.

Most of the radio system components and subscriber equipment have exceeded anticipated technological life expectancy. Many responders, especially volunteers, appear to be using obsolete and non-serviceable radios. Much of the equipment was placed in service almost 12 years ago and no longer is supported by the manufacturer (primarily Harris).

To ensure interoperability within the region, replacement technology should be P25 compliant. Should grant funds for radio purchases become available, all equipment purchased must be P25 compliant. The decision to adopt P25 will balance budgetary restrictions against the needs of the region's first responders. The findings and recommendations presented in this report are intended to aid local officials in the decision-making process.

There are several possible options available to local officials to enhance radio systems and subscriber equipment. One obvious option would be to join either the Bell County system or the GATRRS system. Participating in either system would involve substantial investments in infrastructure, including site enhancements, backhaul networks, radio consoles, and subscriber equipment. These costs appear to have been the barrier to the four counties joining the system previously. Another option is to implement a Phase I P25 conventional network in the counties with some coverage enhancements.

Several of the current systems assessed have degraded due to lack of local expertise in managing radio systems. The implementation of any new system or components should be accompanied by system administrator training. The adoption of new equipment would require training for field users.

The decision to upgrade or replace radio systems must be accompanied by a thorough inspection and assessment of the radio infrastructure, including towers, equipment shelters, power systems, and equipment rooms. MCP recommends that the counties contract with reputable radio system engineers to ensure the sustainability and security of the system infrastructure.

Also, in all cases it is assumed that Copperas Cove will continue its path toward upgrading its existing system and will not convert to any of the proposed solutions. Given the limited area of operations and relatively dense population, an 800 MHz trunked system is the right solution for Copperas Cove.

Several options to enhance radio systems are presented in the following sections. The options are presented in order of minimal enhancements to fully optimal system replacement.

5.1. Option 1: Status Quo Upgrade to P25

The leading concern identified in each county revolved around equipment obsolescence. The most basic option includes replacing all non-P25 compliant equipment with up-to-date models, in addition to some fundamental repairs/improvements. The replacement would include the subscriber radios, repeaters/base stations and dispatch console equipment.

The recommended improvements would include the microwave links (both functioning and decommissioned). No fundamental changes in the architecture of the systems would be necessary. Switching to the digital P25 platform would provide vital new functionality that has been implemented by some of the agencies. This option includes adopting a uniform approach to assigning unit identifications (IDs), group calls, encryption, emergency calls, text messaging, access control and other systemwide features.

Switching all communications to digital mode (P25) likely would provide some marginal coverage improvements, but not address all the reported complaints in a significant way.

The P25 subscriber units vary widely in price. New units fall within a range of \$800 to \$8,000. The functionality and pricing vary widely, not only among the vendors, but among different tiers of equipment within a portfolio of any single vendor. Local governments will need to carry out a due-diligence process to ensure the optimal use of funds. As an example, radio vendors will encourage the selection of multiband units with the promise of enhancing interoperability. However, these units can be justified only for a limited group of potential users (i.e., command staff). Approaching such an upgrade as a concurrent multi-county effort likely would attract cost-competitive solutions from multiple vendors.

Table 5-1 below presents the quantity of units to be replaced and items to be addressed, the approximate costs, and related comments. The table does not include professional services other than installation of the system equipment.

Table 5-1: Option 1 Summary

Category	Approximate Costs	Comments
Portable radios	\$1.5-4.0K	Assuming majority of the radios are non-encrypted single band units
Mobile Radios	\$2.0-4.0K	Assuming majority of the radios are non-encrypted single band units; includes installation

Category	Approximate Costs	Comments
Control Stations	\$2.5-8.0K	Assuming majority of the radios are non-encrypted single band units; includes installation
Repeaters	\$25-30K	Including installation and antenna systems
Dispatch Consoles	\$30-55K	Including installation, set-up and core equipment
Other Infrastructure/services	TBD	Recommended performing diligence surveys for microwave links, antenna systems, power systems, logging recorders, towers, shelters, alarm and monitoring systems

5.2. Option 2: Multi-County Conventional VHF Network

Option 2 represents enhancements to the elements that were described in Option 1. In addition to the replacements and improvements identified in Option 1, this option assumes that all the existing systems would be merged and connected to represent a single network. Option 2 requires the addition of tower sites to improve the coverage. This would include the following:

- Connecting all dispatch centers via an Internet Protocol (IP) network to enable channel sharing, multicasting and redundancy
- Providing intelligence enabling roaming between the sites
- Adding new sites hosting VHF repeaters at the following approximate locations:
 - Evant: to fill in the existing coverage gaps in the western portions of Coryell County, northern areas of Lampasas County, and southern Hamilton County
 - Copperas Cove: add VHF repeaters to the existing 800 MHz site to improve coverage in southeast Lampasas County

Option 2 assumes that it is acceptable for some very rural areas that continue to have limited coverage. Table 5-2 below identifies the incremental costs of Option 2 over those presented for Option 1.

Table 5-2: Option 2 Summary

Category	Approximate Cost	Comments
IP backhaul and dispatch core for the existing 6 dispatch centers	TBD	Single vendor and uniform platform for all dispatch equipment preferred, some savings possible compared with Option 1 if single core is used for all 4 Counties
Land Mobile Radio (LMR) core	\$130K - \$1.3M	May be a HW or SW depending on vendor/solution; assuming 1 region-wide channel for Law Enforcement and 1 for Fire & Rescue, 6 sites, other channels local
Evant site	\$225-270K	Assuming an existing rather than greenfield tower with 9 VHF Conventional channels (3 per County); not including backhaul to dispatch/core
Copperas Cove site	\$75-90K	Assuming space is available, 3 VHF Conventional channels; not including backhaul to dispatch/core

5.3. Option 3: Multi-County Trunked VHF Network

Option 3 includes enhancements to the elements presented in Option 2. Option 3 includes converting the entire network to trunked operation.

The main advantage of this solution compared with Option 2 is simplification of operations for the users. It would provide improved roaming coverage and allow the use of talkgroups rather than a channel-based configuration. This would enable any user to access any other user or group in the region from any location that offers sufficient coverage. It also would allow improved access control and the creation of dedicated talkgroups for specific interoperability purposes (e.g., fire ground, EMS).

It is expected that Option 3 would require a substantially larger investment than Option 2. The main driver for upgrading existing systems to trunked systems is the lack of capacity. As capacity has not been cited as a problem by any of the responders in the region, the marginal functional improvements need to be carefully weighed against the expected increased costs.

Option 3 includes the following:

- Converting the current conventional licenses to trunked licenses
- Placing physical or virtual site controllers at each tower site

- Purchasing a new trunked core or connecting to an existing core in Bell County, Travis County, or Copperas Cove. In each of these three cases, there would be costs related to expansion or upgrade of the core and providing the necessary backhaul connections
- Purchasing trunked software options for all subscriber units

5.4. Option 4: Regional Trunked 700/800 MHz Network

Option 4 is assumed to be only theoretical for several reasons, the most important of which are listed below:

- This option would require 100 percent forklift replacement of all the systems and equipment (except for Copperas Cove)
- More importantly, because of the terrain in the region and propagation characteristics of the 700/800 MHz bands, it would require construction of several additional radio tower sites (two to four per county) with related infrastructure and backhaul, at estimated costs of about \$1 million each.
- The primary benefit of moving to the 700 MHz band is that it supports P25 Phase II technology, which doubles the capacity of the channels. Given that capacity is not a problem, adopting 700/800 MHz would not be cost effective.

Given the above, construction of a regional 700/800 MHz trunked network is not deemed to be a feasible option and will not be subject to quantified analysis.

5.5. Prioritized List of Recommendations

MCP has prioritized the recommendations in order of most cost-effective operational enhancement.

- Option 2: Multi-County Conventional VHF network
- Option 1: Status Quo Upgrade to P25
- Option 3: Multi-County Trunked VHF network

Significant improvements addressing virtually all the reported complaints can be addressed with Option 2, which builds on the existing infrastructure, preserves the current operating practices and structures, and requires relatively modest incremental investment compared with Option 1 (which is considered the absolute minimum). It is therefore the recommended solution.

APPENDIX A: COUNTY RADIO ASSETS

MCP attempted to gather data from each public safety agency within the counties of Coryell, Hamilton, Lampasas, and San Saba. The following tables reflect the data that was provided by participating agencies. It should be noted that not all agencies elected to participate in the assessment process. Table cells will appear blank if the data was not made available to the assessment team.

Coryell County			
Point of Contact: Bob Harrell, Emergency Management Coordinator			
Radio Equipment			
Agency	Equipment Category	Quantity	Band
Coryell County S.O.	Mobiles	27	VHF
	Portables	38	VHF
Copperas Cove Police and Fire	Mobiles	56	800
	Portables	83	800
CTCOG Deployable	Site on Wheels	1	800/VHF
	Base Stations	16	800/VHF
Gatesville PD	Mobiles	20	VHF
	Portables	22	VHF
Coryell City – Osage VFD	Mobiles	4	VHF
	Portables	2	VHF
Evant VFD	Mobiles	4	VHF
	Portables	2	VHF
Flat VFD	Mobiles	3	VHF
	Portables	2	VHF
Gatesville VFD	Mobiles	17	VHF
	Portables	50+	VHF
Levita VFD	Mobiles	3	VHF
	Portables	0	VHF
Oglesby VFD	Mobiles	3	VHF
	Portables	2	VHF
Turnersville VFD	Mobiles	6	VHF
	Portables	2	VHF

Hamilton County			
Point of Contact: W. Mark Tynes, County Judge/Emergency Management Director			
Radio Assets			
<i>Agency</i>	<i>Equipment Category</i>	<i>Quantity</i>	<i>Band</i>
Hamilton County S.O.	Mobiles		VHF
	Portables		
City of Hamilton PD	Mobiles		VHF
	Portables		
City of Hamilton FD	Mobiles	3	VHF
	Portables	10	
Hico Fire Marshal's Office	Mobiles	5	VHF
	Portables	3	
Hico VFD	Mobiles	6	VHF
	Portables	7	
Evant VFD	Mobiles		VHF
	Portables	5	
Star VFD	Mobiles		VHF
	Portables		
Shive VFD	Mobiles		VHF
	Portables		
Pottsville VFD	Mobiles		VHF
	Portables		
Jonesboro VFD	Mobiles		VHF
	Portables		
Carlton VFD	Mobiles		VHF
	Portables		
Cransfills Gap VFD	Mobiles		VHF
	Portables		

Lampasas County			
Point of Contact: Angela Rainwater, Emergency Management Coordinator			
Radio Equipment			
Agency	Equipment Category	Quantity	Band
Lampasas County S.O.	Mobiles	30	VHF
	Portables	15	
City of Lampasas (PD and FD)	Mobiles	13	VHF
	Portables	14	
City of Kempner PD	Mobiles		
	Portables		
Adamsville VFD	Mobiles		
	Portables		
Kempner VFD	Mobiles		
	Portables		
Lampasas VFD	Mobiles		
	Portables		
Lometa VFD	Mobiles		
	Portables		

San Saba County			
Point of Contact: Marsha Hardy, Emergency Management Coordinator			
Radio Equipment			
Agency	Equipment Category	Quantity	Band
San Saba County S.O.	Mobiles	37	VHF
	Portables	18	
City of San Saba PD	Mobiles		
	Portables		
Richland Springs VFD	Mobiles		
	Portables		
Cherokee VFD	Mobiles		
	Portables		
Elm Grove VFD	Mobiles		
	Portables		
San Saba VFD	Mobiles		
	Portables		

APPENDIX B: FIRSTNET OVERVIEW

There is some anticipation in the region regarding the upcoming implementation of the Nationwide Public Safety Broadband Network (NPSBN)—which is being deployed under the auspices of the First Responder Network Authority (FirstNet)—with some officials expecting that the network might supplement and even replace current radio systems. Given the state of technology, relatively low density of population in the region, and related financial calculations, this is extremely unlikely in the foreseeable future.

It would be beneficial for CTCOG to reach out to the Texas single point of contact (SPOC) for FirstNet and arrange an update on the specific plans for the State. The implementation plans are specific for each state and still evolving. The update should include an explanation of the proposed implementation timeline, coverage, functionality and costs.

VISION

All public safety and first responder entities in Texas will have access to effective and sustainable wireless interoperable voice and data communications.

Texas Statewide Communication Interoperability Plan (2014)

The following content provides some basic facts regarding FirstNet and the NPSBN, and their expected impact on the short-term (0-1 year) and mid-term (2-5 years) state of public safety communications.

The NPSBN is an initiative spurred by the federal government on February 22, 2012 with PL 112-96, the Middle-Class Tax Relief and Job Creation Act of 2012. The federal government provided 20 MHz of radio spectrum (known as Band 14) and \$6.5 billion in funding for the project. It is one of the results of the work of the 9/11 Commission, which pointed out the lack of interoperable communications between first responders as a significant factor in the number of casualties on that tragic day.

The objective is to create and manage a nationwide broadband wireless communications network dedicated to the communication needs of the nation's first responders—law enforcement, fire/rescue and EMS. After years of preparatory work, a contract was awarded to AT&T in March 2017 to provide the appropriate infrastructure and services nationwide, with the caveat that the states have the option to opt out—instead of using AT&T, after meeting specific requirements determined by the Department of Commerce and National Telecommunications Industry Administration (NTIA), they can take the responsibility for building and operating the radio access network (RAN) in their area of jurisdiction.

Should the State of Texas decide to opt in to the NPSBN, the existing AT&T 4G Long-Term Evolution (LTE) network will be available to first responders immediately; however, current AT&T coverage in the region is, from the point of view of first responders needs, marginal.

Regardless of whether any given state (including Texas) opts in or out, they must meet the same objectives and presumably provide the same services to first responders as those provided by the NPSBN. Depending on the selected option, the network is supposed to be built-out in five to seven years. It is assumed that in most of the states, the build-out will follow the population density, with some other factors being taken into consideration, such as:

- Covering interstate highway systems and other major highways
- Covering any areas identified as high-risk due to the potential for natural, technological, and/or human-induced disasters

As the CTCOG-member counties covered by this study do not meet any of the above criteria, it is safe to assume that the coverage necessary to carry-out reliable first responder missions will not be uniformly available in the region in the short- or mid-term period.

Another important aspect of the FirstNet/NPSBN undertaking is the fact that the network initially is being designed for broadband data rather than mission-critical voice communications.

Still, there is a relatively widespread expectation that the NPSBN eventually will support mission-critical voice and perhaps replace current LMR systems—which are the subject of this study—at some point in the future. This is neither imminent, nor certain, as several important obstacles must be addressed first.

The technology that is referred to as 4G or LTE initially was designed for the consumer market. It was meant to enable typical non-mission-critical applications, including web browsing, video, messaging and such. Mission-critical voice provisions are being added to the related standards, but it remains to be seen when these will be completed and when the standards will turn into commercially viable products. This is expected to take several years.

The standards are taking into consideration the issues that can be solved with technologies available today. There are some issues for which there are no solutions yet. In other words, even when the standards are finalized and products meeting them become commercially available, there also are some physical constraints that will have to be overcome before a next-generation, professional-quality smartphone safely can replace the currently used LMR portables or mobiles.

Probably the most important of the yet-to-be resolved issues is the set of limitations making the talk-around operations of the current smartphones practically unusable by first responders. Current LMR radios typically communicate with each other via a repeater, which extends their range and provides a link to their dispatcher. However, when all or some of the radios are out of range, they can switch to a pre-programmed talk-around (or “direct”) mode and talk to each

other locally in a reasonable range, such as a fire scene or search-and-rescue mission in remote areas. Their range of operation in an open space can extend to several miles and in an urban environment will easily penetrate most large buildings. Such penetration will enable communications between a firefighter operating within a large structure and fire commanders positioned outside of the building. Due to physical and regulatory restrictions, direct-mode operations for smartphones, once the standards are in place and products are on the market, will range from about 500 feet in open space to about 50 feet in buildings.

The conclusion and recommendation for CTCOG is to maintain awareness of developments regarding FirstNet. It is important to note that the NPSBN is not expected to replace mission-critical first responder voice communications any time soon.