



Commonwealth of Massachusetts Interoperable Radio System (CoMIRS)

5 Recommendations and Gap Analysis

June 2017



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5 RECOMMENDATIONS AND GAP ANALYSIS

This section of the CoMIRS Radio Modernization Strategy Report addresses the recommendations for improving the existing analog trunked radio network and providing a reliable communications platform for the years to come. The section also identifies gaps between the optimal state and the current state and proposes action items to overcome those gaps.

The diagram provides an overview of the recommendations included in this section.

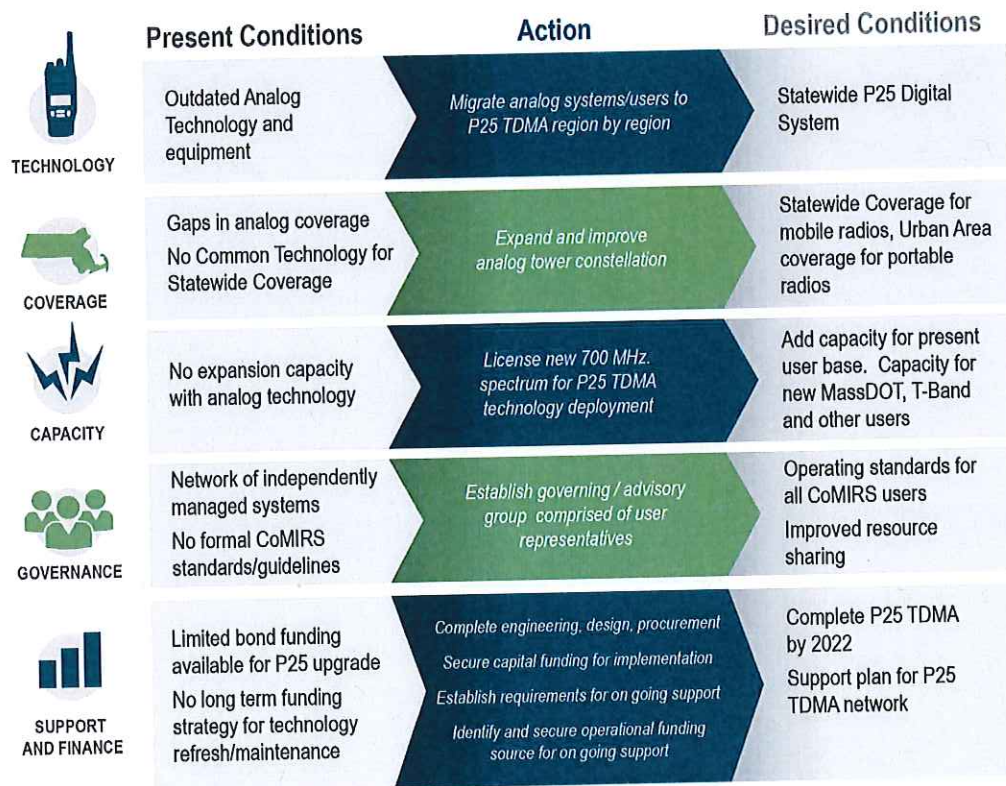


Figure 5-1: Gap Analysis Action Items

The recommendations and gap analysis in this section are organized by these four major categories:

5.1 Technical Recommendations: Technical recommendations address those gaps in the underlying infrastructure of the statewide radio network and the equipment that is used on that network.

5.2 Project Planning Recommendations: Project planning recommendations address the needs for planning, coordinating, and tracking the implementation of the radio network transition.

5.3 Governance Recommendations: Governance recommendations address how the system is managed now and in the future, taking into account its inter-governmental nature and mission critical usage.

5.4 Funding Recommendations: Funding recommendations address how the upgrade of the radio network's infrastructure will be paid for and how the network will be supported going forward.

Each recommendation includes the following elements:

Recommendation Number: A unique tracking number for each recommendation

Recommendation Title: A concise header for each recommendation

Recommendation Description: A description of the recommendation and its importance

Current State: A summary of how the current network stands in regard to the recommendation

Desired State: A summary of how the network should stand if the recommendation is accepted and implemented

Action Plan: The key steps needed to overcome the gap between the current and desired state

These recommendations and their associated action items are included in the CoMIRS Roadmap, which is detailed in Section 6 of this document.

5.1 Technical Recommendations

The technical recommendations for the CoMIRS network focus primarily on providing a reliable, robust communications platform for first responders for years to come. Leveraging industry standards and best practices, the CoMIRS network should be transformed from a hybrid analog-FDMA (frequency division multiple access) network to a fully digital TDMA (time-division multiple access) network. In planning the transition, the existing large simulcast zones should be reimaged to better align broadcast areas with current and anticipated future radio communications patterns. Additionally, the radio network replacement should address inadequate radio infrastructure that exists at some current radio sites and improve the overall grade of service for radio communications across the network.

Each of these technical recommendations is addressed below:

- 5.1.1 Provide a Reliable Communications Network
- 5.1.2 Adopt P25 TDMA for the Statewide Network
- 5.1.3 Adopt Smaller Simulcast Regions
- 5.1.4 Address Sub-optimal Radio Sites in Digital Buildout
- 5.1.5 Improve Grade of Service (GoS) Target for Network Reliability
- 5.1.6 Replace MSP Gold Elite Dispatch Consoles
- 5.1.7 Address Failing Backhaul Links in Central and Southeast Massachusetts
- 5.1.8 Replace Unsupported Time and Frequency Reference Clocks
- 5.1.9 Replace Subscriber Units that Are Not TDMA Capable
- 5.1.10 Replace Backhaul Circuits
- 5.1.11 Address Coverage Issues
- 5.1.12 Adopt Advanced Digital Functions
- 5.1.13 Utilize AES Encryption

5.1.1 Provide a Reliable Communications Network

There are two fundamental and related recommendations in this Strategy Report. The first is to provide a robust and reliable communications network for public safety throughout the state. This entails decommissioning and replacing the existing analog trunked system.

The CoMIRS analog network is at end-of-life and needs to be replaced and decommissioned. The technology used in its radio transmission and backhaul network are outdated and rely on components that are no longer supported. Many of these components are twenty or more years old. Full replacement of the analog trunked network is recommended.

Current State	Desired State
The existing network is reliant on analog technology and components no longer supported by manufacturers.	The entire radio network is manufacturer supported and is not reliant on aging components that risk communications interruptions.
Action Plan	
<ol style="list-style-type: none">1. Prioritize immediate needs for maintaining current operations2. Determine the standard to be used for the radio system replacement3. Adopt a plan to fully decommission and replace the analog trunked system4. Coordinate with partner agencies on the cut-over to the replacement network	

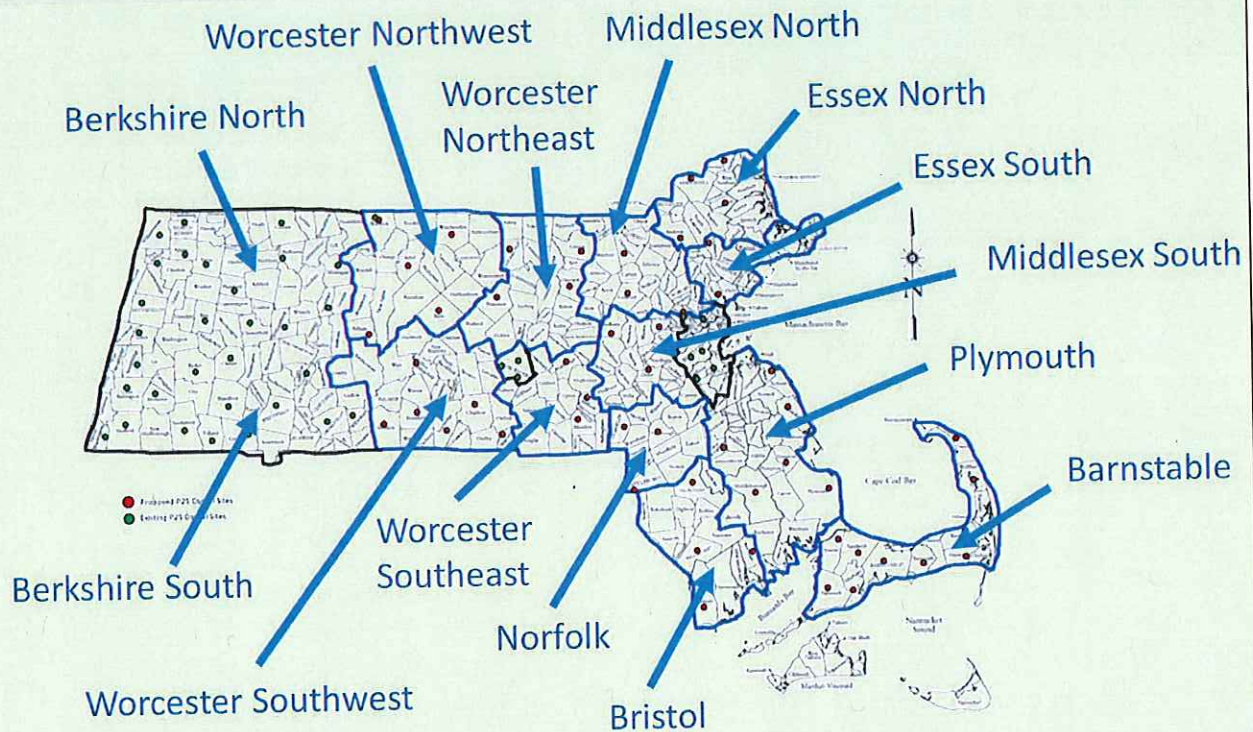
5.1.2 Adopt P25 TDMA for the Statewide Network

The second fundamental recommendation of this Strategy Report is that the Commonwealth should replace its aging analog trunked system with a modern, P25 TDMA radio network. The prevailing industry standard for the most efficient use of scarce radio spectrum is P25 Time Division Multiple Access (TDMA) channel access. TDMA allows multiple users to share the same frequency channel by dividing the signal into different time slots. Each user's communication is transmitted in rapid succession in segments, one after the other, each using its own time slot. TDMA is four times as spectrum efficient as the analog network and twice as efficient as the FDMA network deployed in western Massachusetts. Many of the investments already made in FDMA in western Massachusetts can be leveraged in the statewide TDMA network.

Current State	Desired State
The existing network is primarily analog with areas of FDMA digital radio coverage. The overall capacity of the network is limited by the use of analog technology.	A single, statewide radio network utilizing P25 TDMA standards throughout the Commonwealth
Action Plan	
<ol style="list-style-type: none">1. Plan and deploy a P25 TDMA network to overlay the existing analog systems2. Utilize the 700 MHz spectrum for the digital network3. Plan the migration of analog users to the digital network4. Decommission analog trunked system when migration to digital network is complete	

5.1.3 Adopt Smaller Simulcast Regions

Currently, CoMIRS operates with four analog simulcast regions and two P25 FDMA digital simulcast regions. A drawback of this limited number of simulcast regions is that each region is geographically large. When a local call is made between responders, it occupies a channel for the entire simulcast region. Currently in central Massachusetts, a call between two responders in Fitchburg would use a talkpath throughout the entire simulcast region stretching all the way to the Connecticut border. This Strategy Report recommends the adoption of smaller simulcast regions, aligned with typical areas of operation for existing and anticipated future users.



Current State	Desired State
CoMIRS currently consists of 4 analog and 2 FDMA digital simulcast regions	CoMIRS should utilize smaller simulcast regions (like the 14 region model depicted above).

5.1.3 Adopt Smaller Simulcast Regions

Action Plan

1. Estimate future usage of CoMIRS network
2. Identify typical operating areas for all envisioned CoMIRS users
3. Determine geographic groupings that accommodate most envisioned user groups
4. Identify potential radio broadcasting sites
5. Model broadcast ranges to accommodate user operational areas
6. Coordinate frequency usage
7. Request frequency approvals
8. Plan simulcast region implementations

5.1.4 Address Sub-optimal Radio Sites in Digital Buildout

The existing CoMIRS network has made use of available radio sites often based on where property was publicly owned and available to host radio equipment. This is frequently on fire towers and municipal buildings. These sites are often not optimally located for radio transmissions. The Commonwealth should use the modernization of CoMIRS as an opportunity to review existing radio site locations to improve overall coverage and reliability.

Currently, the CoMIRS trunked analog and digital systems utilize 82 site towers. Twenty of these towers are fire towers. Fire towers generally are sub-optimal as radio tower sites due to their limited height and structural characteristics. These towers were generally not initially built to support antennas and other communications equipment. Rather, these older structures have been retrofitted to house communications equipment based on the needs for radio broadcasting in their vicinity.

In addition to the 20 fire tower sites, CoMIRS uses public agency tower sites for an additional 34 radio tower sites. This includes 16 state-owned towers, 2 antenna locations attached to state buildings, and 16 shared public agency towers. The remaining 28 radio sites are leased from commercial tower owners.

In general, the older analog radio sites rely on fire and state towers for radio sites (16 fire tower sites and 12 state tower sites). The more recently installed digital radio sites predominantly use commercial radio tower (17 tower sites) and shared public agency towers (8 tower sites).

Current State	Desired State
The CoMIRS network includes 20 fire tower and 34 public agency radio sites. There are some areas of poor or non-existent radio coverage resulting in "dead spots" for radio communications.	Each radio site is selected to maximize coverage and assure radio reliability, while minimizing operating costs
Action Plan	
<ol style="list-style-type: none">1. Determine optimal number and placement of digital radio sites to maximize coverage area2. Provide a cost-benefit analysis on moving radio sites to commercial towers or other locations	

5.1.5 Improve Grade of Service (GoS) Target for Network Reliability

Currently the MSP network support staff maintains a GoS target of 2% for call reliability. That means that 98% of all calls are handled in less than the allowable delay time. Given the mission criticality of the network and the improvements planned for its infrastructure, an improved target of 1% GoS is recommended. This is more in line with other modern Land Mobile Radio trunked systems.

Current State	Desired State
The CoMIRS GoS goal is that only 2% of all calls during the busiest hours experience busy times over 3 seconds or longer. The current system is highly reliable and meets its GoS goal.	CoMIRS should establish and achieve the GoS goal that only 1% of all calls during the busiest hours experience busy times of 3 seconds or longer.
Action Plan	
<ol style="list-style-type: none">1. Identify future usage of CoMIRS network2. Model grade of service for anticipated growth in usage3. Set 1% GoS benchmark4. Identify radio sites that exceed 1% GoS benchmark5. Determine mitigation approach to assure 1% GoS provided (e.g., deploy additional channel capacity or increase number of radio sites)	

5.1.6 Replace MSP Gold Elite Dispatch Consoles

Twenty-nine of the consoles in operation at eight State Police locations are from the Motorola Gold Elite family of console systems. The Motorola Gold Elite family of console systems are no longer supported by the manufacturer. These Gold Elite Console Systems are incompatible with the most recent system software release and must be replaced prior to the release upgrade. Manufacturer support for Gold Elite components ends in 2018.

The Department of State Police must immediately replace the Gold Elite Console Systems in operation at General Headquarters (Framingham), Troop H (South Boston), Troop A (Danvers), Troop C (Holden), Troop D/Wireless PSAP (Middleboro), Shelburne Fall E-911 PSAP, New Braintree E-911 PSAP, and the Northampton E-911 Wireless PSAP. These console systems should be replaced with new Ethernet-based dispatch console systems.

Current State	Desired State
There are 29 Gold Elite dispatch consoles that are incompatible with the current release (7.17) of the radio system firmware.	All dispatch consoles on CoMIRS are compatible with the current and next planned radio system firmware release.
Action Plan	
<ol style="list-style-type: none">1. Obtain funding for dispatch console system replacement.2. Define operating requirements for console system replacement.3. Conduct an open procurement looking for any manufacturer's console solution that meets the needs of the MSP and interoperates effectively on CoMIRS.4. Schedule the replacement of the dispatch console systems at each of the eight MSP locations still using Gold Elite consoles.5. Retire the Gold Elite Console Systems.6. Schedule the upgrade of the CoMIRS firmware for all subsystems.	

5.1.7 Address Failing Backhaul Links in Central and Southeast Massachusetts

The MSP trunked subsystems of CoMIRS rely heavily on wireless microwave point-to-point links to backhaul communications from radio tower sites. Many of these important links are beyond manufacturer support and some are experiencing performance issues due to path obstructions that cannot be resolved. When point-to-point links fail, radio communications from sites at the end of the path are lost to the network creating large coverage “holes”.

Failing microwave backhaul links in central and southeastern Massachusetts should be addressed immediately to maintain mission critical radio communications in those areas.

Current State	Desired State
There are known obstruction and technology issues with existing backhaul links.	All backhaul links work as designed without obstruction or reliance on unsupported technology components.
Action Plan	
<ol style="list-style-type: none">1. Prioritize aging microwave links for replacement.<ol style="list-style-type: none">a. Give highest priority to replacing backhaul links that are already experiencing failure or sub-optimal performance.b. Give secondary priority based on whether or not the link is likely to be used for future backhaul as the network transitions to digital coverage. Tower sites that are likely to be used for digital coverage are candidates for near-term upgrade. Those unlikely to be part of a future digital site map should be replaced on an as needed basis.c. Confirm priorities for microwave link upgrades.2. Conduct path studies for each microwave link.3. Determine microwave sizing and communications needs.4. Conduct structural assessments of tower locations.5. Procure and install modern microwave links that meet current commercial standards.6. Maintain decommissioned microwave equipment as spare parts to support other remaining microwave links on the MSP trunked subsystem.7. Plan for the replacement of the remaining aging microwave links as part of the transition to digital radio communications in later stages of the enhancement project.	

5.1.8 Replace Unsupported Time and Frequency Reference Clocks

The analog portion of the CoMIRS network includes four simulcast sites. Highly accurate and dependable reference clocks are required to maintain the functioning of these simulcast sites. The reference clocks at some of these analog sites are outdated and need immediate replacement. Failure to upgrade these clocks threatens the voice communications in important areas of these simulcast sites.

The 13 oldest reference clocks should be replaced to assure the continued quality of voice communications on the analog portions of the CoMIRS network.

Current State	Desired State
There are 13 reference clocks that are no longer manufacturer supported and risk failure.	All reference clocks are manufacturer supported and accurately coordinate simulcast communications.
Action Plan	
<ol style="list-style-type: none">1. Confirm reference clock models as replacements.2. Procure reference clocks and installation services.3. Upgrade reference clocks.4. Confirm communications quality along overlapping portions of simulcast sites.5. Determine proper disposition of old reference clocks.	

5.1.9 Replace Subscriber Units that Are Not TDMA Capable

The CoMIRS network is presently a mix of analog and digital subsystems without full statewide coverage in either technology. Agencies with statewide jurisdiction should be equipped with radios that can operate on both analog and digital systems to maximize coverage availability. Additionally, when users on different types of systems (analog and digital) interact, they often cannot communicate with one another until a system administrator patches their channels together. After communications are established, there is often also a significant degradation in the quality of voice communications across the two platforms.

Analog-only radios are widely used by current users of the CoMIRS network. The migration to the digital system cannot be completed without the replacement of these subscriber units.

Immediate priority should be given to replacing the analog-only radio devices that often operate in areas of primarily digital coverage. These include MSP Troop C in central Massachusetts and Troops A and H in the Boston metropolitan area.

Current State	Desired State
There are over 15,000 radios currently active on CoMIRS by agencies using the network operationally that will not work on a P25 TDMA radio network.	All users authorized to communicate on CoMIRS have use of subscriber units that will work on the envisioned TDMA radio network, and where authorized, take advantage of advanced digital features like encryption and location services.
Action Plan	
<ol style="list-style-type: none">1. Confirm priorities for analog radio replacement.2. Determine approach and schedule for replacing all MSP analog-only radio devices.3. Determine approach and schedule for replacing non-MSP analog-only radio devices.4. Define requirements for analog-only radio replacement.5. Solicit competitive pricing from multiple vendors that offer analog, FDMA, and TDMA capable devices that will operate effectively on CoMIRS.6. Replace all analog-only devices in MSP Troop C.7. Replace all analog-only devices in MSP Troops A and H.8. Replace non-MSP analog devices.	

5.1.10 Replace Backhaul Circuits

Much of the existing CoMIRS backhaul network uses old, circuit-switched backhaul technology. The telecommunications industry has moved away from circuit-switched technology to Ethernet packet based transmission protocols as a more bandwidth efficient and flexible method for point-to-point communications.

The circuit-switched backhaul technology that is in use in much of the existing CoMIRS backhaul network will not be supported by the CoMIRS radio software in 2019 (Motorola System Release 7.19). Backhaul from radio sites using this old technology will not work when the software release is applied and therefore radio communications relying on those radio sites will not work.

Current State	Desired State
The CoMIRS backhaul network is reliant on circuit-switched backhaul technology that will not be supported after the 2019 network firmware update (7.19).	All backhaul connections use Ethernet packet-based transmission protocols and are supported by current and future planned releases of the network firmware.
Action Plan	
<ol style="list-style-type: none">1. Work with CoMIRS partners to identify all existing circuit-switched links on the CoMIRS network.2. Address circuit-switched upgrades when addressing other backhaul issues (e.g., replacement of failing microwave links).3. Establish a timeline (by 2019) for the replacement of circuit-switched links.4. Establish a prioritized schedule for the replacement of circuit-switched links.5. Establish requirements for Ethernet upgrades to CoMIRS backhaul links.6. Procure hardware, software, and installation services for upgrading microwave backhaul links.7. Procure hardware, software, and installation services for upgrading wireline backhaul links.	

5.1.11 Address Coverage Issues

CoMIRS consists of a mix of regional analog and P25 digital trunked systems. No complete statewide coverage exists through either the analog systems or the P25 digital systems alone.

Forty-eight analog trunked radio sites installed between 1993 and 2000 provide analog service from Springfield to Provincetown. These 48 sites are organized into regional analog systems in the Northeast and Southeast regions, Barnstable County, central Massachusetts, and Route 91. Thirty-four P25 FDMA radio sites installed since 2013 provide digital coverage in western Massachusetts.

Within the analog coverage area, there are radio "dead spots" where poor radio coverage or no radio coverage is present. These coverage gaps should be corrected to establish reliable coverage throughout the Commonwealth for the first responders utilizing the network.

Migrating the regional analog systems to P25 digital operation will result in a single, ubiquitous communications platform across the state allowing a subscriber radio to retain reliable communications from Pittsfield to Provincetown without having to manually adjust radio settings.

Current State	Desired State
CoMIRS coverage is a patchwork of analog and digital coverage with several "dead spots".	CoMIRS digital coverage is available statewide, throughout the mainland counties.
Action Plan	
<ol style="list-style-type: none">1. Identify areas of insufficient radio coverage.2. Review and confirm a channel plan for a P25 TDMA digital network.3. Identify available additional frequencies for use by the CoMIRS digital network.4. Seek approval of the CoMIRS channel plan by the Federal Communications Commission.5. Review existing radio sites for use in a future network. This should include structural analysis, shelter space, backhaul availability, antenna positioning, sufficient power supplies, access, and other site considerations.6. Identify new radio sites needed for TDMA channel plan.7. Acquire or lease additional radio sites.8. Rollout out FCC approved TDMA channel plan.	

5.1.12 Adopt Advanced Digital Functions

Several important advanced features, like AES encryption and remote programming, are not available to users on the analog portions of the CoMIRS radio network.

Currently, each individual radio must be physically touched to provide an encryption key or to re-key a fleet of radios should the key become compromised. During manual keying, radios without the current encryption key cannot communicate with other radios in the encrypted mode. Over the Air Rekeying (OTAR) of encryption codes will help mitigate this problem.

Other advanced features are available in P25 digital radios operating on a P25 digital network, including radio location, text messaging, and data terminal communications. None of these features is in widespread use within CoMIRS, but many user agencies have expressed an interest in utilizing these features when they are available on the updated network.

Current State	Desired State
Advanced digital functions are not widely used on the CoMIRS network	CoMIRS supports agency and inter-agency needs for the use of advanced communications features like encryption, remote programming, data communications, and location services.
Action Plan	
<ol style="list-style-type: none">1. Determine which digital features should be used on the CoMIRS network.2. Establish standards for the use of digital features.3. Implement digital coverage statewide.4. Train users on the use of new radio network features.5. Provide oversight and support for the adoption of new network features.	

5.1.13 Utilize AES Encryption

Encryption of radio traffic is used within the P25 digital segments of CoMIRS by various agencies; however, there is no universally adopted encryption scheme within the system. Each user agency determines if encryption is required and, if so, what type of encryption to use.

Encryption is crucial to sensitive radio traffic such as body descriptions, names, discreet locations, and personally identifiable information. Motorola's proprietary Advanced Digital Privacy (ADP) encryption is currently used over the digital portions of the network by MSP and other users. ADP is included in the cost of the Motorola APX radios. ADP is relatively weak and can be easily compromised in comparison to the Advanced Encryption Standard (AES) encryption that is recommended for high-risk operations. AES is included in the P25 standards for digital radio.

The use of proprietary Motorola ADP encryption will limit opportunities for full interoperability. To ensure adequate voice security when required and to promote full interoperability, AES encryption is recommended as a system wide standard. All P25 equipment vendors offer AES encryption.

Current State	Desired State
Encryption is not widely used for communications on CoMIRS and, where it is it often relies on the proprietary and relatively weak ADP encryption protocol.	CoMIRS supports broad use of AES encryption protocols on agency and inter-agency channels, where needed.
Action Plan	
<ol style="list-style-type: none">1. Adopt AES as the standard for digital encryption on CoMIRS.2. Establish procedures and standards for the use of encryption on CoMIRS.3. Establish protocols for the programming of encryption keys.	

5.2 Project Planning Recommendations

While the technology needs of moving to a TDMA network are well understood, the success of the transition will require adequate planning and oversight. Initial planning activities should begin now, including site identification and acquisition activities that can be time-consuming. Additionally, this Strategy Report provides an estimate of each radio sites' upgrade needs, but an actual inventory and radio site assessment is needed for each current and planned radio site. Once a proper technical implementation plan is created, oversight is needed to coordinate the implementation of the new radio sites and the upgrade of existing radio sites from analog to digital. These activities will require significant hardware and services acquisitions, which should be competitively procured.

Each of these project planning recommendations is addressed below:

- 5.2.1 Begin Site Identification and Acquisition Activities
- 5.2.2 Inventory and Assess Each Radio Site
- 5.2.3 Perform Proper Technical Planning Up Front
- 5.2.4 Coordinate the Transition from Analog to Digital
- 5.2.5 Conduct Competitive Procurements

5.2.1 Begin Site Identification and Acquisition Activities

The rollout of a statewide radio network is logistically challenging. Site identification and acquisition can be time consuming and present unforeseen obstacles. The initial steps for the CoMIRS modernization should begin as soon as possible, even while funding for the overall system refresh is being identified.

Current State	Desired State
The current state has many sites that can and should be used for the future digital network. Some sites should be replaced to improve reliability and coverage. Some new sites will be needed to support the envisioned coverage plan.	EOPSS has long-term agreements for the use of all radio sites needed to implement the coverage envisioned for the CoMIRS digital radio network.
Action Plan	
<ol style="list-style-type: none">1. Procure engineering services to support technical planning of the network.2. Conduct inventory and site evaluations of all existing radio sites.3. Identify sites that need to be replaced by new digital sites.4. Identify new radio site locations.5. Negotiate usage agreements for new and replacement radio site locations.6. Negotiate expanded usage agreements for existing radio sites that will house both analog and digital radio equipment.7. Determine alternative site locations for radio sites where appropriate leases or agreements cannot be reached.	

5.2.2 Inventory and Assess Each Radio Site

Once engineering professional services are procured, each radio site should be visited and a specific upgrade plan created for each site. In particular, technical expertise is needed to determine whether an existing site has sufficient resources and space to accommodate a second set of radio site infrastructure until the transition from analog to digital is complete. In addition, there may be unforeseen site issues that need to be identified early in the project.

Current State	Desired State
EOPSS and its network maintenance contractor has a good understanding of the needs for the current analog network; a better understanding is needed of each radio site's suitability and needs to serve as an RF location for the future radio network.	EOPSS has a fully documented and updated list of all radio site infrastructure inventories and upgrade needs; EOPSS has all the information needed to procure upgrades to each envisioned radio site
Action Plan	
<ol style="list-style-type: none">1. Conduct inventory and site evaluations of all existing radio sites2. Determine suitability of each radio site to house all needed analog and digital equipment to support communications during transition3. Document needed upgrades to site location4. Document needed remediation to existing analog equipment5. Document needed digital site equipment6. Create purchase list(s) to be included in radio site enhancement procurements	

5.2.3 Perform Proper Technical Planning Up Front

This Strategy Report is based on available planning and information. The next step is to elaborate this strategic plan with formal engineering designs for each radio site. Proper technical planning is needed at the beginning of the project to assure the anticipated coverage and capacity are realized. Technical changes are easier to accommodate early on in the modernization lifecycle.

Current State	Desired State
There has been off-and-on planning for the future digital radio network; simulcast regions and radio site locations and needs should be formally reviewed, revised, and adopted.	EOPSS has a technical plan for the implementation of the digital radio network that accounts for all anticipated future use of the network and the capabilities of all planned radio sites.
Action Plan	
<ol style="list-style-type: none">1. Procure the services of an independent radio engineering company.2. Conduct radio site inventories and assessments.3. Review and update design for simulcast region planning.4. Coordinate obtaining frequency approvals.5. Create detailed technical specifications for each radio site.	

5.2.4 Coordinate the Transition from Analog to Digital

There are 245 agencies currently using CoMIRS. The complete transition from analog to digital will require coordination with all of these agencies. Where radio replacement is required, there may be lengthy municipal budget and acquisition processes to take into account. Proper coordination and communications are needed throughout the planning and transition processes.

Current State	Desired State
The divide between analog usage and digital usage is relatively clearly defined geographically.	All current users can transition seamlessly to the new digital radio communications; all new users have clear standards for the adoption of digital radio services.
Action Plan	
<ol style="list-style-type: none">1. Coordinate with existing agencies on transition needs to move from analog to digital.2. Coordinate procurements of upgraded digital user equipment.3. Coordinate integration of conventional radio communications on the digital network.4. Implement digital radio coverage by simulcast region.5. Establish clear cut-over timelines for existing users.6. Track progress towards rolling out new digital coverage and user readiness to adopt digital services.7. Coordinate training on new equipment and operating procedures.	

5.2.5 Conduct Competitive Procurements

In order to address the immediate needs of the system, EOPSS needs to go through the competitive acquisition process to procure equipment. As such, EOPSS needs to put together requirements and requests for quotes (RFQs) or requests for responses (RFRs) in support of the equipment purchase. In addition, EOPSS needs to develop requirements, statements of work, and multiple RFQs to support the transition to P25 digital.

The following are recommended elements for the CoMIRS acquisition strategy:

- Release industry-wide RFQs\RFPs for competitive bidding. This will ensure best price and best value to the Commonwealth. Competitive bidding will significantly mitigate the likelihood of protests, which will result in a more rapid execution of the procurement.
- Issue separate RFQs\RFPs for each type of equipment the Commonwealth purchases for the network upgrade. Procurements should be based upon technical specifications and system performance and must be manufacturer agnostic.
- Issue a RFQ\RFP for implementation and integration for a Systems Integrator to install the equipment and build the network.
- Issue a RFQ\RFP for operations and maintenance of the network.

Current State	Desired State
The current network predominately utilizes the technology and services of a single land mobile radio vendor.	The network is designed and procured to support the services and equipment of multiple land mobile radio vendors.

Action Plan

1. Utilize existing state contracts for hardware and services procurements, including the ITT57 2-Way Radio Equipment and Supplies statewide contract.
2. Issue RFR/RFQ for the acquisition of LMR engineering planning services.
3. Issue RFR/RFQ for the selection of an implementation contractor or systems integrator to oversee the digital network rollout and transition from analog communications.
4. Issue RFRs/RFQs or reach agreements with asset owners for radio site infrastructure upgrades.
5. Issue RFRs/RFQs for radio site hardware and installation services.
6. Issue RFRs/RFQs for subscriber equipment.
7. Issue RFR/RFQ for system operations and maintenance services.
8. Negotiate contracts and statements of work.
9. Oversee contract execution.

5.3 Governance Recommendations

As with all projects involving significant change, proper governance is needed to establish strategic direction, resolve unforeseen issues, and track progress toward shared goals. The technology changes recommended in this Strategy Report also provide an ideal opportunity to re-envision how the network is governed. Foremost among the planning for governance is understanding who will be using the network and establishing clear responsibilities among its major partners. Processes need to be created to oversee requests for access and standards need to be developed to govern technology acquisitions and usage on the network. Throughout the transition, a proper governance body can help coordinate agency activities, establish shared standards, and facilitate inter-agency issue resolution.

Each of these governance recommendations is addressed below:

- 5.3.1 Clarify Governance and Oversight Responsibilities
- 5.3.2 Finalize Intergovernmental Agreements
- 5.3.3 Formalize the Process for Agencies to Request Use of CoMIRS
- 5.3.4 Approach MassDOT and Other Potential Users Now
- 5.3.5 Develop a Plan to Serve as an Option Should T-Band Spectrum Be Revoked
- 5.3.6 Manage Transition of New Agencies to CoMIRS
- 5.3.7 Develop P25 Subscriber Standards for all CoMIRS Users

5.3.1 Clarify Governance and Oversight Responsibilities

Currently, EOPSS is the lead organization for decision-making and financing of the radio network. The MSP is the lead organization for support and maintenance of the network. As the network continues to grow to accommodate more agencies, the decision-making, funding, oversight, maintenance, and support responsibilities need to be clearly articulated. This is particularly important should additional large agencies seek to join CoMIRS operationally.

EOPSS should take the lead to define and establish a group that has governing control of the radio network. This body should consist of representatives of the major users on the network, including both operable and interoperable users. EOPSS should take a lead role in the Governance Board, as it represents many of the agencies that are currently using the network. This board would be responsible for governance activities, including the development and implementation of:

- **Shared Use Agreements:** The governing body should lead the development of shared use agreements for all agencies using the network, including subscriber units, consoles, conventional radio assets, the trunked system, and other components that will officially be used on the network.
- **Maintenance Standards:** The governing body should lead the development of maintenance standards for all Core interfaced equipment. This will help ensure the peak operational condition of all network equipment. EOPSS or its designee can take the lead in establishing maintenance agreements with vendors to ensure a competitive price is available for all equipment owners.
- **Technology Refresh Standards:** The governing body should also establish technology refresh standards that all network users should agree to follow. It is critical that the governing body ensure that all users can operate on the network when needed. Establishing refresh standards helps assure that plans are in place to adapt to the latest required technology for the betterment of the entire network.
- **FCC License Requests:** The governing body should also manage FCC license acquisition and spectrum coordination. As the user base expands, the governing body will become the central repository for all FCC / spectrum management issues to ensure that these resources are available across the Commonwealth when users require bandwidth.

Current State	Desired State
There is no governance body responsible for overseeing CoMIRS. The SIEC provides some guidance on interoperability matters. EOPSS is chiefly responsible for funding and decision making. The MSP is responsible for support and maintenance.	Responsibilities for governance, support, and maintenance are clearly understood and documented. Governance, support, and maintenance address the needs of all operable and interoperable user agencies on CoMIRS.

5.3.1 Clarify Governance and Oversight Responsibilities

Action Plan

1. Confirm nature of governance needed to oversee CoMIRS operable and/or interoperable communications.
2. Set charter for governance body.
3. Clarify responsibilities across parties, including access, proper use, support, maintenance, funding, and other matters.
4. Document governance responsibilities in enacted memorandums of understanding amongst partner agencies.

5.3.2 Finalize Intergovernmental Agreements

There is currently no process in place to memorialize the ongoing support requirements for Core connected trunked systems or radio control consoles. This has been a concern for CoMIRS system administrators and user agencies. The shared use, maintenance, and support of existing and planned digital radio infrastructure needs to be clarified amongst the owners and operators of this infrastructure. This includes EOPSS, Massport, and the Cities of Boston, Cambridge, and Worcester, among others.

As the leading agency in the Commonwealth for Public Safety, EOPSS should lead the effort in the facilitation and negotiation of Memorandums of Understanding / Memorandums of Agreement (MOU/MOA) between and among partner jurisdictions and agencies. These MOUs/MOAs should clearly delineate responsibilities in matters such as:

- Ownership of the system
- Funding
- Operations and Maintenance

Current State	Desired State
Agreements for use and maintenance of Core connected assets are informal and often undocumented.	All major Core-connected assets have clearly defined ownership and maintenance responsibilities.
Action Plan	
<ol style="list-style-type: none">1. Identify and define ownership of all key CoMIRS Core connected assets.2. Define and document the maintenance responsibilities for all Core connected assets.3. Create and finalize intergovernmental agreements by all owners of CoMIRS Core-connected assets.	

5.3.3 Formalize the Process for Agencies to Request Use of CoMIRS

Currently, the processes for requesting and obtaining rights to use CoMIRS are informal. These decisions are largely made by EOPSS. As the network matures into a statewide shared service, a more formalized user request and acceptance process is recommended. This may also include the collection of user activation or other usage fees.

Current State	Desired State
Use of the CoMIRS network has grown over time as different agencies have contributed to its growth or have requested access to the network. The process for requesting access to the network (particularly operably) is informal and, at times, ad hoc.	There is a clearly defined process for new agencies to request use of the CoMIRS network for either interoperable or operable communications. Additionally, there are clearly defined standards for appropriate use, acceptable technology, and organizational responsibilities for new and existing user agencies.
Action Plan	
<ol style="list-style-type: none">1. Determine which governance organization should field requests for new users on CoMIRS.2. Define and document the criteria for new agencies to participate on CoMIRS.3. Establish communications mechanisms for new user requests and the request statuses.	

5.3.4 Approach MassDOT and Other Potential Users Now

Public safety organizations in Berkshire and Franklin Counties, as well as other state and municipal agencies, have expressed interest in using the CoMIRS network for operable communications. Additionally as the network capacity and infrastructure is modernized, other large agencies with regional or statewide radio communications needs may request use of the CoMIRS network. Chief among these could be expanded use of CoMIRS by regions or divisions of MassDOT.

Currently, the MassDOT Highway Division Region 6 uses CoMIRS operationally. Proper planning is needed if the remaining five regions or other divisions of MassDOT are to join CoMIRS operationally. Both MassDOT and the existing users of CoMIRS have similar and pressing radio communications needs. Addressed independently, the Commonwealth will assume added equipment and maintenance costs across the separate networks. Addressed together, the Commonwealth can achieve economies of scale and lower the overall, combined acquisition and maintenance costs of these radio networks.

A determination is needed in the short-term as to whether these MassDOT regions and divisions are interested in using the network and what their usage needs would be. These discussions should take place early on so that proper coverage and capacity can be planned and spectrum obtained, if needed. Moreover, these organizations' operational needs should be considered in plans for changes to the existing simulcast regions.

Current State	Desired State
Region 6 of the MassDOT Highway Division currently uses CoMIRS. The remaining five regions of the Highway Division utilize a mix of radio networks. Public safety users in Berkshire and Franklin Counties have also expressed interest in transitioning to operable use of CoMIRS.	The investment in a modern, digital, statewide radio network is best leveraged to serve the communications needs of multiple municipal, county, regional, and state users. This includes MassDOT, Berkshire County, Franklin County, and others, as applicable.

5.3.4 Approach MassDOT and Other Potential Users Now

Action Plan

1. Approach MassDOT, and other interested parties, to determine interest in using CoMIRS for their other regions and/or divisions.
2. Identify transition needs for agencies that may seek to utilize digital CoMIRS network.
3. Determine impact on grade of service (GoS) for additional use of CoMIRS.
4. Compare coverage needs to existing or planned CoMIRS coverage.
5. Address existing interest in joining CoMIRS in the short-term by users in Berkshire County, Franklin County, and the Department of Correction.
6. Initiate memorandum of understanding or other tools to formalize new agency participation on CoMIRS.
7. Determine capacity of CoMIRS network to support new users and what enhances (including additional talkpaths) are required.
8. Fund increases to the number of talkgroups available (if needed).
9. Determine milestone dates for new users to begin use of CoMIRS radio resources.
10. Transition new user agencies to CoMIRS.
11. Decommission other end-of-life radio systems.

5.3.5 Develop a Plan to Serve as an Option Should T-Band Spectrum Be Revoked

As a provision in the 112th Congress' Middle Class Tax Relief and Job Creation Act of 2012, access to the T-Band spectrum (470 – 512 MHz) would be ended by 2022/23. If implemented as currently stated in statute, this would affect hundreds of public safety agencies in eastern Massachusetts and the regional communications network BAPERN. Currently, few of these agencies are preparing for this under the belief that the statutory provision will be rescinded or amended.

With its expanded capacity and statewide digital coverage, CoMIRS should be a good position to accommodate some of the communications needs currently met by radio systems on the T-Band spectrum. Additionally, the freed up 800 MHz spectrum currently used for the CoMIRS analog trunked system should become available once the analog trunked system is decommissioned. These 800 MHz frequencies can be repurposed, with the assent of the FCC, for use by municipal and regional entities in eastern Massachusetts.

Current State	Desired State
Hundreds of public safety organizations in eastern Massachusetts rely on T-Band spectrum for mission critical communications. Access to this spectrum is planned to be revoked by 2022/23. There is no overall plan for replacement communications for those public safety organizations affected by this spectrum change.	There is an actionable plan to accommodate the communications needs of public safety organizations in Massachusetts should the T-Band spectrum be returned to the FCC as currently specified by statute.
Action Plan	
<ol style="list-style-type: none"> 1. Determine the overall scope of the impact of the end of access to T-Band on public safety communications in eastern Massachusetts (e.g., determine how many licensees currently use T-Band for mission critical communications). 2. Determine the interest in using CoMIRS for regional or municipal communications should T-Band access end. 3. Determine options for accommodating affected public safety agencies on CoMIRS or by other means. 4. Determine the capacity needs to accommodate T-Band communications. 5. Create an action plan for how the Commonwealth can provide options to municipal and regional users of T-Band, should it be necessary. 	

5.3.6 Manage Transition of New Agencies to CoMIRS

The charter of any CoMIRS governance board should include responsibilities for overseeing the activities necessary to support the adoption of CoMIRS by new user agencies. Responsibilities for this body should include:

- Approving and overseeing equipment transfers from new users to the CoMIRS network
- Approving and overseeing new infrastructure equipment purchases
- Requesting and obtaining financing for site upgrades and other infrastructure expenses
- Approving and overseeing changes in LMR site capacity, grade of service, and talkpaths
- Approving and overseeing timelines for cutover of new users to the CoMIRS network
- Reviewing reports of CoMIRS performance before and after upgrades and new user adoption
- Performing other governance activities required for the successful transition of new users to CoMIRS

Current State	Desired State
There are few formalized on-boarding procedures for new user agencies on CoMIRS.	All new agencies approved to use CoMIRS have an action plan for transitioning to use of CoMIRS. New agencies clearly understanding their responsibilities and those of other CoMIRS partners.
Action Plan	
<ol style="list-style-type: none">1. Identify new agency transition needs.2. Define transition plans for new user agencies.3. Establish milestones for transitioning to use CoMIRS.4. Establish oversight of equipment transfers and new equipment acquisitions.5. Oversee impacts on network performance and grade of service.	

5.3.7 Develop P25 Subscriber Standards for all CoMIRS Users

Coordinating purchasing and technology usage across hundreds of organizations and multiple levels of government is challenging. Best practices indicate that well defined and promulgated standards can help achieve common goals, and in land mobile radio systems, promote interoperability and improved communications.

Purchasing, maintenance, and acceptable use of radio equipment on the CoMIRS network is the responsibility, at least in part, of all operable and interoperable user agencies. With the adoption of a channel access method (TDMA) for the CoMIRS network, standards are needed well in advance to assure that subscriber technologies will be compatible with the new digital standards. Most existing subscriber units on the CoMIRS network are not compatible with this standard.

Currently, many smaller communities struggle to purchase radios needed for first responders and often purchase cheaper subpar equipment due to budgetary constraints and a general lack of understanding of minimal radio standards. These subscriber units often work directly on local networks amongst themselves and may allow communication with nearby localities. While locally compatible, these devices may not be compatible with regional or statewide networks, limiting or precluding interoperable communications with these first responders.

Any responsibilities on the CoMIRS network that are delegated to user agencies should be addressed with a clear, well-communicated standards document. Foremost among these standards should be guidelines for the purchase and use of subscriber units on the CoMIRS network.

Current State	Desired State
Purchasing decisions are made largely by each user agency.	Clear, well-communicated standards are implemented to guide the purchase of subscriber units that promote interoperable communications amongst all network users.

5.3.7 Develop P25 Subscriber Standards for all CoMIRS Users

Action Plan

1. Determine governance responsibilities for developing, promulgating, and enforcing network standards.
2. Identify contact points within all user agencies for communicating standards and other information.
3. Identify and document existing standards.
4. Create repository for maintenance and communication of network usage standards.
5. Draft subscriber and other needed network standards.
6. Solicit feedback on proposed standards.
7. Approve and publish standards.
8. Identify gaps in existing technology and practice that violate published standards.
9. Remediate gaps in current standards.
10. Track implementation of standards.

5.4 Funding Recommendations

Proper funding is the central critical element to achieving the vision described in this Strategy Report. Statewide P25 radio systems are not cheap, nor are the ruggedized subscriber units first responders use on the network. This Strategy Report provides a roadmap for these transition costs, but the Commonwealth will still need to determine how those costs are financed. Additionally, increase support costs are likely, particularly during the transition period from analog to digital. Long term support models need to be developed and properly financed. Finally, much of the cost of the transition will be replacement of aging, incompatible user equipment that belongs to municipal or state agencies. Consideration needs to be made now as to whether or not the Commonwealth will adopt an emergency communications grant program like other states have implemented, to help with funding.

Consideration of the following funding topics is addressed below:

- 5.4.1 Identify How to Pay for CoMIRS Modernization
- 5.4.2 Fund Support and Maintenance like an Enterprise Shared Service
- 5.4.3 Consider Burden Sharing Early On

5.4.1 Identify How to Pay for CoMIRS Modernization

This Strategy Report identifies the estimated total costs for the radio modernization and recommends different finance tools for funding the transition. The decision on the financing option(s) to use is a Commonwealth decision. This decision should take into account the funding required to buildout the statewide radio infrastructure, replace subscriber units, and support and maintain the network and its users. Financing for these funding needs may involve multiple agency budgets and shared financial responsibility across municipal, county, and state user agencies.

Current State	Desired State
\$68 million was earmarked for the CoMIRS system in capital budget authorizations. This amount has not been appropriated and is insufficient to cover the full costs of the digital modernization.	The complete replacement and upgrade of the CoMIRS analog network to TDMA is fully funded, funding is available to begin the transition soon, and the network is well supported for years to come.
Action Plan	
<ol style="list-style-type: none">1. Identify potential funding sources for CoMIRS (capital funding, highway funds, 911 funds, user fees, grants, etc.).2. Confirm potential additional user agencies and their potential funding sources.3. Confirm financial impact of any additional agencies on CoMIRS.4. Determine annual support and maintenance needs, including staff sizes.5. Obtain capital and operational funding.6. Track and report expenditures.	

5.4.2 Fund Support and Maintenance like an Enterprise Shared Service

The existing network has had limited downtime and a good track record for quality grade of service. Going forward, there will be more radio sites to maintain and more users to support. Currently, these responsibilities are performed by a relatively small network support team at the Massachusetts State Police.

End user and network support should be considered an enterprise service and funded accordingly. Other states fund portions of their operational costs with radio network usage fees. This should be considered to grow the support team that will be needed long-term. Additionally, an increase in support funding needed should be anticipated in the years before decommissioning the analog networks, since the support team and its maintenance vendor will be responsible for both networks simultaneously.

Current State	Desired State
CoMIRS support and maintenance is largely funded via operational funds to the Department of State Police. The network support team is relatively small compared to other states and given the size and complexity of the network.	A centralized support team with adequate resources is available to manage the network and work with current and future user agencies on improving operable and interoperable communications.
Action Plan	
<ol style="list-style-type: none">1. Conduct a survey of existing user agencies to identify radio support needs.2. Identify all existing radio support resources (for current and potential users).3. Determine the "to be" organization of radio support services for CoMIRS, including staff size, responsibilities, regional organization, and other considerations.4. Determine annual funding sources that provide adequate funding for needed state and maintenance vendor resources.	

5.4.3 Consider Burden Sharing Early On

A significant cost in the modernization of the radio network will be the replacement of incompatible and aging user radios. Many of these radios are currently used by municipal first responders and public safety. The cost of radio replacement can be prohibitive. Early on, the Commonwealth should consider whether or not the State will assume a funding burden sharing role for the replacement of subscriber units and/or the ongoing purchase of new units.

Current State	Desired State
Subscriber unit purchases are largely the purchasing agency responsibility. Occasionally, grant funding is available to help subsidize these acquisitions.	Large and small agencies at the municipal, county, and state level are capable of purchasing adequate numbers of quality subscriber units that meet the future standards for subscriber unit usage on the CoMIRS network.
Action Plan	
<ol style="list-style-type: none">1. Determine and evaluate options for subscriber unit purchasing.2. Determine interest from user agencies in participating in a burden sharing, radio purchase program.3. Determine whether or not the Commonwealth should consider establishing a radio fund for first responder subscriber units.4. Evaluate potential funding options for first responder radios, including capital funding, 911 surcharge funding, user access fees, and other funding options.5. If determined, implement shared purchasing program or emergency communications grant program.6. Alter state contracts as needed.	