Technical Implementation Plan

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A message from the co-chairs

We are pleased to present you with the *Technical Implementation Plan* (TIP). This plan is the result of the cooperative work of state, local, and tribal representatives who are committed to improving public safety communications interoperability in Washington state.

The work that contributed to this plan started with providing state and local agencies, and tribal nations the opportunity to participate in the planning process and identify requirements and needs for improving interoperability. Next, we compiled an inventory of current public safety communications assets that are owned by state and local agencies throughout the state. Last, after conducting a requirements analysis of several system architectures, we chose a standards-based, shared infrastructure solution to implement a statewide interoperable public safety communications system.

The TIP includes a standards-based architecture and protocols with which state and local emergency responders will have the capability to interoperate in real time and on demand. We have detailed the steps that the state must take to implement the selected architecture. We have also described the governance and funding support activities that will help us achieve communication interoperability.

We ask for your support to help us advance this plan so that law enforcement officers, firefighters, emergency medical service providers, and other first responders can more effectively serve the citizens of Washington state.

Sincerely,

Chief James Broman
Co-chair, State Interoperability Executive Committee
Past President, Washington State Fire Chiefs Association

Gary Robinson
Co-chair, State Interoperability Executive Committee
Director, Department of Information Services

Executive summary

Initiated by the State Interoperability Executive Committee (SIEC) in August 2004, this *Technical Implementation Plan* (TIP) is a critical milestone toward improving public safety communications interoperability.

SIEC members based the plan on a process that started with identifying state agency needs and requirements. We (the SIEC) consulted with local and federal agencies, tribal nations, and vendors to obtain their feedback. We also developed a current inventory of public safety communications assets across the state. Lastly, after conducting a requirements analysis of several architectures, we chose an approach that is standards-based and uses shared infrastructure to develop a statewide interoperable public safety communications system. This approach is referred to as the multiple subsystems architecture approach.

What was our approach to planning?

Highly interactive, the planning process included many opportunities for state, local and federal agencies, tribal nations, and vendors to provide commentary, feedback, and direction on the interim work products. We accomplished this through a series of information collection sessions that included:

- Conducting regular SIEC meetings and SIEC Advisory Working (SAW) Group meetings.
- Holding information gathering meetings in each of the nine homeland security regions of the state.
- Discussing reviews of vendor responses to a Request for Information (RFI) process.
- Conducting briefings with individual SIEC members.

We coupled our approach with the state's Enterprise Architecture (EA) planning process, and with the systems development process endorsed by the SAFECOM program within the federal Department of Homeland Security (DHS). Washington's Statewide Homeland Security Strategic Plan was also a key consideration in the development of this plan.

We applied the EA process to assist with three specific areas of the planning process:

- Early on, the Department of Information Services (DIS) performed an initial evaluation and determined the SIEC Guiding Principles are closely aligned with the EA principles adopted by the Information Services Board (see Section 5, Governance for a description).
- During the development of the architectural alternatives, DIS performed an evaluation and determined how each of the three architectural approaches

aligns with EA principles. The evaluation results helped identify the alternative that would best meet the needs of public safety agencies to improve interoperable communications.
- In the preparation of this report, we analyzed three potential governance approaches for their alignment with the EA principles and the SIEC Guiding Principles. The results of that assessment are presented in Section 5 of this plan.

This report uses the terminology "proposed system" to represent the overall set of technical and process capabilities outlined as the "multiple subsystems approach" in the SIEC May 2005 *Alternatives Report*.

What technologies were chosen for the proposed system?

This TIP provides guidance for the state to move ahead with the development of a statewide interoperable public safety communications system. The proposed system will provide significant improvements in how state agencies communicate to meet the responsibilities of their day-to-day mission. The system will also provide state agencies with the capabilities to improve their interoperability with federal, local, and tribal entities. The TIP provides a high-level approach for planning the transition of the current agency-based public safety mobile radio systems to a standards-based, frequency-independent, multiple subsystems technology architecture.

The multiple subsystems architecture consists of the following key elements:

- A Radio over Internet Protocol (RoIP)-based interoperability system that enables non-state agencies to interconnect their radio systems with the state system. RoIP also provides immediate improvements in the ability of existing state agency systems to interoperate.
- A statewide digital transport backbone system that provides connectivity to all transmitter locations. It also provides the interface to other state and federal networks for access to various applications and data that are available.
- A mutual-aid communications system deployed across the state to enable interoperability at and across the commonly-used public safety frequency bands (VHF Low, VHF High, UHF and 700/800 MHz). This allows those agencies that have not yet implemented standards-based communications capabilities to communicate directly with state agencies and dispatch centers.
- A statewide, Project 25 (P25) standards-based, frequency-independent system of systems that uses equipment common to all agency-focused systems providing full interoperability. It provides connectivity and interoperability to all state agency participants, and federal, local and tribal agencies that choose to participate in the system.

- A statewide mobile data system that provides low and medium speed data communications capabilities for participating agencies' subscribers.

Figure S.1 further illustrates the critical aspects of the proposed system.

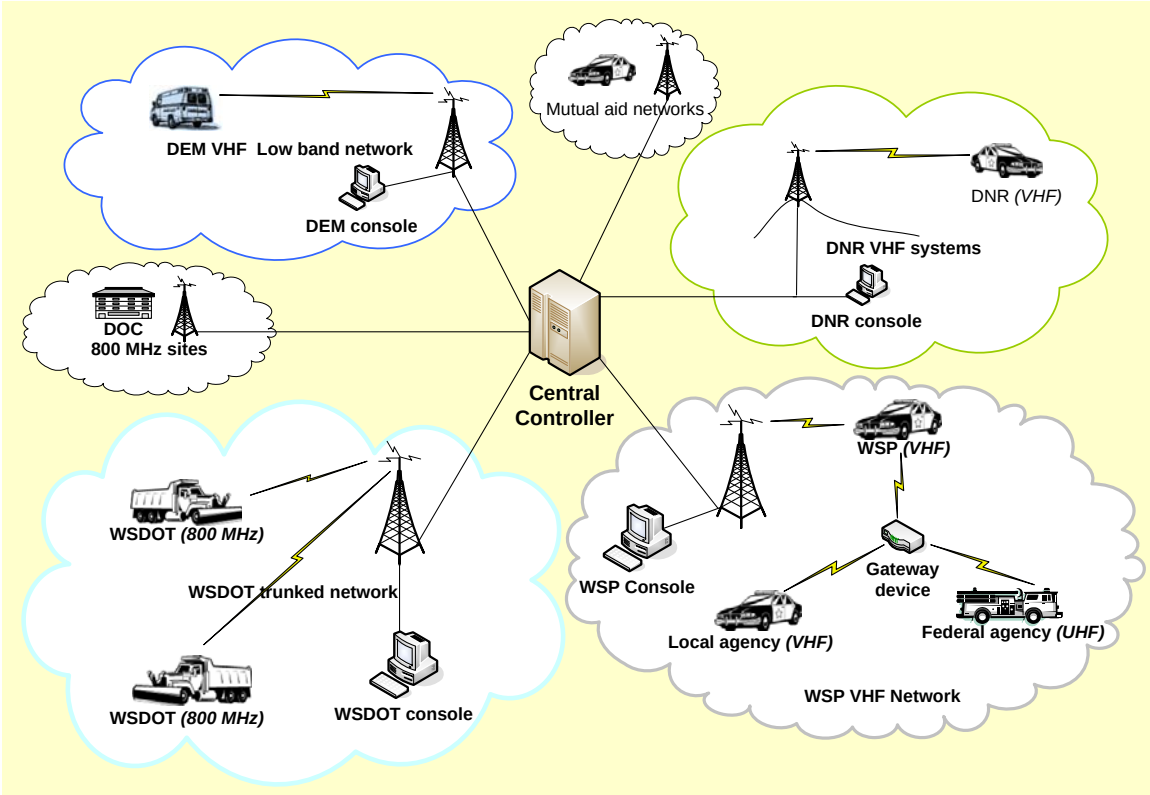

Figure S.1 – Multiple subsystems conceptual architecture

How will the proposed system be planned and managed?

We must address four areas of governance to successfully plan and manage public safety mobile radio communications systems:

- Strategic planning and standards
- Asset ownership
- System management and operation
- Maintenance

SIEC members and working group members will continue to provide oversight and planning, as well as managing the development and enforcement of standards.

We considered several models, some in use by other states, to develop the recommended approach for the proposed system management and operation. The primary models considered were a “lead agency,” a multi-jurisdictional governance board, or to continue with the current approach of decentralized, agency-based governance.

We recommend designating a “lead agency” and transitioning to this approach as new system components are implemented. This approach aligns well with the state's Enterprise Architecture principles, and includes the following components:

- The lead agency must have overall responsibility and direct accountability for the development and management of the system. Eventually, this agency would manage and control the common and shared infrastructure assets and processes associated with interoperable communications within state agencies. This includes base stations, repeaters, Radio over Internet Protocol equipment, towers, wide area communications network, and network control centers.
- The lead agency will operate as a service-providing organization and will have processes in place to insure that the needs of the other agencies are incorporated into the planning and operational processes.
- The transition to the lead agency approach would occur as system components that require centralized management are put into place. Initially, the lead agency would focus on planning and process development. As the initial technology-based interoperability solutions are implemented, the lead agency would manage the hardware and software components associated with those solutions. Management of the new mutual-aid capabilities would most likely be the next capability to transition, followed by the statewide backbone and the central controllers. The agency-based radio systems would transition as new P25 digital technologies are implemented. Other arrangements could be made on an agency-specific basis.
- The lead agency would have responsibility for the fiduciary aspects of the proposed system, including funding, operational costs, and cost recovery mechanisms. We will need to develop appropriate financial considerations that will include all state, local and federal agencies, and tribal nations participating in the use of the system.
- State agencies that use the proposed system would retain control over their portable and mobile radios (i.e. subscriber units), dispatch centers and radio dispatch console equipment.
- Asset ownership must reside with the lead agency or as few agencies as possible, and must be managed in accordance with any legislative or constitutional constraints.

We anticipate that internal resources will provide maintenance, although the state could consider requesting proposals for vendor-provided maintenance as an option during the overall system procurement process.

What will be different from how things are done today?

Several major changes will take place as a result of implementing the proposed system.

- The proposed radio systems will have a higher degree of shared equipment than today, which will provide for overall better usage of assets and investment. We can augment today's approach of sharing microwave transmission capabilities that connect our radio sites by sharing common control equipment. This will provide a higher level of interoperability between state agencies. Local, tribal, and federal agencies may also participate in this shared resource capability.
- State agencies will retain control of their subscriber units and dispatch centers. A single, lead agency will ultimately manage the day-to-day operations of the proposed system. As state agencies replace their existing systems with the proposed technologies, the lead agency will provide a single point of accountability for all state agencies' radio communications. The lead agency will insure that the needs of each agency are met consistent with the priorities of the SIEC and the available funding mechanisms.
- The lead agency will also provide a single point of accountability for all financial issues related to the proposed system, from funding appropriations to developing the appropriate cost sharing processes among state agencies using the system.

We will carefully monitor the progress of this project to insure that these changes are accomplished successfully and without impacting the day-to-day operations of each radio system.

When and how will the proposed system be implemented?

The proposed system implementation will occur over a six-year period, starting with a one-year planning and procurement phase that includes developing detailed technical specifications and selecting and procuring the system technical components.

The recent hurricane disaster events raised awareness of the need to provide a greater level of interoperability between state agencies and local, tribal, and federal agencies for routine and crisis-related communications. As a result, our first initiative under this plan is to analyze the specific gaps that exist today relative to interoperability between agencies and develop mitigation plans to provide significant near-term improvements. We will phase in these capabilities over the next two years and make them available for local, tribal, and federal agencies to use.

We will provide additional improvements in interoperability between the state, local, tribal, and federal agencies by further enhancing the “mutual aid” radio capabilities that exist today. Concurrently, we will insure that the state microwave network, which connects our radio sites, will have sufficient capabilities to support the proposed systems that we will implement over the next six years. We will transition to these new systems on an agency-specific basis to insure that the needs of each agency are incorporated into both the design and the actual cutover process.

During the implementation period, we must use comprehensive project management to coordinate several related communications system initiatives, including:

- Implementing the proposed communications system.
- Operating and maintaining agencies’ existing systems.
- Managing the 800 MHz frequency rebanding project.
- Coordinating the federally mandated very high frequency (VHF) narrowbanding efforts.

We estimate that we will need 94 personnel to support the proposed system by the time it is fully implemented. These resources include the 74 personnel currently supporting existing state agency systems, and 20 new required positions to operate and maintain the added functionality of the proposed system.

During this planning period, we need to identify the funding sources and determine how we can apply the existing funding sources toward purchasing the proposed system.

What will the proposed system cost?

We performed a cost analysis on the proposed system that identifies the implementation costs, and the costs to operate and maintain the existing systems. It is important to note that the costs to implement the proposed system are in addition to the planned expenditures to operate and maintain state agencies’ existing systems during the transition period.

Through a formal procurement process, we will determine the actual costs of the proposed system. Currently, we estimate that the proposed system acquisition and its recurring costs will fall within 20 percent of the total cost that vendors will propose during that process.

During the proposed system implementation, we expect a reduction in the annual recurring costs to maintain the existing systems. But because the implementation plan requires the use of existing systems while the proposed system is being built, we anticipate some overlap with the proposed system's recurring costs. We

will determine the magnitude of these overlapping costs during the detailed system design and implementation planning that is scheduled during the procurement phase.

The estimated system acquisition and recurring costs are as follows:

- The cost to acquire the proposed system will total approximately $257 million over the six-year implementation period.
- Proposed system recurring operation and maintenance costs will total $177 million over the projected ten-year life cycle of the technology. The annual recurring costs begin at approximately $4 million starting in the second year, and gradually increase up to a maximum of $25 million per year at the end of the implementation period, which ends in the tenth year.
- Combined costs will total $435 million (i.e., system acquisition costs at $257 million plus system recurring costs at approximately $177 million for the ten-year life cycle).

We did not include an estimate for end-of-life replacement costs for infrastructure and radio subscriber equipment.

What are we spending today for the existing systems?

Starting in 2005, state agencies are budgeted to spend a total of $344 million over a ten-year period for operations and maintenance, and upgrades to existing agency-specific systems. Here is a breakdown of those costs:

- Overall system acquisition costs total $219 million. These expenditures will be used for planned improvements to existing systems and to keep existing systems upgraded during the proposed system implementation period.
- Annual existing recurring costs are budgeted at approximately $12.5 million per year – over ten years this totals $125 million. We expect to continue incurring some of these costs during the implementation of the proposed system.

A simple comparison of the proposed system's costs and today's costs might lead one to conclude that the proposed system will cost $91 million more over a ten-year period. However, the actual cost difference will be somewhat greater – due to continued support and changes to existing systems during the proposed system implementation.

What benefits does the proposed system provide?

We can expect some obvious tangible improvements in public safety communications as a result of deploying the proposed multiple subsystems

architecture. These improvements will be most noticeable to end users who will experience the following improvements in voice and data radio communications:

- Statewide coverage enhancements for mutual aid
- Signal and voice quality improvements resulting from digital technology
- System functionality additions for mutual aid and mobile data
- Usability enhancements of the proposed system capabilities
- Interoperability with other state, federal, and local government agencies

Based on the experiences of other states, the real value to Washington state is two fold – minimized costs for labor and equipment and improved public safety. The anticipated benefits include that:

- We **avoid potentially redundant costs** by implementing shared systems between agencies that can consolidate fixed assets. This reduces the amount of duplicated infrastructure, and system management and operational expenses including network connectivity, maintenance, leased lines fees, and land leasing fees.
- We **increase productivity** as a result of better coordination between first responders. This occurs with using a shared communications system that handles voice, data, and mutual-aid needs during day-to-day and major emergency situations.
- When we **increase statewide functionality**, we increase interoperability for all system users with wide area roaming and secure communications for voice and data channels.

What other public safety groups can benefit from the proposed system?

All local, tribal, federal, and non-state public safety and initial responder agencies will have an opportunity to share in the benefits of the future state public safety radio system. The multiple subsystems architecture provides several options for non-state emergency response agencies to interoperate with the proposed system. These options include access to the statewide standards-based frequency-independent radio system, shared mutual aid channels, and Radio over Internet Protocol gateway technology.

What are the risks that we face?

The state will face many risks and potential obstacles during the planning and implementation of a system this size. These risks include technological, political, financial, and procedural factors, some of which are outside the direct control of the state. This plan identifies the primary risk areas and provides potential mitigation strategies for minimizing the impact of those risk factors on the successful system implementation.

We are particularly concerned about the availability of radio frequency spectrum and the ability to properly allocate that spectrum. We believe this may adversely impact deployment and operation of the proposed system. Mitigating this risk requires a coordinated effort to inventory, manage and possibly reallocate radio spectrum for efficient usage among all state agencies.

What happens next?

Finally, this plan identifies the factors that are most critical to the success of the project, particularly the need for:

- High-level sponsorship.
- Strong governance structure.
- Open communications and collaboration among the participants.
- Acquiring adequate and sustainable funding.
- Implementing key centralized processes such as frequency management and overall planning and control of the system.

We suggest a series of "next steps" to guide the required near-term activities, which will move us from disparate agency-based radio systems to a highly interoperable system. These next steps include:

- Working with the Information Services Board to obtain approval of the TIP.
- Communicating details of the TIP to all stakeholders, and getting input and buy-in from state, local and federal agencies, and tribal nations.
- Identifying the critical funding sources.
- Designating the lead agency.
- Confirming the priority of rapidly improving interoperability between state agencies and local, tribal and federal agencies.
- Developing short-term plans for analysis and implementation of interoperability improvements, including expanded mutual-aid capabilities and the design of a pilot program for the proposed P25 multiple subsystems architecture.
- Initiating the centralized frequency planning process.
- Creating the system management, financial and operational processes that the lead agency will manage.

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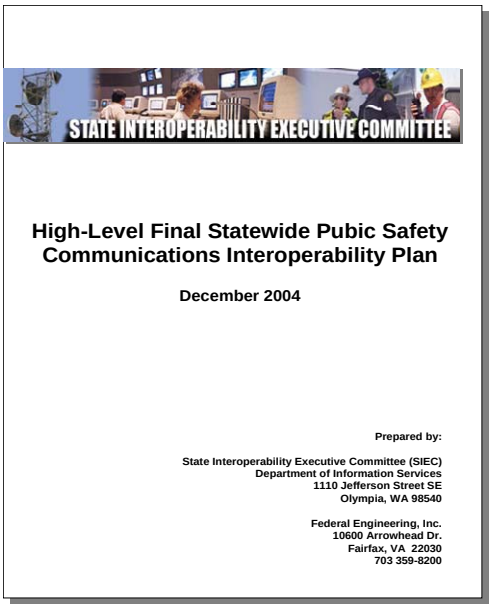
1 Program Summary

Interoperability is an essential capability within public safety communications systems, enabling personnel from two or more entities to interact with one another. It also allows the exchange of information according to a prescribed method to achieve predictable results.

To address emergency communications system interoperability in Washington state, Governor Gary Locke signed House Bill 1271 into law on April 16, 2003, which created the State Interoperability Executive Committee (SIEC). This legislation was codified into Revised Code of Washington (RCW) 43.105.330. The SIEC is responsible for managing how Washington state public safety agencies use wireless communications to carry out their daily operations and coordinate responses during major events[1].

During 2003 and 2004, the SIEC produced several reports[2] that highlighted the current interoperability issues and current inventory of public safety communications equipment in use within the state. In December 2004, the SIEC reached a milestone in interoperability planning and published the *High-Level Final Statewide Public Safety Communications Interoperability Plan.* That plan describes the high-level goals and both short- and long-term actions for improving public safety communications capabilities for the state.



Cover of December 2004 Report

The goals and recommendations on governance, funding, and technology were created from the input collected at statewide interoperability forums, interviews with public safety officials, and the findings from the phase one statewide communications equipment inventory.

As the next step toward achieving the goals outlined in the high-level plan, the SIEC launched the second phase of the planning effort in January 2005 to identify users' needs and evaluate interoperability solution design options. This current work effort has produced a series of detailed planning deliverables that

[1] The vision and mission, and responsibilities of the SIEC can be found at: http://www.siec.wa.gov/committees/siec/mission.aspx
[2] The reports may be found at: http://www.isb.wa.gov/committees/siec/publications.aspx

describe the state's existing systems, users' requirements, alternative architectures, and the conceptual design of the statewide technical architecture.

Using all of the information obtained during the past year, the SIEC produced this *Technical Implementation Plan* (*TIP),* which proposes a statewide communications system along with the requisite governance structure to oversee the funding, procurement, implementation, and operations and management of the system for participating state agencies.

1.1 What are the goals of this initiative?

In December 2004, the SIEC's *High-Level Final Statewide Public Safety Communications Interoperability Plan* outlined the following goals for improving interoperability:

Goal 1: Establish statewide interoperability as a high priority for all stakeholders, including state, local, regional, tribal and federal agencies and entities.

Goal 2: Maximize the improvements in interoperability by institutionalizing collaborative approaches across the state based upon common priorities and consensus at the regional level.

Goal 3: Create an architecture approach which establishes a framework for interfacing between disparate systems, and promotes migration to new technologies in line with relevant standards platforms.

Goal 4: Migrate to a technology that provides state, local, regional, tribal and federal systems with the level of interoperability that is appropriate for their missions.

What is interoperability?

For the purposes of the SIEC mission, interoperability is defined as:

An essential communication link within public safety communications systems that permits units from two or more entities to interact with one another and to exchange information according to a prescribed method in order to achieve predictable results.

Goal 5: Optimize the use of all funding sources at the state, local, regional, tribal, and federal levels.

Goal 6: Maximize the use of "best current practices" approaches to improving interoperability.

Goal 7: Create a statewide backbone communications capability that would provide connectivity for state, local, regional and tribal groups.

1.2 What is the Interoperability challenge?

Although the following scenarios are hypothetical incidents, they could become real events someday that would require a coordinated response to protect lives and limit property and environmental damage:

- A magnitude 6.5 earthquake strikes downtown Seattle causing damage to buildings and raising public safety concerns across the region.
- A large wildfire ignites in Benton County that threatens the Hanford facilities holding radioactive materials and waste.
- A mild eruption at Mount St. Helens spreads ash and debris throughout the area.
- A dense fog in a highway construction zone leads to a multiple vehicle pile-up and several injuries.

Add to this list the routine emergency events that state agency responders deal with day-to-day, and the urgent need for a modern public safety communications system becomes obvious.

The current situation faced by state agencies has been verified through studies coordinated by the SIEC and reported in deliverables produced during the past two years. The challenge was recognized early on in the planning process.

The challenge

Public safety officers, firefighters and emergency medical service providers are too often hampered in their ability to effectively respond in a coordinated manner to crimes, disasters, fires, and medical emergencies because their communications systems are often incompatible.

The facts are[3]:

- One in three public safety agencies have experienced operational difficulties due to lack of wireless interoperability.
- Jurisdictions have invested in different, incompatible wireless technologies over the past 20 years.
- Public safety communication is spread over ten bands of spectrum.
- Washington's diverse geography presents logistical problems.

[3] From *Focusing on Emergency Communication Systems Interoperability*, which can be found at http://www.isb.wa.gov/committees/siec/publications/Focusing.pdf

In addition to solving the inherent problems caused by the incompatible legacy communications equipment, to be successful, the state must solve these widely recognized issues:

- Limited and fragmented planning
- Lack of coordination and cooperation
- Limited and fragmented funding
- Limited and fragmented radio spectrum[4]

This problem is multi-faceted and was created over a long time period. It cannot be solved with a silver bullet, single-faceted approach. The solution proposed in this plan is based on a long-term strategy.

1.3 How do we solve the problem?

Early in the planning process, the SIEC recognized that technology alone will not solve the state's communications problems. The approach followed to develop this TIP includes a mixture of all the key elements for building the solution including the following:

- The plan is based on a proven system development life-cycle methodology and proposes a planning approach for resolving issues related to limited and fragmented statewide planning and coordination.
- The multiple subsystems technical solution provides the desired voice and data communications functionality and allows the agencies to migrate to the proposed system in a reasonable time frame.
- The proposed governance structure will instill central oversight for the common shared infrastructure components, and yet allow the state agencies to retain operational autonomy to achieve their diverse missions.
- The proposed governance will also provide guidance to local governments with respect to interoperability challenges.
- The standard operating procedures, processes, and training requirements to enable effective use of the technology are included in Appendix F.
- As an initial step to fund the solution, the system life-cycle costs are identified along with recommendations for pursuing funding to support the proposed multi-phase system implementation.

[4] *Based on Why Can't We Talk*? A Guide for Public Officials. National Task Force on Interoperability. February 2003.

One of the tools used to develop this plan is the Interoperability Continuum developed by SAFECOM. The continuum, presented in Figure 1.1 identifies five key elements for achieving interoperability.

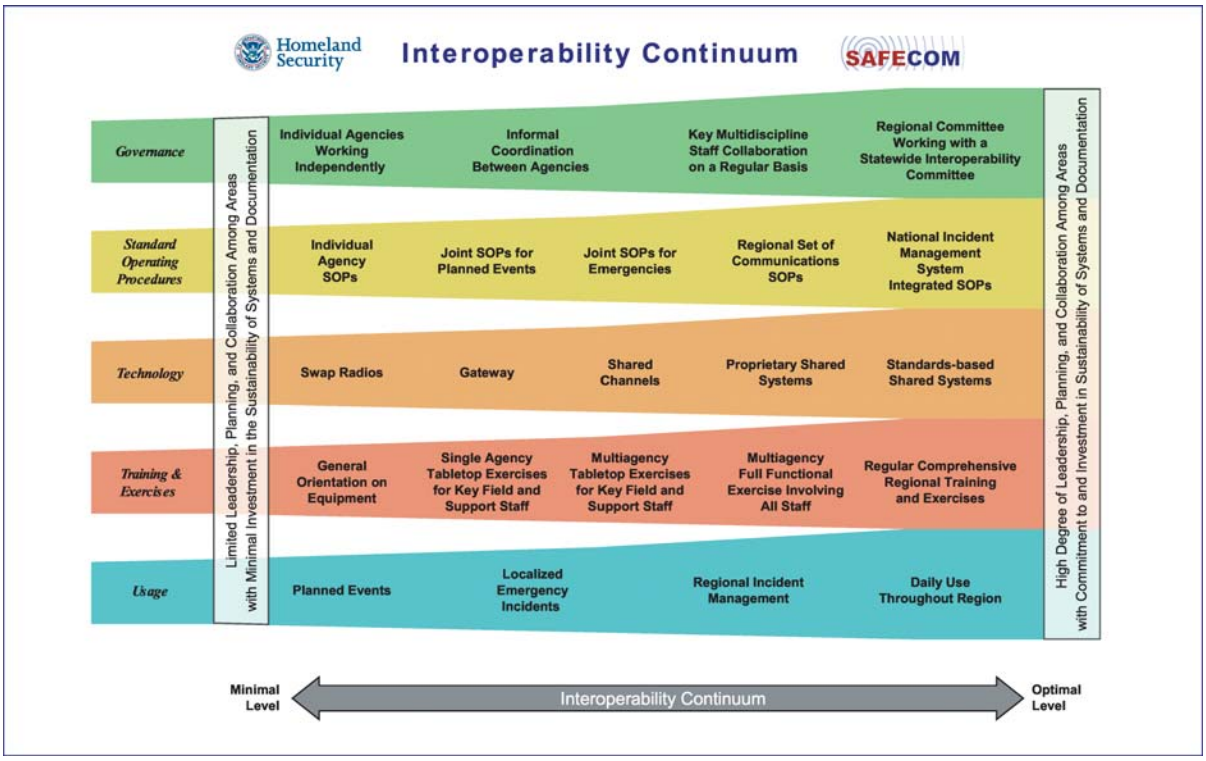


Figure 1.1 – SAFECOM[5] Interoperability Continuum

1.4 What is the purpose of this plan?

This *Technical Implementation Plan* is the final deliverable that concludes a year-long project to develop a comprehensive plan for designing and implementing a system solution to satisfy the voice and mobile data interoperability needs of the public safety agencies in the State of Washington.

Initiated in August 2004, this project has followed the two-phased planning methodology displayed in Figure 1.2 to produce six major deliverables:

- *High-Level Final Statewide Public Safety Communications Interoperability Plan,* December 2004
- *Statewide Interoperable Public Safety Radio Network – Request for Information,* January 2005.

[5] The SAFECOM program is managed within the Department of Homeland Security's Science and Technology Directorate. Through SAFECOM, the federal government is attempting to address public safety communications issues in a more coordinated, comprehensive and, therefore, effective way.

- *Inventory of Public Safety Communications Systems Phase 2 Report*, February 2005
- *System Capabilities and User Needs Report*, March 2005.
- *Alternatives Report,* May 2005
- *System Architecture Report,* August 2005

These documents are available on the SIEC Web site at:
http://www.isb.wa.gov/committees/siec/publications.aspx

These deliverables provide the source information for developing this TIP.

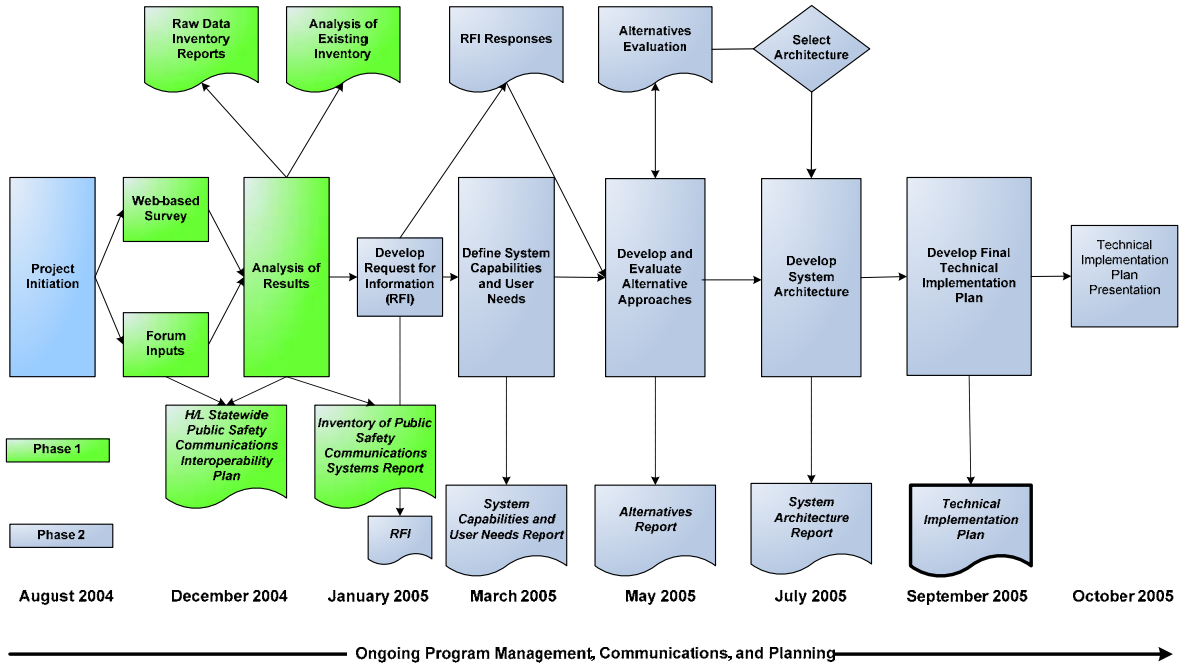


Figure 1.2 – Project methodology

1.4.1 *Technical Implementation Plan* objectives

The purpose of this plan is to provide a roadmap for the SIEC to use for planning and implementing solutions to improve public safety and public service communications systems interoperability for state agencies. As a secondary objective, the proposed system provides state, local, federal, regional, and tribal agencies with additional technology options to improve interoperability with state agencies.

The objectives are summarized in Figure 1.3 below.

TIP objectives

- Summarize the planning work to date and provide the background that supports developing this plan.
- Review the desired system capabilities and user needs, along with the alternative business and technical solutions considered by the SIEC.
- Summarize the multiple subsystems technical architecture and equipment components that comprise the design of the proposed new system.
- Describe the strategy and preliminary task plan for designing, purchasing, implementing, and maintaining an interoperable communication system.
- Present the estimated life-cycle costs to implement and maintain the proposed system over a ten-year period, along with the expected benefits.
- Review the operating procedures and staff training requirements for transitioning to the multiple subsystems technical solution.
- Address the governance needs by recommending an organizational structure to govern the proposed system.
- Describe a series of the next steps the state can act on to continue progress and prepare for system procurement.

Figure 1.3 – TIP objectives

2 Background

Although there are many state agencies that share the responsibility for ensuring public safety, six agencies own, manage, or operate the majority of the state's public safety land mobile radio (LMR) system assets. They are:

- Department of Natural Resources (DNR)
- Department of Corrections (DOC)
- Washington State Department of Transportation (WSDOT)
- Washington State Department of Fish and Wildlife (WSDFW)
- Washington Military Department Emergency Management Division (EMD)
- Washington State Patrol (WSP)

Over the years these agencies have developed, purchased and operated LMR systems primarily to meet the needs of their specific departmental missions. In recent years there has been significant coordination between agencies and sharing of infrastructure and backbone network resources to service mutual needs. For example, WSP provides the backbone microwave transport services for some state and local agencies. Although they have made incremental technical and operational progress toward improving interoperability, the current situation overall is that the state agencies are still not able to communicate on demand, in real time, when needed and authorized with their state, federal, local, and tribal counterparts. In August 2004, the SIEC initiated this planning effort to identify potential solution options and develop this plan for improving the level of interoperability for state agencies and for providing a roadmap for federal, local, and tribal agencies to follow to be able to interoperate with state agencies.

2.1 What is the current situation in Washington state?

Completed in December 2004, the SIEC collected input from state, tribal and local agency system users on their current asset inventories, system capabilities, and users' needs through a coordinated series of information collection activities:

- stakeholder interviews
- statewide forums
- Web-based survey tools

The details of this statewide assessment are presented in the *Inventory of Public Safety Communications Systems – Phase 2 Report*[6].

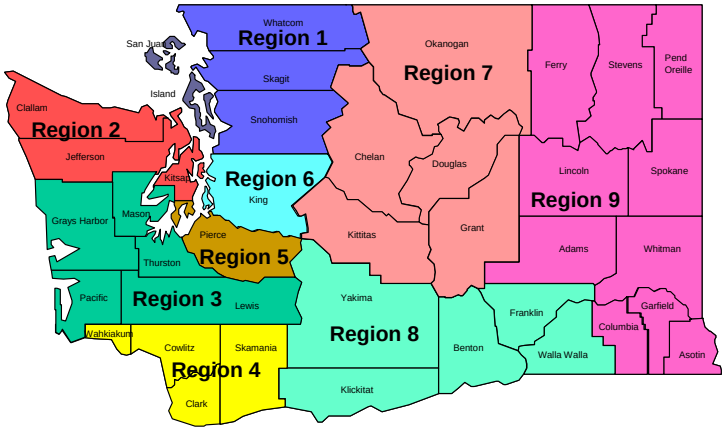
Some of the pertinent findings from the asset inventory and user needs assessment are provided in Section 2.1.2, statewide forums, and Section 2.1.3 Web-based survey results.

2.1.1 Stakeholder interviews

Interviews were conducted with SIEC members, members of the SIEC Advisory Working (SAW) Group, and additional individuals representing a diverse group of users from state and local agencies, federal government and tribal nations. The results of these discussions were documented and used to establish the key findings and recommendations presented in the planning deliverables, as well used to confirm the goals of the project.

2.1.2 Statewide forums

Regional forums were conducted in each of the nine homeland security regions of Washington state over a four-week period in October 2004. The forums were attended by over 200 individuals representing state federal, regional, and local agencies and tribal nations that have a need for interoperability with the state agencies.



Homeland Security Regions in Washington

Their contributions were valuable, and along with providing an excellent set of user needs, the participants identified many important communications issues as described below.

- Just about every possible technology that could be used for public safety communications is in use somewhere in Washington.
- In the VHF band, some agencies use narrow band equipment, but most use wideband. Some use 800 MHz, some UHF, and others are considering systems that use the 700 MHz or 4.9 GHz frequency bands.
- Some agencies use trunked systems, some non-trunked, some Project 25 (P25), and others non-P25 systems.
- Some regions have interoperable networks, and some agencies share frequency bands. There is widespread use of mutual-aid frequencies,

[6] http://www.isb.wa.gov/committees/siec/publications/Public%20Safety%20Committee.pdf

although these frequencies are generally limited to subscriber unit-to-subscriber unit communications and they are not centrally monitored.
- Use of specialized frequencies such as the Law Enforcement Radio Network (LERN) and the On Scene Command and Control Radio (OSCCR) system is expanding and helping improve interoperability.
- There are Memorandum of Use (MOU) agreements in place between the state agencies and many local, tribal, and federal agencies.
- Some agencies use mobile data systems, including Automated Vehicle Location (AVL).
- Some agencies have agreements in place for infrastructure sharing, particularly for use of tower space to generate revenue to offset costs.
- Some agencies have identified funding to forge ahead with new technologies while others have languished with 30-year old technology and no hope of finding the money needed to move forward.
- Some agencies have an open and collaborative mindset while others expressed concern about sharing resources and the planning process.
- Some agencies are embracing new technology and some are skeptical and stalwart in maintaining what has worked for them for years, indicating that they will change only when mandated (and funded).
- Some agencies define communications interoperability as swapping radios or having additional radios in their vehicles; some as sharing frequencies; some as coordinating operational procedures; others do not know.
- Some agencies are taking a hardware approach as the solution, some a software approach, and some a “process” approach through mutual aid Memorandums of Understanding (MOUs) and other handshake agreements.

2.1.3 Web-based survey results

To gather detailed information on the interoperability needs and inventory of public safety communications equipment statewide, the SIEC developed a comprehensive Web-based survey that was made available to all state and local agencies and tribal nations for an initial 12-week period beginning October 2004. Responses collected via the online survey were supplemented with information collected by the SIEC during previous surveys completed in December 2003 and July 2004.

The Web-based survey and asset inventory was conducted by following the same general approach as the previous SIEC studies.

Who responded to the survey?

The survey collected information about the public safety radio system assets, funding needs, and governance issues. Approximately 200 agencies within the

state's public safety and emergency response communities participated in the Web-based survey. The communities represented by the agencies completing the survey represent about 83 percent of the state's population. The regional breakdown of this is shown in Figure 2.1.

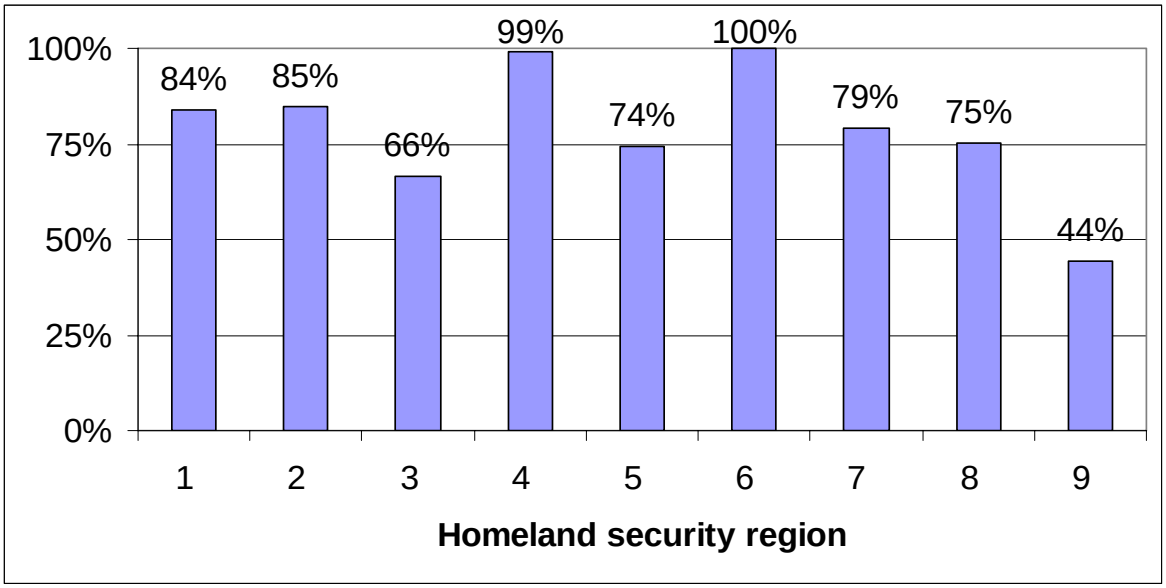
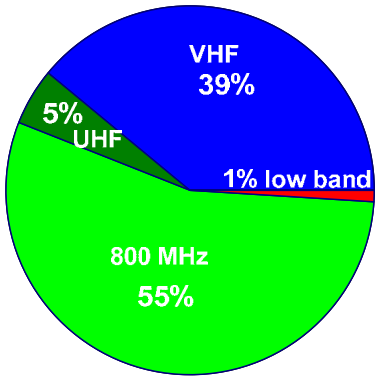


Figure 2.1 - Population represented in completed survey - by Homeland Security region

The key findings from the survey are summarized below.

Pertaining to the statewide agencies communications systems:

- Twenty-five percent of the agencies reported radios 10 years old or more.
- Approximately 90 percent of radios are not P25 capable[7].
- Interoperability is limited for most agencies
- More subscriber equipment on 800 MHz than on VHF and UHF combined.
- The majority of agencies operate systems in the VHF High and 800 MHz frequency bands.

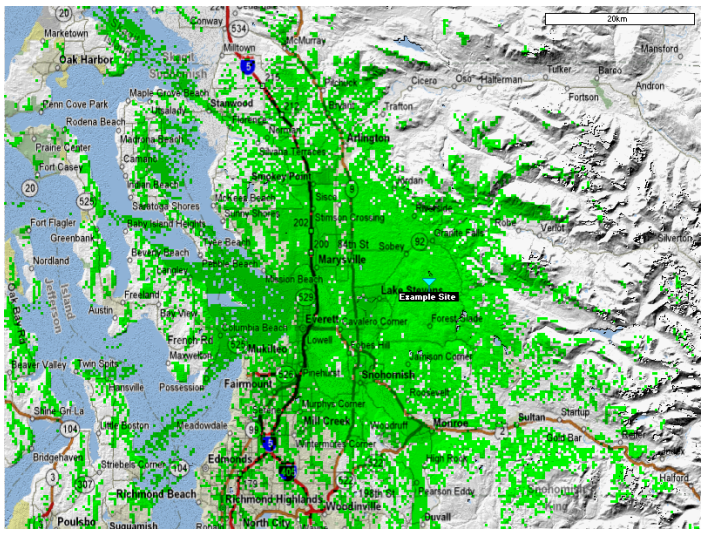


Distribution of radios by frequency band

[7] The term "P25 capable" indicates radios that are able to be upgraded to operate in a P25 technical architecture but do not currently have that capability.

Radio coverage:

- Coverage was reported as the highest operational obstacle.
- Mobile radio coverage satisfaction was reported at 3.7 on a scale of 1 to 5.
- Portable radio coverage satisfaction was reported slightly lower than mobile radio coverage.
- There is a high dependence on cellular technology.
- Maps indicating theoretical coverage for state agency systems were developed.



Example of theoretical radio coverage map for an area in Snohomish County (green indicates acceptable coverage)

System capabilities:

- Twenty-three percent of respondents indicated they did not have sufficient capacity for larger incidents such as:
  - Major wild land fires
  - Large natural disasters
  - Weather related events
  - Simultaneous emergencies.
- Aging equipment is a major factor limiting system upgrades.

A typical wildfire situation

Mutual aid:

- Seven percent of the respondents indicated they do not have mutual aid calls.

- Agencies that do have mutual aid calls reported that approximately 10 percent of their calls involve mutual aid.
- Sixty-six percent of respondents reported dispatch center intervention is required in a mutual aid situation or large scale operation.
- Only 19 percent of the responders have gateway or console-patch interconnect capabilities and only 16 percent reported patching as effective.

A typical dispatch center

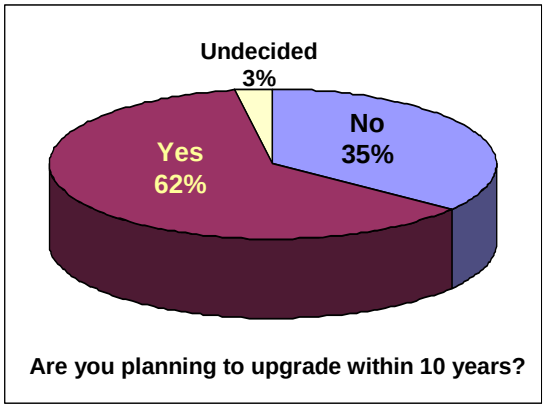
Mobile data:

- Agencies that do not use data routinely do not see the need to have data.
- Those agencies using data are finding that data is becoming more mission critical, however, they still have heavy dependence on voice.
- Twenty-six state and local agencies are using commercial systems for mobile data.

A typical mobile data configuration

Funding system upgrades:

- Sixty-two percent of the respondents indicated that they plan to upgrade existing systems within the next ten years.
- Local funds and federal grants will be the largest source of funding for local agency communication system projects.
- Cost recovery methods are largely dependent on general funds and grants
- Forty percent of agencies indicated they will begin replacing systems in 2005.



Example of a survey question and responses

Suggestions for the SIEC to improve statewide communications:

- Provide resources for local government to use to help with identification of funding.
- SIEC should be the thought leader for the state in communications technology, however **not** impose solutions.
- The state should take the lead in facilitating regional planning efforts.
- SIEC should benchmark best practices and share this information with local governments.
- Planning seems to be the single most important action to improve interoperability.

SIEC mission statement

In the interests of public safety, the State Interoperability Executive Committee (SIEC) pursues and promotes statewide interoperability policies and standards, which will ensure interoperable emergency communications.

In summary, with the existing radio system technology in place today, law enforcement officers, firefighters, highway maintenance workers, emergency medical service providers and other public safety officials that support the citizens of Washington state are limited in their ability to communicate on-demand, in real time, when needed, and when authorized. Many agencies are not able to communicate across disciplines or across the multiple frequency bands used by agencies across the state. This results in:

- Increased risk to life and property due to inaccessibility of safety/medical personnel unable to receive coordinated emergency instructions.
- Increased costs (emergency vehicles requiring multiple radios; additional training, no leverage for aggregated purchasing discounts) that are due to the lack of a coordinated approach.

2.2 What are the users' needs?

To establish a baseline of user needs for determining viable interoperability solution alternatives, the essential functional, operational, and technical requirements were identified and described in the *System Capabilities and User Needs Report*, March 2005.

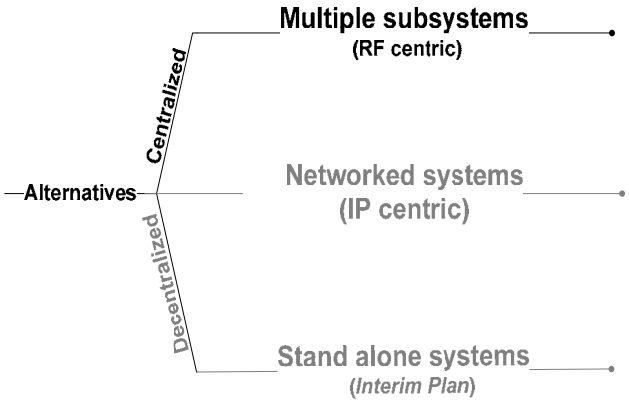
1. **Operational requirements** are derived from user interoperability needs expressed in forums, stakeholder interviews, and the online survey. Operational requirements include the following:
   - State, local, tribal and federal agencies interoperability operating capabilities
   - Radio system user features
   - Channel capacity, and system roaming and availability
   - System management

2. **Functional requirements** include the basic user capabilities to satisfy first responder hands-on needs to communicate effectively during routine and mutual aid situations such as:
   - Network backbone infrastructure
   - Voice quality
   - Applications needs for mobile data, alerting, and automatic vehicle location (AVL)
   - Internet protocol gateways for voice and data communications

3. **Technical requirements** are the capabilities necessary to fulfill operational goals and functional requirements. They take into consideration the following needs:
   - Statewide mobile and portable radio coverage needs
   - Government regulations and compliance standards
   - Voice and data security and encryption parameters
   - System migration and compatibility with existing systems

2.3 What alternatives did the SIEC consider?

Based on the user requirements and goals established by the SIEC, members of the state's participating agencies utilizing land mobile radio systems, and the state's consultant performed an evaluation of the technical and business alternatives. The specific purpose was to identify viable architecture solutions for improving voice and data communications systems interoperability.



Alternative architectures considered by the SIEC

The SIEC considered the following three options for improving voice radio and mobile data communications interoperability for state, local, tribal, and federal agencies, and other agencies[8]:

Alternative #1 – Multiple subsystems: a centrally managed system-of-systems approach based on centralized radio systems architectures that are not restricted to a single frequency band.

Alternative #2 – Networked systems: an architecture that is frequency independent and based on Radio over Internet Protocol (RoIP).

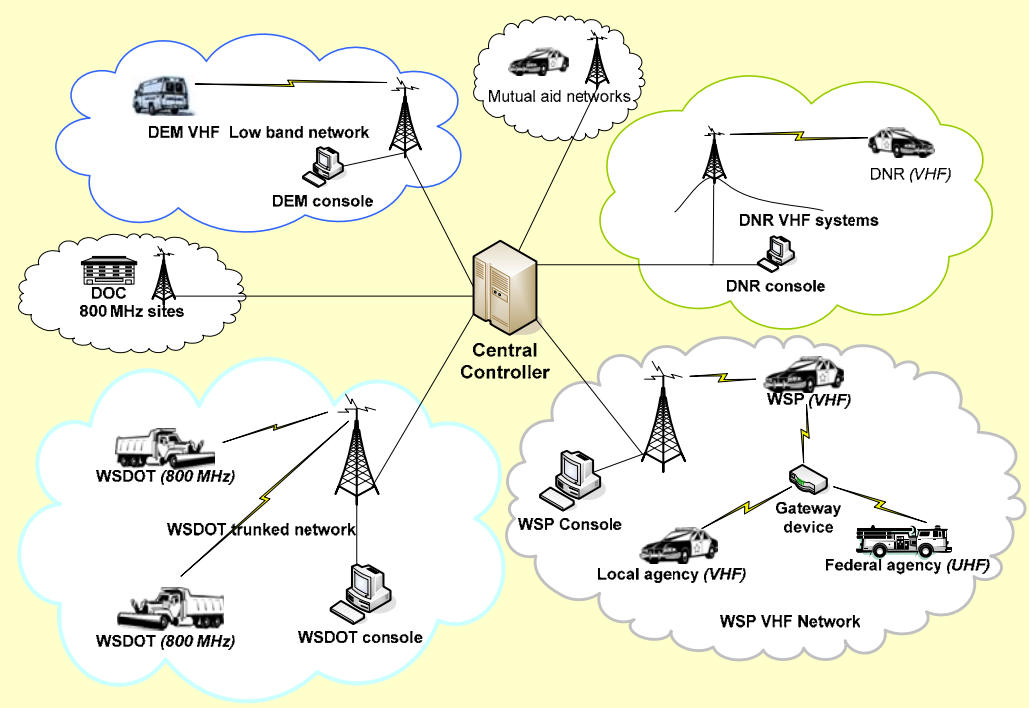
[8]Other agencies include public and private utilities, hospitals, port districts, and private emergency service providers that are routinely involved in mutual aid situations.

Alternative #3 – Stand alone systems: implies that the participating state agencies would continue operating stand alone systems following the strategy recommended in the *Interim Plan*.

2.4 What alternatives did the SIEC select?

In June 2005, the SIEC reviewed three alternatives and decided on an architectural approach that will provide state agencies with the needed technology and business solutions to achieve communications interoperability.

The June 2005 *Alternatives Report* includes a full description and comparison of the characteristics and costs of the alternatives considered by the state[9]. The selected alternative, the multiple subsystems approach, utilizes a network of radio sites, transport mechanisms, interfaces and audio switches connected together through one or more centralized control centers.



The multiple subsystems approach

The central controller provides direct interoperability between users on each subsystem. Rather than forcing a single-frequency band solution, this approach leverages the state's existing radio systems operating in different bands, and

[9] http://www.isb.wa.gov/committees/siec/publications/AlternativesReport052005FINAL.pdf

provides a phased migration to common air protocols based on Project 25 (P25) standards.

Appendix C provides an overview of P25 and the various phases of standards development.

As displayed in Table 2.1, the baseline user needs and requirements were compared to the three alternative architectures to help determine the approach that best meets users' needs and satisfies the goals established by the SIEC.

Comparison criteria	Multiple subsystems alternative #1	Networked systems alternative #2	Stand alone systems alternative #3
Meets system requirements	The baseline requirements were developed and validated by end users, and documented in the *System Capabilities and User Needs Report*.		
Operational	100%	66%	16%
Functional	78%	78%	12%
Technical	80%	60%	20%
Average compliance rating	**86%**	**68%**	**15%**

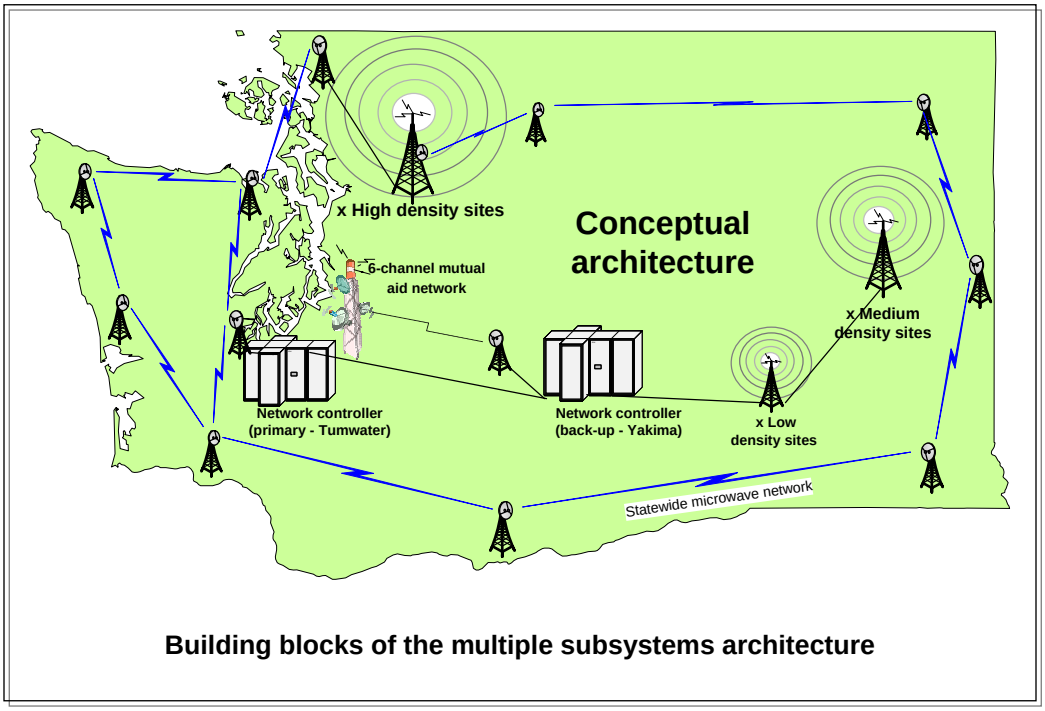
Table 2.1 – Alternatives compared to system mandatory requirements

2.5 What is the conceptual design of the proposed system?

Conceptually, the selected technical architecture is designed around one of the key SIEC Guiding Principles as described in Section 3.4, to "build wisely, build once and share often." The multiple subsystems architecture is an open standards-based solution that can be assembled by using off-the-shelf components from multiple vendors.

The fundamental approach to the proposed system is that each agency-specific radio system is designed based on the needs of that agency, and the multiple agency systems are linked together through the use of common technologies and infrastructure. Economies and capabilities of scale are provided by the aggregation of agency-specific and shared (mutual aid, Radio over IP, etc.) technologies at common locations. The main building blocks of the multiple subsystems architecture are:

- Radio frequency (RF) sites of high, medium, and low density
- Radio dispatch centers
- Radio network control centers/controllers
- Subscriber equipment
- Support infrastructure including the statewide microwave network



Building blocks of the multiple subsystems architecture

The architecture is designed to provide voice and data communications services to over 9,600 state agency users that operate over 16,000 mobile and portable radios throughout the state. The architecture is expandable beyond that point although the costs for such an expansion have not been included in this plan as the magnitude and timing of the need for expansion are not known at this point in time. It was also recognized during the design process that implementing this proposed system architecture will require significant changes to standard operating procedures (SOPs) for all participating state agencies.

In order to deploy and take full advantage of the advanced functionality that end users desire, such as trunking and mobile data, some agencies will need to adopt SOPs where currently none exist. Other state agencies that currently use these functions may be required to alter their existing procedures to accommodate these system enhancements.

The implementation plan described in Section 6 takes these SOPs into consideration. The resources required to implement changes to SOPs have been built into the cost estimates, which are presented in Section 7.

3 Plan description

The proposed solution is designed to satisfy the requirements for improving interoperability for state public safety agencies, and also addresses the needs to interoperate with federal, local, and tribal agencies. In addition, the plan recommends a governance structure for the state to consider, and identifies risk, costs, and potential benefits. Lastly, it suggests the next steps and activities necessary to complete the procurement, implementation, and operational phases.

SIEC vision

Public safety officials throughout Washington are able to communicate using interoperable technology in real time and on demand.

3.1 Business opportunity and need

The State of Washington is faced with an opportunity to solve many of today's public safety communications issues, and at the same time significantly enhance interoperability with other agencies from the federal, regional, local and tribal levels. By implementing the proposed system described in this plan, the state can connect the state agencies and over 9,600 users to a statewide, integrated wireless voice and data communications network. The proposed system will provide interoperable communications capabilities to enable law enforcement officers, firefighters, highway maintenance workers, emergency medical service providers and other public safety and first responder officials to more effectively serve the citizens of the state.

3.2 System solution scope

The vision and goals established by the SIEC are the business drivers that have guided the development of detailed system requirements. As depicted in Figure 3.1 on the following page, the user and system requirements have been identified, and reported as part of the various deliverables of this project. These requirements make up the scope of system implementation requirements that the final system solution should satisfy.

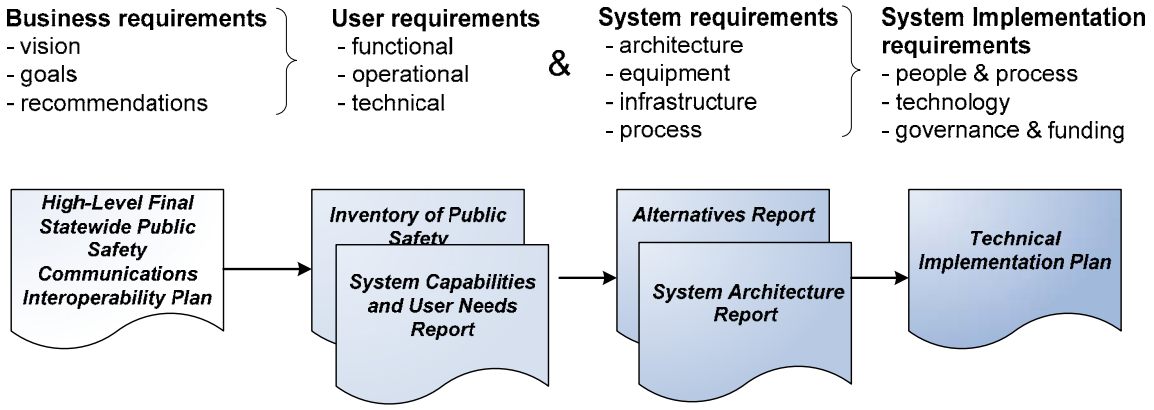


Figure 3.1 – Relationship between SIEC vision/goals and proposed system requirements

3.2.1 Participating state agencies

Although there are other state agencies that have public safety missions, six agencies own and/or operate most of the land mobile radio (LMR) system assets. The state agencies that are the focus of this planning effort and who comprise the primary user base of the proposed new radio system are listed in Table 3.1 below. These agencies are referred to as the "participating agencies."

Agency	Total users[10]	Total radios[11]	LMR system
Department of Natural Resources	2,080	2,230	VHF conventional
Department of Corrections	3,200	3,785	800 MHz conventional and trunked
Department of Transportation	3,100	4,950	800 MHz trunked
Department of Fish and Wildlife	260	800	VHF conventional (uses WSP system)
Emergency Management Division	300[12]	180[13]	VHF Low band conventional (CEMNET)[14]
Washington State Patrol	700	3,830	VHF conventional
Totals	9,640	15,775	

Table 3.1 – State government-operated communications systems

[10] Total users represent the approximate number of radio users assigned throughout the state at any given time.
[11] Total includes portable and mobile radios as reported in the *Inventory of Public Safety Communications Systems*, February 2005.
[12] This user total includes all local and state emergency management (EM) offices, most of whom own their own radios.
[13] This radio count is for radios owned by EMD only
[14] Washington State Comprehensive Emergency Management Network (CEMNET) supports all state and local EM offices

3.2.2 Other state agencies

Additional state agencies with land mobile radio (LMR) assets are listed below. Although these agencies could also be integrated into the proposed system, the costs and requirements for doing so are not included as part of this report.

- Department of General Administration
- State university police departments
- Liquor Control Board
- Department of Social and Health Services
- Horseracing Commission
- Department of Labor and Industries
- Gambling Commission

3.2.3 Other agencies

Although the focus of the architecture assessment was state agencies, all local, tribal, federal, and non-state public safety and initial responder agencies will have an opportunity to share in the benefits of the proposed system. By selecting the multiple subsystems architecture, non-state emergency response agencies will have more options to achieve greater interoperability with state agencies.

While these other agencies will certainly realize benefits from the proposed system, and may eventually connect into it, the primary focus of this report is for interoperable communications between state agencies.

3.3 Constraints and dependencies of the proposed system

- **Technical standards:** the system will conform to P25 standards, in accordance with the standard adopted by the SIEC on June 8, 2005.
- **Funding:** limitations may constrain the final design and level of functionality that can be implemented.
- **Spectrum:** limitation in available spectrum for use by the state, FCC-mandated changes in existing spectrum use, and treaties affecting spectrum utilization in border regions will significantly limit implementation options for voice radio, mutual aid, and mobile data in certain areas of the state.
- **Network capacity:** transport system limitations may restrict or preclude the ability of the state to share the use of the statewide backbone with other non-state agencies.

3.4 System development guidelines

During the initial planning stage of this initiative, the SIEC endorsed a set of guiding principles (Table 3.2) for developing the statewide system.[15] These principles have been adhered to for designing the system architecture.

SIEC guiding principles
Build wisely, build once and share often.
Spectrum licensed by the state should be maintained as a natural resource and, to the greatest extent possible, be shared and maintained to provide the greatest return on investment.
Communications solutions should be based upon non-proprietary "open" standards when possible.
Topography and population density may dictate the appropriate use of radio frequencies and technology. For example, areas in Washington state that have mountains and tall buildings may require different technology than areas where there are extensive flat lands.
All solutions for state funded radio systems should consider the sharing of assets between state and local governments when possible.
All solutions using state funds should be planned with an enterprise view toward connectivity and interoperability with state communications assets.
All equipment shall have a lifecycle strategy to assist in planning and management.

Table 3.2 – SIEC guiding principles

Throughout the development of this TIP, the scope of work for producing this deliverable has been based on the SIEC's goals and guiding principles, the system requirements described in the *System Capabilities and User Needs Report*[16]*,* and system design considerations presented in the *System Architecture Report*[17].

In a parallel effort related to the development of the architectural alternatives, the Department of Information Services confirmed that the SIEC Guiding Principles

[15] *Interim Statewide Public Safety Communications Systems Plan*, Prepared by the SIEC March 30, 2003
[16] http://www.isb.wa.gov/committees/siec/publications/SCUN05182005final.pdf
[17] http://www.isb.wa.gov/committees/siec/publications/SAR_Final_081005.pdf

are also in alignment with the core principles of the Enterprise Architecture framework.[18]

3.5 Other considerations for the implementation plan

The development of specific mobile data applications, including the determination of how and where data is shared across agencies and the deployment of specific end-user software tools is not included in this plan. These issues would be handled by each agency on an individual case basis. The data network capabilities, with the limitations of bandwidth available, are neutral to these application issues as long as they follow the standards that the data network is based upon.

Since the total capacity of the current or upgraded statewide transport networks has not been determined at this time, the ability of these networks to support the proposed system as detailed in this plan may not include the total scope of work or costs to provide these capabilities.

Washington's Statewide Homeland Security Strategic Plan also provided valuable input to the planning process.

[18] Enterprise Architecture is comprised of ten guiding principles and has been adopted by the Information Services Board as a preferred way of investing in technology. These principles can be found at https://www.nascio.org/hotIssues/EA/index.cfm#tool-kit

4 System conceptual design

The proposed system for Washington State is the culmination of a planning and needs analysis process that grew out of the *High-Level Final Statewide Public Safety Communications Interoperability Plan* published in December 2004[19]. The system conceptual design was further refined and developed in the *System Architecture Report*[20] published in August 2005.

For purposes of the SIEC mission interoperability is defined as: An essential communication link within public safety and public service communications systems that permits units from two or more different entities to interact with one another and to exchange information according to a prescribed method in order to achieve predictable results.

4.1 APCO levels of interoperability

Guidelines adopted by the Association of Public-Safety Communications Officials (APCO) have been used to measure the levels of interoperability improvements provided by the proposed radio system components. APCO defines the six levels of interoperability as displayed in Table 4.1 below.[21]

Level	Interoperability method	Benefit
6	Standards-based shared systems	The ultimate interoperability solution, which is useful for any scale of event from small to massive
5	System-specific roaming	Radios are programmed to work on the other's infrastructure within a set of pre-planned channels
4	Gateway/console patch	An effective way of connecting disparate systems with the possibility of different frequency bands
3	Mutual aid channels	Extends the communications range and allows connection to a console dispatcher
2	Talkaround	Provides interoperability where multiple radio users talk radio-to-radio on the same frequencies
1	Swap radios	The simplest and most basic method to physically exchange radios with other agencies involved in an event

Table 4.1 – APCO six levels of interoperability

[19] http://isb.wa.gov/committees/siec/publications/Communications.pdf

[20] http://www.isb.wa.gov/committees/siec/publications/SAR_Final_081005.pdf
[21] http://www.apcointl.org/about/gov/HSTFWP.pdf

4.2 SAFECOM levels of interoperability

SAFECOM's Interoperability Continuum[22] (Figure 1.1) describes five critical elements for success in planning and implementing interoperability solutions. Within the technology continuum, SAFECOM has defined a slightly different method of characterizing levels of interoperability ranging from minimum to optimal levels as described in Table 4.2.

SAFECOM levels of technology interoperability
Swap radios – Swapping radios, or maintaining a cache of standby radios, is an age-old solution that is time-consuming, management-intensive, and may only provide limited results due to channel availability.
Gateway – Gateways retransmit across multiple frequency bands providing an interim interoperability solution as agencies move toward shared systems. However, gateways are inefficient in that they require twice as much spectrum because each participating agency must use at least one channel in each band per common talk path, and because they are tailored for communications within the geographic coverage area common to all participating systems.
Shared channels – Interoperability is promoted when agencies share a common frequency band, air interface (analog or digital), and are able to agree on common channels. However, the general frequency congestion that exists across the United States can place severe restrictions on the number of independent interoperability talk paths available in some bands.
Proprietary shared systems and standards-based shared systems – Regional shared systems are the optimal solution to interoperability. While proprietary systems limit the user's choice of product with regard to manufacturer and competitive procurement, standards-based shared systems promote competitive procurement and a wide selection of products to meet specific user needs. With proper planning of the talk group architecture, interoperability is provided as a byproduct of system design, creating an optimal technology solution.

Table 4.2 – SAFECOM levels of technology interoperability

[22] Interoperability Continuum, A tool for improving public safety communications and interoperability, http://www.safecomprogram.gov/SAFECOM/tools/

4.3 Technical architecture

The technical architecture is based upon the use of multiple subsystems and is designed around the SIEC guiding principle of "building wisely, building once and sharing often." It is an open standards-based solution that does not mandate a single-frequency band-based solution, but instead leverages the state's existing radio systems operating in different bands. It provides a phased migration to common air protocols based on Project 25 (P25) standards.

This architecture satisfies the needs of the state agencies and supports delivery of the voice and data communications desired in statewide public safety land mobile radio systems. Furthermore, the architecture also incorporates additional mutual aid resources across the state for enhanced interoperability between state, federal and local agencies. This includes the deployment of mutual aid channels across the state in VHF low band (30-50 MHz), UHF (450-470 MHz), VHF high band (136-174 MHz) and 700/800 (764-869 MHz) frequency ranges; as well as radio gateways to provide additional methods of connecting to federal, state, local and tribal agency radio system users

4.3.1 Architecture overview

The multiple subsystems architecture is an integrated "system of subsystems" standards-based design incorporating both analog and digital radio system capabilities. While there is common functionality that is provided by the technology platform, each agency's radio system is designed based on the functional requirements of its users. To clarify terminology, each agency's radio system is considered a subsystem of the overall architecture. It is designed to accommodate two primary wide area voice radio subsystems in the VHF high band (136-174 MHz) and 700/800 (764-869 MHz) bands. These two bands are the most widely used by state and local government agencies but the architecture is expandable to incorporate other bands as well.

The design utilizes an integrated network of radio frequency (RF) transmitter sites, transport mechanisms, interfaces and switches connected together through one or more centralized radio network control centers to provide direct interoperability between users on each of these subsystems. The two primary wide area voice radio subsystems, in the VHF high band and 700/800 MHz bands, would use trunked simulcast or multicast and conventional digital P25 channels to provide wide area radio coverage to participating agencies.

The architecture also includes the infrastructure for providing wide area, P25 low speed as well as medium speed mobile data capabilities. Intersystem transport of data and voice traffic would be provided over state-owned and/or provided digital transport networks which could include digital microwave, fiber optic, leased line or satellite communications links. Agencies operating on the voice and data wide

area subsystems would realize level 6 interoperability using the APCO definition and level 5 according to the SAFECOM definition.

The complexity of the multiple subsystems architecture would require, at a minimum, the centralization and consolidation of control, management and maintenance functions for the common, shared infrastructure equipment. This includes microwave transport, voice and data central controller equipment, mutual aid systems, Radio over Internet Protocol (RoIP) systems and network management equipment. Furthermore, the state would be required to manage state licensed radio spectrum on a centralized basis for the benefit of all agencies. This centralized frequency management approach is necessary to realize sufficient channels for effective deployment of the multiple subsystems architecture.

RoIP

A RoIP network would supply additional connections for interoperability with federal, state, tribal, and local agency radio system users who are not participants (at this time) in the proposed system. This system would use radios provided by these other agencies or the state to establish dedicated or on demand communications links between the proposed radio system and the systems used by these other agencies. During the implementation of the wide area subsystems, the RoIP network would also provide interim, immediate improvements in the ability of the existing state agency systems to interoperate while transitioning to the proposed system. Existing state-owned audio gateways could be redeployed for use as tactical on site interoperability solutions in remote areas utilizing RoIP connections via deployable satellite or terrestrial links to connect onsite communications into the wide area radio system.

The RoIP system would provide APCO level 4 or SAFECOM level 2 interoperability between agencies interconnected on the RoIP network.

Analog mutual aid

Analog mutual aid channels in Low band (30-50 MHz), UHF (450-470 MHz), VHF and 800 bands would also be deployed throughout the state as part of this solution. This additional mutual aid channel capability would provide other agencies with direct access to state agencies and dispatch centers, but is limited to when those other agencies' radios are operating within the coverage area provided by this mutual aid network. Mutual aid channels may be connected via the RoIP system, as part of the wide area voice radio subsystems, or as separate and distinct conventional channels in each region.

The final method of connection will be dependent on overall bandwidth restrictions as well as final system design plans and could vary by region. The state should also assume a lead role in implementing 700 MHz mutual aid

channels as systems are deployed in this band. Agencies would achieve level 3 interoperability, in both the APCO and SAFECOM definitions, when using the mutual aid channel network.

Mobile data

The mobile data portion of the architecture would be deployed and capable of operating at either low or medium speed data rates in the VHF or 700/800 MHz bands depending on radio site coverage and frequency availability. The system could also utilize a satellite-based system where/when terrestrial connectivity is not available.

Low speed data capabilities would be available at all sites at the low speed data rate specified in the P25 standard (9600 bps). Medium speed data capabilities would be available at all but the most remote sites and would be deployed in accordance with the wideband data standards established by the Telecommunications Industry Association (TIA) in the TIA 902 series of documents. Since TIA 902 is a relatively new set of standards, equipment capable of operating within these standards may not be widely available during the initial system procurement. Therefore, any mobile data equipment purchased without this capability should be upgradeable to this standard at some future date. Medium speed data rates using this standard will vary between 76.8 Kbps and 264 Kbps based on channel bandwidth and modulation schemes. All mobile data channels would be connected back to the radio network control centers for traffic routing and control.

A typical mobile data subscriber equipment configuration is depicted in Figure 4.1 below.

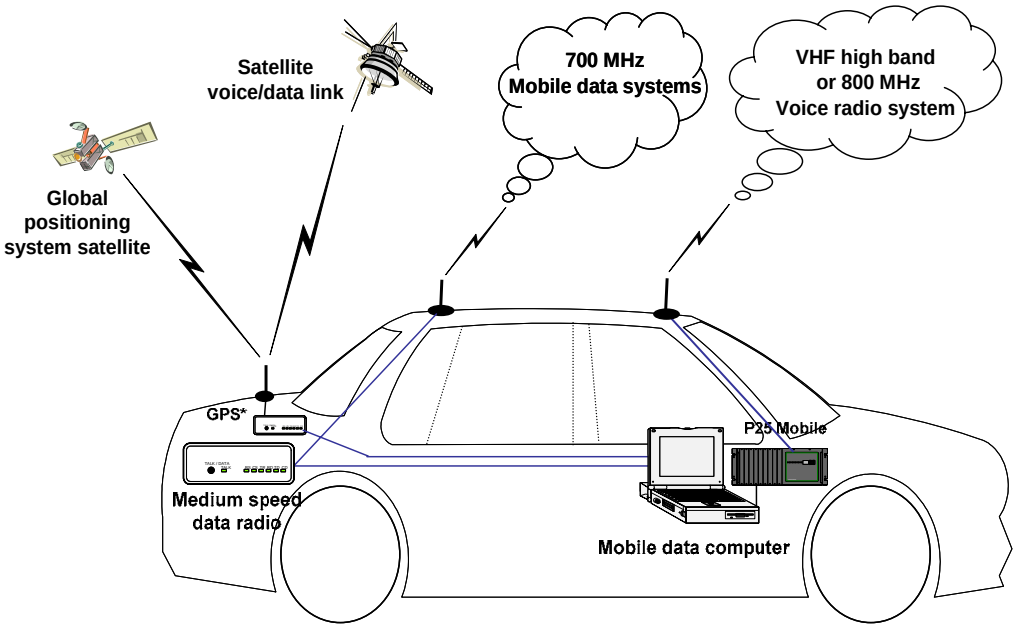


Figure 4.1 – Typical mobile data equipment configuration

4.3.2 Components

The multiple subsystems architecture is organized into several sets of component building blocks:

- **Radio frequency sites** – are a mixture of 150 small, medium and high density radio sites[23] that are sized based on frequency availability, tower site constraints, transport bandwidth availability and user needs.
- **Radio dispatch centers** – include the 39 small- and medium-sized radio dispatch centers[24] currently operated and maintained by participating state agencies.
- **Radio network control centers** – are centrally managed and maintained for primary and backup radio network control. These centers will perform voice and data routing for the wide area voice, data and mutual aid channels, RoIP system routing, overall system control, network security and network management functions.
- **Subscriber equipment** – are the portable and mobile, voice and data subscriber radio equipment that are compatible with the system infrastructure and are owned, operated and maintained by the participating agencies.
- **Support infrastructure** – include towers, shelters, emergency and standby power, and digital transport systems.

Figure 4.2 displays the multiple subsystems conceptual system architecture.

[23] For an explanation of the variable density concept for radios sites please refer to Appendix E.

[24] Small dispatch centers would include 1-2 radio dispatch consoles while medium dispatch centers would include 3-8 radio dispatch console. Currently none of the state agency dispatch centers include more than 8 radio dispatch consoles.

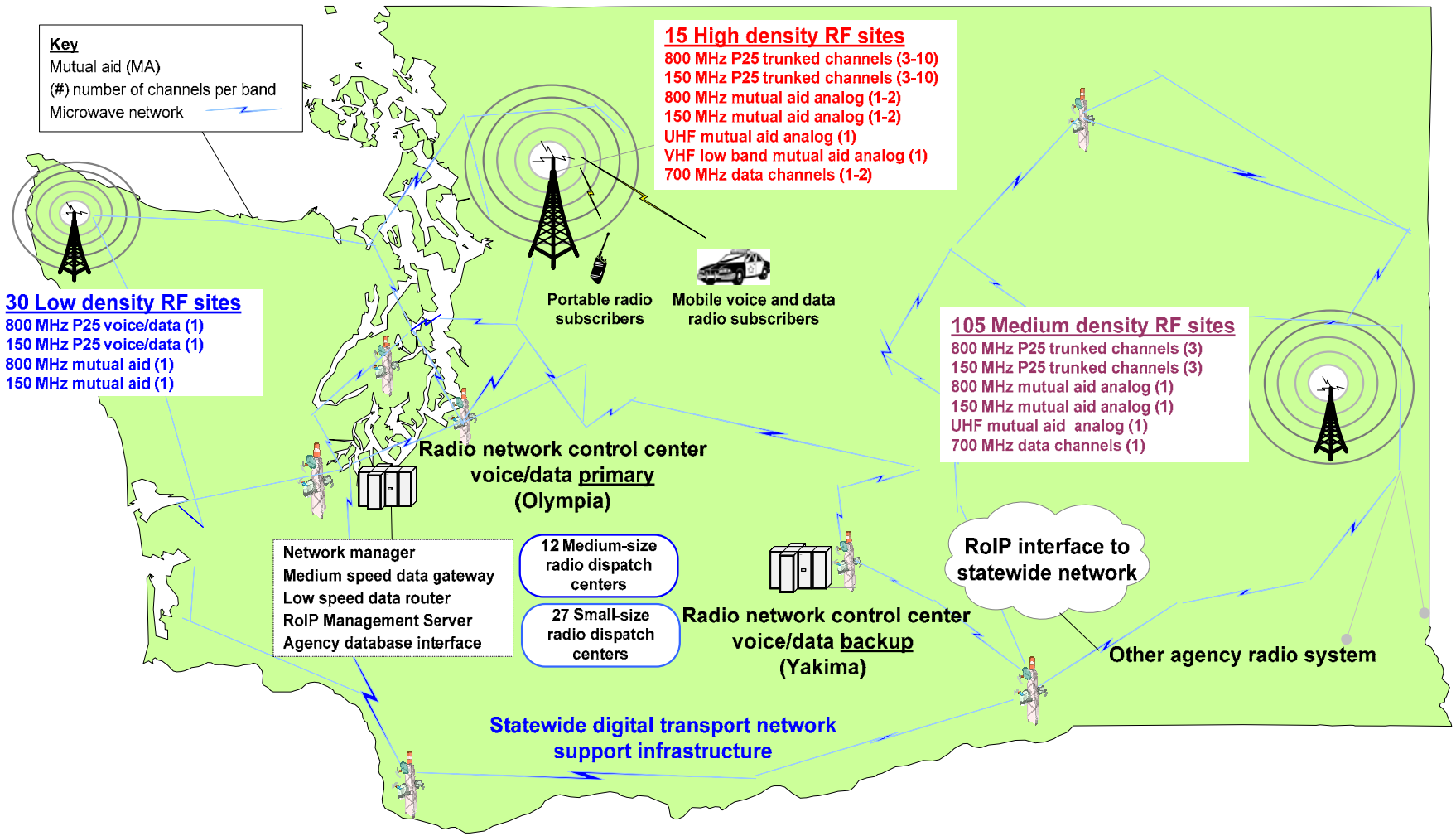


Figure 4.2 – Conceptual view of the architecture components

Figure 4.3 below displays a view of the architecture building block specifications.

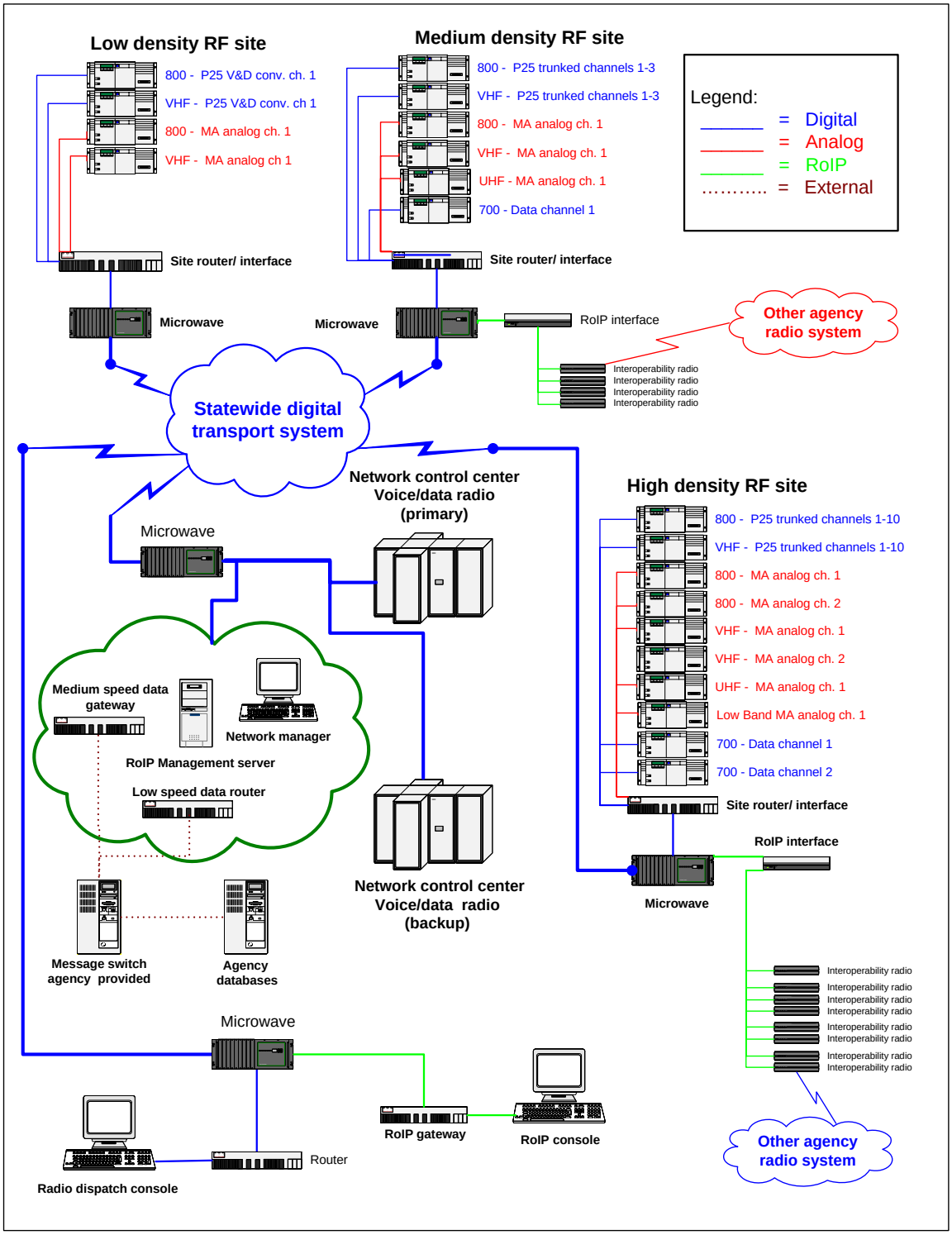


Figure 4.3 – Multiple subsystems building block specifications

4.4 Support infrastructure requirements

In addition to the radio communications and control equipment required to deploy the multiple subsystems architecture, additional supporting infrastructure will also be required. This additional infrastructure includes items such as equipment buildings and tower site improvements as well as upgrades and enhancements to statewide digital transport systems. To minimize overall costs, existing state owned and/or managed sites would be used wherever possible or the state may evaluate partnering with other agencies with towers in areas where the state desires coverage. This may lead to some consolidation in the overall number of sites needed by state agencies for radio communications.

4.4.1 Equipment buildings and tower sites

One of the primary design assumptions for the conceptual system architecture was that all RF sites required for deployment are, or will be made capable of supporting the equipment proposed in the system architecture. During the development of the *Alternatives Report*[25], state agencies identified 81 sites that would need additional site work to bring them into compliance with currently accepted standards for radio sites.

A typical radio tower site

These site costs, as well as the costs to develop two new sites for use as the primary and backup radio network control centers, are included in the report.

Typical site improvements for existing tower sites consist of structural modifications including site hardening, providing standby and emergency power, upgraded electrical service and site grounding, equipment building expansion and rework, etc., that is required in order to meet the specifications of a high availability public safety radio system.

4.4.2 Statewide digital transport systems

The system architecture described in this report requires significant digital transport capacity. Three additional primary design assumptions regarding the state's digital transport systems were made early in the conceptual design:

1. All transport paths would be capable of supporting digital data transmissions (digital microwave or equivalent).

[25] http://www.isb.wa.gov/committees/siec/publications/AlternativesReport052005FINAL.pdf

2. Adequate transport capacity exists (capacity requirements defined in *Systems Architecture Report*) or will be built by the state for the proposed system architecture. Satellite communications could be considered for areas where microwave or terrestrial backhaul is not available. The Washington State Patrol has several microwave transport upgrade projects underway or under consideration.
3. Transport capacity provided by the current planning efforts will be available to support the proposed system. For example, the Integrated Wireless Network (IWN) is a joint venture between the Department of Homeland Security, Department of Justice (DOJ), and the Department of the Treasury. DOJ is working with state agencies such as the Washington State Patrol (WSP) and the Washington State Department of Transportation (WSDOT). WSP is partnering with the DOJ on constructing a high-speed digital microwave transport network. DOJ is providing funding for equipment in exchange for service.

4.5 Frequency management considerations

Implementing the multiple subsystems architecture will require significant changes to existing policies, procedures and practices, particularly in the area of frequency management. There are three primary areas of concern within frequency management that will require special attention to successfully implement the multiple subsystems architecture.

4.5.1 Radio frequency considerations

Although there is a wide spectrum of radio frequencies that has been made available for public safety use (Figure 4.4), the number of frequencies available within this range is very limited. Centralized frequency planning and coordination is necessary for the state to implement the number of channels required by the multiple subsystems architecture. Sharing and reuse of existing frequencies across all state agencies is vital in the VHF and 800 MHz bands.

A critical success factor

Developing comprehensive frequency sharing, reuse coordination and licensing plans is critical to the long-term goals for communications interoperability and the day-to-day operations of state agencies. This is a very detailed planning effort that should be started now by conducting an inventory of all state licensed and eligible spectrum, and coordinating available spectrum for the use and benefit of all state agencies. Further, the state should partner with local, federal and tribal entities wherever possible to aggregate and utilize available spectrum to establish mutually beneficial frequency utilization plans. This will prepare the state to move forward quickly once the detailed system design and implementation plans are finalized through a procurement process.

While state agencies have independently been developing plans and processes to address FCC-mandated spectrum reconfigurations, these plans should be coordinated with the detailed system implementation plans for the proposed system to avoid any potential duplication of efforts and resources. Every effort should be made to ensure that equipment replacement and upgrades required to meet the narrowbanding deadlines are performed in a manner consistent with the proposed system architecture.

Recent treaty agreements with Canada[26] have also helped to clarify the potential use of the 700 MHz spectrum in border areas. The prospect of using dedicated spectrum allocated for statewide systems[27] is extremely compelling. The state already holds a license for 2.4 MHz of 700 MHz spectrum, all narrowband channels, dedicated by the FCC for statewide, geographic-area licenses.[28]

A significant and dedicated effort to explore the use of this spectrum should be performed by the centralized, consolidated frequency manager in conjunction with the Region 43 700 MHz Regional Planning Committee. This spectrum could be utilized as a supplement to the 800 MHz spectrum already licensed by the state or could be implemented as the primary band for state agencies currently operating at 800 MHz to ease transition to the proposed system.

[26] This agreement was reached on June 20, 2005. The full text of the agreement is available on the FCC Web site at http://www.fcc.gov/ib/sand/agree/files/can-nb/764_806.pdf

[27] http://wireless.fcc.gov/publicsafety/700MHz/state.html and http://hraunfoss.fcc.gov/edocs_public/attachmatch/DA-01-406A1.pdf

[28] Licensed under callsign WPTZ781

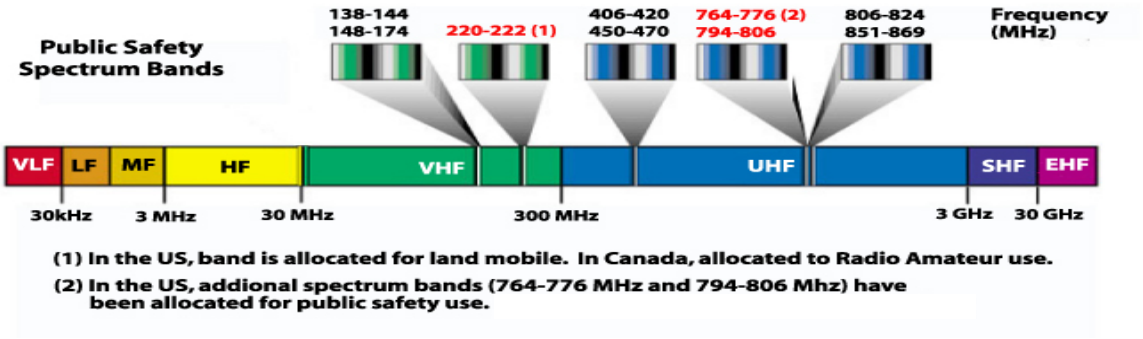


Figure 4.4 – Public safety spectrum bands

4.5.2 Rebanding considerations for 800 MHz frequencies

State agencies currently using 800 MHz frequencies are faced with a significant logistical exercise of "rebanding" their existing 800 MHz channels as part of an FCC initiative[29] to eliminate harmful interference to public safety systems caused by commercial wireless carriers.

It is likely that the agencies affected by rebanding will be required to replace and or retune significant portions of their infrastructures and subscribers in order to operate in this reconfigured 800 MHz spectrum. This retuning or replacement of equipment is slated to be performed at no cost to the public safety licensee, all costs being paid out of relocation monies set aside by a commercial wireless carrier. A primary consideration in this process is that the retuning or replacement of equipment shall only be done to provide facilities and equipment comparable to the existing facilities and equipment of the public safety licensee.

Funds to provide enhanced facilities or equipment will not be covered as part of this reconfiguration. Where replacement of equipment is required, the state should make every effort to receive equipment that would be capable of or upgradeable to operation on the P25 standards-based platform intended to be deployed as part of the proposed system. The incremental costs to upgrade the direct replacement equipment during the 800 MHz rebanding process would be significantly less than purchasing new P25 replacement equipment at a later date – provided that state funds can be made available during this window of opportunity.

4.5.3 Narrowbanding Considerations

Radio systems currently operating on VHF and UHF systems will be affected by a recent FCC Report and Order whereby all channels in these bands will have to

[29] http://wireless.fcc.gov/publicsafety/800MHz/bandreconfiguration/index2.html

move to narrower bandwidths in order to promote higher spectrum efficiency. This process is now commonly referred to as “narrowbanding” or “refarming.” [30]

In essence, this action by the FCC creates a timeline under which all current radio users in the VHF and UHF bands must modify their systems to operate on narrowband channels by January 1, 2013. The resulting reduction in the operating bandwidth of these channels may result in an overall reduction in coverage for systems continuing to operate in an analog mode after narrowbanding. Many state, local and federal agencies are planning to purchase or have purchased radios that are upgradeable to or capable of P25 digital operation. Radios operating in a P25 digital format on narrowband channels have been shown to have generally similar coverage to analog wideband channels, all other system parameters being equal.

[30] http://www.npstc.org/documents/Narrowbanding%20Fact%20Sheet.pdf

5 Governance

Building a new radio system to serve the needs of the state's public safety agencies is a significant challenge that necessitates a long-term planning, design, implementation, and maintenance effort. The complexity of the multiple subsystems architecture will require a high degree of both project and system management in order for the system to operate effectively and provide the desired benefits to all participating agencies.

Ultimately, the success of a project of this magnitude will require a process of continuous communications, coordination, planning and management usually referred to as governance.

Best practices

The National Governors Association (NGA) Center for Best Practices stated in the issue brief, *Achieving Statewide Public Safety Wireless Interoperability*:

"The governance structure is instrumental to building out an interoperable communications system. Not only does the governance structure solidify relationships and bring various stakeholders to the table, this body provides a vehicle for exploring innovative technologies and potential funding to achieve a given jurisdiction's vision of interoperability.

Including local representation on the governance body and in the interoperability planning process is critical. The state governance board that oversees the development of public safety communications needs to include the local public safety agency requirements for emergency communications."

States that have successfully built or are building statewide, multi-jurisdictional and multi-discipline public safety radio systems were researched on the question of governance. Some of the resulting organizations were formed through legislation, some were created by executive order and still others were developed on an *ad-hoc* basis. Regardless of how they were created, they share a common mission of ensuring that the public safety communications systems under their jurisdiction work well and are interoperable.

Examples of successful projects and the oversight structures employed by other states are included in Appendix D. These examples are based on conversations with many state representatives, supplemented by information gathered by the National Governors Association Center for Best Practices in Washington, D.C.

There are numerous models used for interoperable radio system governance at the state and local levels. But despite the differences in the models, there are several similar characteristics that are apparent in the majority of these structures:

- Due to the complexities of multiple independent agencies attempting to collectively manage a shared system, a single entity is usually selected to oversee and manage the system. In many cases, this entity has ownership of either the common shared components of the system or the entire system. Management may include actual fiduciary responsibilities as well as control responsibilities, depending on the legislative/legal issues involved.
- Strong sponsorship from the highest levels is required for the governance structure to be imbued with sufficient credibility and authority to be effective.
- The development and refinement of operating policies and procedures is a dynamic process influenced by advancement in technology, lessons learned during and after implementation as well as changes in user agency missions and priorities.

Governance strategies

The National Governors Association for Best Practices noted in the issue brief *Strategies for States to Achieve Public Safety Wireless Interoperability*:

"The need for a coordinating body is clear. However, the reality is that many public safety agencies are reluctant to cede management and control of their communications systems due to disparate agency missions and jurisdictional responsibilities. Interoperability requires shared management, control, policies, and procedures. While it may appear to be a technical issue, interoperability has more to do with establishing trust and buy-in among stakeholders."

This brief goes on to state that:

"Governors can use the following strategies and best practices to achieve statewide interoperability:

• institutionalize a governance structure that fosters collaborative planning among local, state, and federal government agencies;

• encourage the development of flexible and open architecture and standards;

• support funding for public safety agencies that work to achieve interoperability and reject agency budgets that do not include interoperable solutions; and

• support the efforts of the public safety community in working with the FCC to allocate ample spectrum for public safety and create contiguous bands for public safety spectrum."

5.1 Governance processes

Defining a governance structure for the proposed system is as critical an element to the success of the system as the technical architecture. Governance, in this case, will include the processes of:

- Strategic planning, standards and policy development
- Asset ownership (land, towers, buildings, base stations, dispatch consoles, subscriber units, etc.)
- System management and operation
- Maintenance

The multiple subsystems architecture is not dependent on any particular governance process, as it is based on the needs of the users rather than an organizational approach.

The following sections will address the options considered for each of these processes.

5.1.1 Strategic planning, standards and policy development

These processes are currently supported by the SIEC and its associated workgroups and the proposed system architecture does not require that this be changed. The current structure could continue, with periodic review of membership and charter as the SIEC feels appropriate.

5.1.2 Asset ownership

The physical ownership of all the assets used in the current radio systems is specific to each of the agencies utilizing these systems. Migration to the proposed system does not require that a single agency own all of the assets of the system.

The following highlights the salient ownership issues that need to be considered:

- Real estate assets in particular (land, buildings, and towers) could easily continue to remain with the agency where they currently reside with the appropriate site use agreements and/or financial arrangements for inter-agency use of assets, in line with the relevant legislative and constitutional requirements.

- The voice and data radio base stations, site controllers and supporting site equipment used at each tower site in the proposed system could be owned in a centralized or decentralized manner consistent with the approach to system management and operation that is determined for the proposed system.

- Ownership of the equipment used at radio dispatch centers and subscriber voice and data radios used to access the multiple subsystems architecture could remain within the current agencies.

- Ownership of the core or common radio system assets of the proposed architecture such as central voice and data network controllers, mutual aid channels, RoIP gateways and digital system transport systems should ideally be assigned to one entity to provide a single point of contact for interoperability concerns and a consistent interface to the separate subsystem participants.

5.1.3 System management and operation

The system management and operation processes are currently handled within each agency for their own subsystems. There are sharing agreements between several agencies for microwave transport, tower site use and channel access. Decisions on radio system coverage, system capabilities and features, and all technology purchases are made by each agency independently.

The options considered for system management and operation are:

1. **Continue the current approach** where individual state agencies would continue to work and manage their systems/assets independently.

2. **Designate an existing or new state agency** to own, operate and manage the proposed system (lead agency structure).

3. **Establish a separate multi-agency/jurisdiction governance board** with full authority and responsibility to own, operate, and manage the proposed system (governance board structure).

1. Continue the current approach

There is a strong feeling within the existing agencies that each agency needs to be individually accountable for the services provided to their end users, and that the only sure way to provide that level of service is to manage it themselves. This approach would maintain the status quo of how the multiple subsystems are governed on a decentralized basis. It is possible to continue these arrangements for the proposed system, where each agency would manage their subsystem's operation independently.

Advantages:

- No change to existing inter-agency agreements
- Little to no change to how funds are generated or allocated
- No change in accountability at the agency level for their internal services or for the services provided to other agencies through existing agreements

In order to have some consistency in approach and strategy, each agency would be required by the SIEC to provide a five- to ten-year plan describing their system plans and interoperability processes, which would then be approved by the SIEC. This plan would need to be approved by the SIEC prior to the implementation of any additional enhancements.

However, there are new elements to the multiple subsystems architecture that would be used by all agencies and would need to be assigned to one of the state agencies to manage on behalf of the overall proposed system. These elements include the operations and maintenance of the central voice and data network controllers, mutual aid channels, RoIP gateways and digital system transport systems. Each of these elements would potentially interface with each state agency subsystem and would require a substantial amount of coordination for effective operation and management.

Capacity management of the central switches, the RoIP subsystem, and the links to each agency subsystem would also need to be coordinated with the activities of each agency. Changes in trunking, talk groups and other features would need to be coordinated so that the capabilities of the central switches could be maximized and users are given system access required to execute their missions. Careful change control, clear resource allocation rules, maintenance polices and naming conventions would have to be followed and monitored in order to prevent system-wide service disruptions.

Disadvantages:

- Processes to more closely coordinate change activity and planning between the agencies would need to be developed, and the behavioral/cultural factors that have historically allowed for each agency to act solely on their own would have to change.
- The risk of impacting the overall systems is much higher with this approach since changes made by one agency could affect not only their own agency but the shared components as well.
- These new processes and coordination mechanisms would most likely require additional time and resources from what is in place today, and should be established long before the actual procurement process starts.
- The use of separate agency-owned subsystems may not provide consistent statewide radio coverage or roaming capabilities to all state agencies.
- Budgeting and funding for enterprise/shared infrastructure would need to be integrated with the existing funding and budgeting processes.

2. Lead agency structure

Under this alternative, the overall planning, technical oversight and management of the proposed system would be assigned to a lead state agency. In conjunction with the SIEC, the lead organization would establish advisory and user group committees to ensure broad-based participation from user agencies as well as other state, local, tribal and federal interests.

Advantages:

- The responsibility for the development and leadership for the proposed system would be clearly defined and would result in direct accountability for system performance.
- Appropriations and funding could be directed to the lead state agency whose executive leadership would report directly to the governor.
- Utilizing an existing state agency would reduce the start-up difficulties and lead time associated with establishing new administrative processes and procedures.

Disadvantages:

- Designation of an existing state agency as the lead may not be perceived as a positive measure by other state, local or federal agencies depending on their track record of collaboration with these agencies.
- There is a significant amount of effort involved to migrate from the current mode of operation to this approach, including building credibility as well as the human resources and budgeting considerations.

3. Governance board structure

Under this alternative, the overall planning, technical oversight and management of the state public safety radio system would be assigned to a newly created state radio system board. Members could include representatives of the state agencies utilizing the systems as well as representatives of other state, local, tribal and federal agencies. The diversity of membership helps reinforce the goals of maximizing interoperability across all participating entities. The board would be vested with the powers of a state agency, such as the power to enter into contracts, develop and maintain a budget, employ staff, etc. This approach has been used successfully by other state and local communities.

Advantages:

- A state radio system board would provide a single statewide focal point for leadership and coordination of interoperable radio communications.
- Diverse representation and widespread participation in policy matters could garner widespread support of the proposed system concept.

- Decisions would include more local involvement, resulting from participation and "buy in" by individuals with closer ties to various agencies specific needs and concerns.

Disadvantages:

- Consensus decisions by a large board may be difficult to realize.
- Creation of a new structure, with the subsequent development of the requisite policies and procedures could significantly delay implementation of the proposed system and the resulting improvements in interoperability.
- There may be legal issues with non-state agency representatives participating in funding/governance decisions that affect the state system.

The SIEC completed an analysis how each of these alternatives align with both the Enterprise Architecture principles and the SIEC Guiding Principles. The results of the analysis indicated that the best fit was with the "lead agency" model, followed closely by the "governance board structure" model. Details of this analysis are shown in Appendix H.

5.1.4 Maintenance

The maintenance approach for the multiple subsystems architecture could include two primary alternatives:

- Self-maintained (with some degree of vendor/radio shop support)
- Outsource to a service provider

There is a strong adverse opinion in most public safety organizations to rely totally on an outside vendor for all maintenance and support. This approach is much more the exception than the rule for statewide systems. The recommended approach is that the state would perform the system maintenance using primarily internal resources, supplemented by vendor-provided maintenance contracts where appropriate. During the procurement process for the proposed system, the state could ask for proposals for an outsourced approach and evaluate it based on the cost and risk factors that are presented by the vendors.

5.2 A recommended organizational approach for the proposed system

Increasingly, governance bodies for state-owned interoperable radio systems are being established through the planning and coordination efforts of a State Interoperability Executive Committee (SIEC). Based on the experience and credibility established to date, it is recommended that the SIEC in Washington act as the guiding authority for the operation and management of the common and shared infrastructure components of the proposed system. These components would include base stations, repeaters, towers, backbone communications and the two network control centers. The day-to-day responsibilities of system operations and management would ultimately reside with a single, "lead" agency. However, the near-term focus of this agency should be to maximize the immediate improvements in interoperability between the state agencies and the local, tribal, and federal agencies. The planning, policy development, and process definition work to support the short-term and long-term responsibilities of the lead agency would also be a priority work effort. While these efforts are underway, the existing agencies would continue to be responsible for the day-to-day operation of their radio systems. Responsibility for dispatch centers and subscriber units would remain the responsibility of each agency in both the short- and long-term.

If an existing agency is selected as the lead agency, it should retain its constitutional structure at least for the short term. This will allow normal financial and human resources policies and processes to be utilized until a better need-for-change assessment has been completed. In coordination with the SIEC, escalation for service, financial or human resource issues would follow the normal management hierarchy of the lead agency. A senior management team member of the lead agency should be a member of the SIEC.

5.2.1 Centralized radio system management

One key to a successful proposed system implementation and operation will be centralizing the management of the systems. Separate, distinct and uncoordinated management of separate systems will not work in the complex technical environment of the multiple subsystems architecture.

The intricacies of multiple independent agencies attempting to collectively implement and maintain a shared communications infrastructure have led many states to select a single organization to perform these roles. This approach provides direct accountability for system performance as well as a singular focus on providing critical public safety radio services.

Centralization would also lead to more consistent access to public safety communications resources, increases in overall capacity for first responder

communications due to sharing of resources and elimination of duplicated or overlapping facilities.

The increase in capabilities and functionality of the architecture also demand a higher reliance on conformance to standards and shared system policies. This is a distinct departure from the current practice of each agency planning and operating a separate and distinct radio system primarily based on the needs and policies of their own agency.

Primary to the success of centralized system management will be developing collaborative and cooperative processes by which each participating agency will have a voice in the planning, procurement, implementation and management of the proposed system.

5.2.2 Role of the lead agency

There are many complex issues that the lead agency, under direction from the SIEC, would need to address, particularly in terms of the financial and human resource issues identified in this section. The lead agency would manage the procurement, construction, implementation, and operation of the shared infrastructure components of the multiple subsystems architecture.

This single-agency approach assigns ultimate responsibility for all aspects of the radio network control centers and support equipment. This agency would provide or contract with other local, tribal and federal agencies or vendors to provide the tower sites and intersystem transport required for deploying the remainder of the proposed system.

The transition to the lead agency structure would be a gradual one, based on the need to provide centralized management of the technology and personnel resources that support common interoperability functions. Initially, it is important to designate that the lead agency is the ultimate goal so that there is a clear direction and strategy. The short-term responsibilities of the lead agency would be to:

- Develop the detailed implementation plans for the next phases of the overall multiple subsystems architecture approach
- Implement a centralized frequency management plan and capabilities for all state agencies, and where possible include local and tribal agencies
- Start to develop the operational and governance processes and policies that will be necessary to support the future method of operating

The lead agency does not imply a unilateral decision making process that ignores the inputs and needs of the state agencies. It will be crucial for the SIEC

to insure that the lead agency develops the processes for soliciting and considering agency-specific needs and that there is a satisfactory process for vetting and approving the decisions that are made that could impact funding, system capabilities and service levels (including coverage) and system operations.

The lead agency would drive the overall planning and implementation plans for all future technology changes, working closely with the SIEC and the SAW Group. The new mutual aid capabilities would be managed by the lead agency as well.

The transition of the backbone planning and management responsibilities to the lead agency should be negotiated based on the status of any major expansion or upgrade efforts underway, but should take place before the implementation of the new agency-based P25 technology begins. As those new systems are implemented, management and operational functions for those systems would become part of the lead agency's responsibilities. The lead agency would negotiate with the existing agencies for the exact timing and resource requirements based on the agency-specific technology implementation plans. This would allow some flexibility to accommodate projects that are underway within an agency and would enable a phased approach bound by the implementation plans for the multiple subsystems architecture.

This phased approach will require close coordination between the SIEC, the existing agency radio system groups, and the lead agency for any changes to the existing systems that would take place over the planning and transition period. While the existing agencies would continue to plan the short-term changes to their systems, the lead agency should be involved in this planning so that those changes can be coordinated with the other changes being made for overall improvements in interoperability.

The actual transfer of asset ownership would take place based on accounting requirements and in tandem with the management and operations responsibilities unless further analysis of the detailed implementation plans favored a different approach. In cases where transferring assets would not be allowed, appropriate agreements (memorandums of agreement, etc.) would be developed as required.

Operations and maintenance of the agencies' subscriber radios and radio dispatch consoles would remain the responsibility of the individual agencies.

The lead agency will also act as the frequency manager for the state ensuring that all state licensed radio spectrum is used in the most efficient manner possible for the benefit of all state agencies. This would include working with other state, local, tribal and federal entities in conjunction with existing regional

planning committees to develop comprehensive frequency plans for statewide interoperability.

The lead agency would oversee several system operations and maintenance support groups, and work in concert with the SIEC Advisory Working (SAW) Group and the SIEC Strategic Advisory Funding Enterprise (SAFE) Working Group to achieve the goals set by the SIEC.

The lead agency would appoint a system manager to oversee the detailed design process and procurement of the new technologies. This position would also serve as the project manager during the system implementation phase and then transition to a network systems management role as regional subsystems come online and the subsystems progress into the operations and maintenance phase. The funding for this position should be addressed as soon as the decision to use the lead agency approach is made.

The SIEC would be responsible for setting policy and working with the lead agency to:

- Develop the organizational structures and system objectives
- Identify initial and recurring funding sources
- Approve system access policies and priorities
- Resolve disputes regarding system policies
- Develop cost recovery approaches for operations and maintenance

Operating under the direction of the SIEC, the lead agency will establish the appropriate accounting practices and structures for system revenues, expenses, and capital improvements.

5.2.3 Core competencies of the lead agency

The lead agency should have or be able to acquire certain core competencies in order to successfully implement and manage a project of this scope and type. These key characteristics would include:

1. In-depth knowledge of advanced wide area radio system technologies.
2. Comprehensive knowledge of digital transport systems and technologies.
3. Familiarity with the acquisition and maintenance of FCC licenses for wireless spectrum.
4. Ample experience with and success in securing federal grants for communications related projects.
5. Skill in working directly with state, local, tribal and federal agencies to develop effective communications plans.
6. Thorough understanding of the requirements for establishing and maintaining complex, wide area communications systems.

7. Demonstrated success in managing long-term technical projects.

As the new technology-based systems are implemented and the need for maintenance of the agency-based legacy systems is diminished, the existing personnel involved in maintaining these systems could be transferred, or assigned on a contract basis to the lead agency's support groups. The personnel required to maintain the agency-owned subscriber and dispatch equipment would remain within that agency. The negotiations for the selection of personnel and timing of such transfers would occur between the lead agency and the individual agencies, subject to SIEC oversight and guidance. This is obviously a very sensitive issue that would receive the highest degree of attention and planning.

5.2.4 System manager support organization

The system manager would acquire dedicated staff engaged in managing the operation and maintenance of the radio network control centers. The staff would also be responsible for operating other common infrastructure components of the multiple subsystems architecture on behalf of the participating agencies.

It is estimated that 20 additional new technical and support personnel would be required to operate and maintain the network control centers in the proposed systems as well as to support the additional mobile data, RoIP and mutual aid capabilities. The new staff would be in addition to the 74 personnel who are currently directly employed by the state agencies supporting existing or legacy systems.

The lead agency system manager would provide, or contract with others to provide, the services necessary to support the new radio system in three distinct areas. These groups would report to and coordinate all system maintenance activities with the system manager:

1. The **Land Mobile Radio Group** is responsible for the maintenance of base stations, site controllers and site interfaces used at remote radio sites that are interconnected to the radio network control centers.

2. The **Transport Systems Maintenance Group** is responsible for the maintenance of the telecommunications transport systems used to interconnect the remote radio sites and radio network control centers.

3. The **Facility Maintenance Group** is responsible for the maintenance of the towers, buildings and ancillary support systems used at all facilities.

5.2.5 Working group support

The lead agency would also work in concert with all committees and working groups of the SIEC to address the details of system implementation and operations related to funding and financing, and system management. A close working relationship between the lead agency and the SIEC working groups will ensure that the public safety communications interests in the state are adequately represented.

The SAW Group, in particular, would work in conjunction with the lead agency and designated system manager to refine the system design as well as to develop and implement the operational policies and procedures for the system. This would include developing maintenance and operations standards as well as configuration management policies and naming conventions.

Once the proposed system is operational in each region, separate user groups may be established for advising the lead agency in developing further policies and procedures for operating and using the voice, data and radio dispatch components of the system.

5.3 People and resources

The state has considerable resources already devoted to maintaining existing radio communications systems and support mechanisms. The implementation of the proposed system will require additional staff dedicated to operations management and maintenance.

5.3.1 Staffing requirements

As existing or legacy systems are replaced with the proposed radio system, and as operations and maintenance responsibilities transition to the lead agency, the need for the existing personnel in the current agency to support those systems would diminish over time. Conversely, as the proposed system is brought online and direct vendor support diminishes when the warranty phase ends, the need for additional support personnel would increase. To meet the demand of technical support, the existing personnel within the participating agencies could be transferred or contracted to the proposed system support team. This would be done on an agency-specific basis subject to negotiations between each agency and the lead agency. Those personnel that are required for continued support of the agencies' subscriber radios and dispatch centers could continue in their current assignments.

Further, the state has developed considerable technical talent in managing tower sites, radio equipment and digital transport systems. These resources should be utilized in support of the proposed system to the greatest extent possible.

5.3.2 Education and training needs

The SIEC recognizes that technology alone will not solve the interoperability problems in the state. If public safety officers can't operate the equipment or are unfamiliar with the procedure to engage communications with other agencies during a mutual aid, multi-jurisdiction response, the investment in the system will never achieve the intended benefits. Therefore, the estimated costs for training staff during the initial system implementation and ongoing system support have been included in the cost plan. Although specific needs for staff training will be determined during the procurement phase, there are some general guidelines to follow.

Appendix F identifies operational practices and 12 training requirements to implement these process changes. Additional training costs have been factored into the cost estimates presented in Section 7.0.

SAFECOM's Interoperability Continuum (Figure 1.1) identifies five elements that must be addressed to develop a sophisticated interoperability solution. As expected, training is one of the critical elements. A comprehensive program of training and exercises that covers these five levels will facilitate a successful statewide solution.[31]

SAFECOM Interoperability Continuum
Training and exercises

- General orientation on equipment
- Single agency tabletop exercises for key field and support staff
- Multi-agency tabletop exercises for key field and support staff
- Multi-agency full functional exercise involving all staff
- Regular comprehensive regional training and exercises

5.4 Funding sources

The lead agency would become the focal point for the funding process of the proposed system. Through close coordination with the SIEC and the existing agencies, the lead agency would receive and allocate all funding appropriations for these new technologies and capabilities. This is obviously a complex process

[31] http://www.safecomprogram.gov/SAFECOM, *Interoperability Today*, Summer 2005 Volume Two

and a great deal of interaction will be necessary with the existing agency-based funding streams to insure that it is done properly and best reflects the priorities of the SIEC.

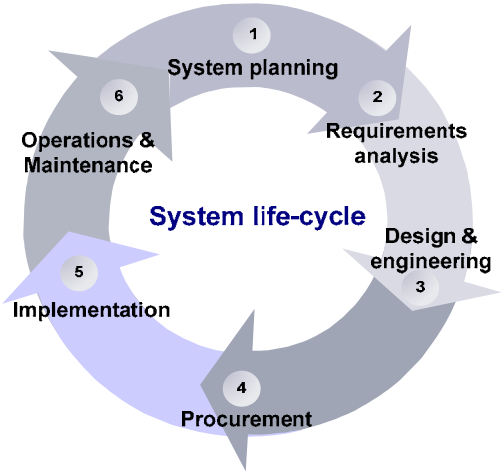
An obstacle to implementing shared radio system components in the past has been the separate and distinct funding sources used by the separate agencies to fund their radio systems. The rules that each agency has to operate under in regards to use of funds from different federal, state and local sources often precludes or severely inhibits the cooperative and innovative partnerships that would otherwise be possible. While it is unlikely that the federal funding source guidelines will be changed, the affected agencies (primarily WSDOT, WSP, and DNR) should determine the degree to which the current and future funding from those sources can be applied to this initiative.

Some procedures are already in place to enable one agency to provide services to other agencies, such as WSDOT's use of the WSP microwave backbone system. These mechanisms could be used to facilitate the interagency transfer of funds related to the provisions of these services. In some cases, careful consideration of the removal or modification of statutory obstacles to the sharing of resources and funding will be required.

Development of an ongoing coordinated funding process for implementing the proposed system is a prerequisite for the project to continue. In order for the funding to be utilized most efficiently, one organization should control those funds for the benefit of all the agencies participating in the proposed system. This control should have ample oversight and each agency, including potential federal and local partners, should have input into the use of those funds as systems are deployed in their regions or locales.

6 Implementation planning

Implementing a system such as described in this plan is an arduous task even under the best conditions. Undoubtedly there will be many technical, operational and funding challenges to overcome along the way. These will be further complicated by various resource and process issues that will surface when the state agencies transition from their existing independent modes of operation to the more centralized system-management approach. Fortunately, there are actions that the state can take now in planning to meet these challenges and set a course for a successful implementation.



Typical system life-cycle phases

This section describes the project management approach and implementation strategy that will guide the state through the detailed engineering, procurement, and system implementation phases of the project. The state requires a comprehensive plan that lays out the work ahead in a phased approach, based on a timeline that can be flexible enough to adjust to the state's ability to fund the project.

The project approach identifies the major activities required to operate and maintain the proposed system. These include a description of the policies and standard operating procedures needed to effectively operate and manage the voice radio and mobile data systems. This overall strategy is based on a proven systems engineering approach and addresses these key planning aspects:

- Project approach life-cycle plan
- Phased migration plan to implement recommended solutions
- Task plan and work breakdown structure
- Project organization
- Implementation schedule
- System management and administration
- Risk management

6.1 The overall approach

This plan is based on the approach described in the Department of Homeland Security SAFECOM program guide titled: *How-To Guide for Managing the Radio System Life Cycle*.[32]

The six-phase project methodology provides a road map for implementing the proposed system and has been followed to facilitate planning efforts to date. The phases are listed below along with the status:

1. System planning (ongoing phase)
2. Requirements analysis (completed phase)
3. Design and engineering (current phase)
4. Procurement (next phase)
5. Implementation (future phase)
6. Operations and maintenance (future phase)

6.1.1 Work completed or in progress

The first three phases of the lifecycle and the activities that have been performed lead up to developing this plan are described below.

Phase 1 – System planning

System planning is an ongoing activity that will continue throughout the duration of the project. The *High-Level Final Statewide Public Safety Communications Interoperability Plan*, December 2004, established the initial goals that have guided the initiative to date. This *Technical Implementation Plan* builds on the initial planning objectives and defines the conceptual design of the proposed system and sets the course for future phases with a focus on the system implementation. It should be expected, that once the system is procured and a specific vendor solution is confirmed, a detailed implementation plan will be prepared that specifies in detail the tasks for the system installation. Further, the SIEC should continue to monitor the effectiveness of the system implementation effort and renew the planning process on at least a bi-annual basis.

Phase 2 – Requirements analysis

Requirements were extracted from a series of information collection activities that occurred during October and November 2004, including stakeholder interviews,

[32]Many of the guidelines and tasks described in this section are contained in SAFECOM's *How To Manage Radio System Life Cycle, http://www.safecomprogram.gov/SAFECOM/library/systems/1048_HowTo.htm .*

statewide forums, and a Web-based survey. This information was then analyzed and interpreted as high-level system capabilities that were further defined into operational, functional, and system technical requirements as presented in the *System Capabilities and User Needs Report*, March 2005. These requirements were used as a baseline for developing and evaluating alternative architecture approaches that are described in the *Alternatives Report*, May 2005.

Phase 3 – Design and engineering

In June 2005, the SIEC reviewed the design characteristics of three technical and business architectures and selected the multiple subsystems approach as the model for designing the proposed system. The *System Architecture Report*, August 2005, describes the physical design specifications and conceptual architecture for a statewide voice and data communications system. It is expected that a final design and detailed engineering study will be performed by the vendor and the state once the state procures the system.

6.1.2 Planning for future phases

Based on the lifecycle planning model, the next three phases and their related work activities are described below.

Phase 4 – Procurement

It is expected that purchasing the proposed system equipment components and related services will be managed by the Washington State Department of General Administration (GA). Based on this assumption, the procurement strategy will follow GA's standard procedures and best practices for managing the competitive contracting process. Due to the size and complexity of this purchase, a team of subject matter experts from the system planning team would be assigned to work with GA throughout the system procurement cycle. Typical activities that are generally performed during the procurement process include, but are not limited, to the following:

- Work with the state procurement officer to develop the key documents required for a competitive contracting solicitation, including requests for proposal (RFP's).
- Evaluate vendor responses, which includes selecting vendors and negotiating work contracts.
- Establish contract management plans and tracking methods, including tools for tracking subcontract work results, project costs (planned and actual), and milestones and objectives.

- Prepare a realistic procurement plan that addresses new equipment installation and removal of legacy equipment if required.
- Conduct regular project review meetings to keep key stakeholders informed on system procurement status, issues, contract modifications, and resource needs.

It is possible that the existing Western States Contracting Alliance (WCSA) purchasing capabilities could be utilized, but the complexity and magnitude of this system would require detailed vendor engineering and planning that should be obtained through a competitive bidding process.

Phase 5 – Implementation

Because of the size and complexity of the system implementation effort, it is expected that this work will be jointly performed by the state and the selected vendor(s). If the implementation is to be performed primarily by the vendor(s), then the SIEC or lead organization will be needed to manage the entire implementation process. This oversight authority is a necessity to coordinate communications among the agencies and resolve issues. The basic functions and/or tasks required for implementing the LMR system include the following:

- Project management
- Technical solution construction/development, installation, and testing
- Site improvement and installation
- Procedural solution implementation
- System documentation
- Acceptance testing and performance evaluation
- System startup and deployment to agency users
- Education and training

Phase 6 – Operation and Maintenance

The specific tasks for performing system operations and maintenance (O&M) will be defined once a system is procured and a detailed system integration plan is developed. The list below includes common O&M activities that were considered for estimating the personnel staff requirements and cost estimates presented in Section 7. The O&M phase includes:

- Developing a system management plan that includes topics such as equipment assignments, radio programming, and managing dispatch operations.
- Developing and maintaining the talk group structure, monitoring system usage, and archiving system usage logs.
- Developing and maintaining an inventory management system.

- Tracking and maintaining tower and site permits.
- Developing and implementing a preventive maintenance plan (e.g., radios and switches).
- Developing operations and configuration management plans.
- Developing, implementing and testing disaster recovery plans.
- Monitoring and tracking system performance.
- Monitoring the regulatory environment for changes that affect the system.
- Establishing daily system administration policies and procedures.

6.2 A phased approach to implementing the recommended solution

To provide structure for this complex system implementation effort the project is organized into three architecture-driven segments:

- Short-term interoperability improvements
- Mutual aid improvements, architecture pilot, central network controller requirements, and statewide backbone capabilities
- Multiple subsystems radio site and subscriber unit components

The lessons learned from the recent hurricane disasters cause the need to put a higher emphasis on the ability to interoperate between state agencies and local, tribal, and federal agencies. This should be the first priority of the planning and implementation efforts. This improvement could occur through technology-based solutions, followed by the expanded mutual aid systems and the expanded backbone capabilities.

The next segment would address the mutual-aid subsystems, the central network control capabilities, a trial of the proposed P25 multiple subsystems architecture and the overall statewide microwave backbone network. While some planning has been done regarding mutual aid, and much has been done regarding the microwave capabilities, this planning effort will coordinate those efforts with the requirements for the short-term interoperability requirements. This segment will also provide a validation of the architecture and of the technologies and will provide valuable input to the planning for the overall implementation effort.

The final detailed planning process would address the requirements for implementing the recommended architecture. This planning effort will be done on an agency-specific basis, in coordination with any existing or other proposed changes to the agency-based systems.

Each of these three segments would include the following work efforts:

1. Detailed planning
2. Procurement

3. Implementation
4. Integration and testing
5. Operations and maintenance

Phase 1 – Detailed planning

The detailed planning phase should begin as soon as possible following the approval of the TIP, and is expected to continue throughout the duration of the system implementation effort. This phase provides ongoing planning and administrative oversight for all tasks, and also includes important pre-implementation activities.

The planning phases include the following tasks:

1. Obtain the required approvals on the TIP.
2. Execute next steps and recommendations as approved in the TIP.
3. Establish the final detailed governance structure and policies.
4. Develop a detailed risk management and mitigation plan.
5. Establish the system implementation team.
6. Develop the system administration and support plans.
7. Develop the funding plan for the overall phased approach to the system.
8. Develop an integration plan for the current agency-specific public safety communications projects underway.
9. Establish system configuration and change management procedures.
10. Conduct a comprehensive assessment of state-owned towers as well as local, federal or tribal owned towers that could be utilized in the system deployment.
11. Conduct a comprehensive assessment of state licensed and eligible spectrum.
12. Develop statewide frequency utilization plans in partnership with local, federal and tribal entities.
13. Hire a technical consultant to assist with the procurement phase.
14. Periodic evaluation of the system implementation progress toward established critical measurements points and milestones.
15. Develop and execute appropriate exit strategies should the project fail to meet the critical measurement points and milestones.

It will also be critical during the planning phase and at periodic intervals during the implementation process, to review the current and planned projects within each agency to assure that appropriate system configuration and change management procedures are followed.

Particular attention should be provided to agency-specific timing issues as well as validating that the functionality of the various proposed changes are compatible with the overall implementation plan.

Phase 2 – Procurement

Another administrative phase is the procurement phase. This phase also begins as soon as the TIP is approved and would be performed concurrent with the systems planning phase and last approximately 14 months. Tasks included on the procurement phase are:

1. Develop request for proposals (RFPs) for the proposed technology-based interoperability solution and for the overall system components.
2. Evaluate RFPs and responses.
3. Select system/vendor(s) for proposed system implementation.
4. Conduct contract negotiations.
5. Develop detailed system design.
6. Develop detailed system implementation plan.

Phase 3 – System implementation

The implementation of the overall multiple subsystem approach will take several years and a considerable amount of funding. Rather than put that effort in the critical path of substantial interoperability improvements, the first effort should be to find a technology and process solution that will make a large difference in a much shorter timeframe.

A target timeframe of six years has been established to complete all implementation activities.

The first priority should be on making significant improvements to the ability to interoperate between state agencies and local, tribal and federal agencies. While there is no guarantee that any of those agencies will take advantage of that capability, recent success in the Olympic Public Safety Communications Alliance Network (OPSCAN) project may help facilitate a high degree of interest and involvement.

The implementation plan should be first focused on the following activities as part of the detailed design process:

- Reconfirm the capabilities and gaps related to interoperability between state agencies and local/tribal/federal agencies.
- Prioritize those gaps through the SAW Group with representation from state, local, tribal, and federal agencies.
- Identify technology solutions that can provide the most benefit in the shortest amount of time. The most likely technologies to provide this

kind of a solution are gateway-based, and include a range of hardware and/or software-based capabilities.
- Choose a pilot area and procure and implement the proposed solution.
- Assess the results of the pilot, modify as required and deploy statewide.

This approach will maximize the ability to improve interoperability with the local, tribal, and federal agencies. It is anticipated that this first phase could be completed within 18 months of a decision to move ahead.

If the selected technology solution is something other than Radio over IP, then the next phase would be to provide Radio over IP across the state in order to facilitate additional interoperability between the state agencies as well as with the local, tribal and federal agencies.

The next, and perhaps concurrent phase, would be the expansion of the mutual aid capabilities. As the benefits from the expanded mutual aid capabilities begin immediately upon implementation, a plan that drives to an early implementation will result in earlier benefits. Close coordination would be required between these two planning efforts as well as with the potential local, tribal, and federal participants. This phase would take approximately 24 months and could be done in parallel with the immediate interoperability improvements.

A pilot of the proposed architecture should be done in order to validate the proof-of-concept and to insure that the proposed technologies operate as planned. This pilot would be limited to a small geographic area and would include representation from all participating state agencies. The detailed design of this pilot should be started concurrently with the other planning efforts. Multiple vendor approaches may be considered to provide confirmation of not only the architecture but its ability to support multiple vendors' equipment. This phase should be completed within 24 months in order to be able to complete the overall implementation within the six-year target timeframe.

The planning for the microwave backbone network should be done as the requirements for the short-term interoperability technology solution(s) are identified. This planning would be done in conjunction with the existing planning efforts underway for the backbone, including current expansion efforts and IWN.

The implementation of the primary and backup central controllers would be the next step in the implementation process. Planning for this phase can begin immediately, and implementation could begin after validation of the architecture is done through the pilot.

The last part of the planning process would be to address the implementation of the proposed system technologies in the agency-based systems, including the mobile data network as it shares the common infrastructure. These plans would

be done in conjunction with the existing agency planning efforts and would be driven to complete the overall implementation within a six-year timeframe from the SIEC's decision to move ahead, with the assumption that adequate funding will be available to support that timeframe. If adequate funding is not available, the overall planning effort would be modified to address what could be done to maximize the benefits for the funding that was provided.

This part of the implementation plan could be structured either by agency-specific implementation plans or by a geographically-based approach, such as by Homeland Security region. While high-level details of both approaches are shown below, the agency-specific implementation approach is recommended based on its ability to minimize the impact on each agency.

Agency-specific implementation

Each agency would develop a plan to migrate from their existing technologies to the proposed system in a way that best considers their internal requirements. While the SIEC would facilitate inter-agency discussions to minimize the duplication of visits to transmitter sites, it is likely that the implementation will result in some of this occurring. The advantage of this approach is that it allows each agency to customize the implementation and cutover to minimize the impact and risk to their users. The difficulty of planning for agency operations using different technologies over multiple geographic regions may be diminished with this approach, but based on the statewide nature of the agency systems, there will be some overlap required with the existing technologies. The common operational processes and policies would be established by the lead agency prior to any agency implementation efforts, as the responsibility for system operation and maintenance would transition to the lead agency as the new technologies are implemented.

Regional implementation

By structuring the implementation around the Homeland Security regions (see Figure 6.1), this approach allows for a consistent demarcation of areas throughout the state and facilitates correlation with federal grant requests and funding. Although using the DHS regions may be more difficult in the short term for many state agencies whose existing systems are not aligned with the demarcation pattern, it organizes the implementation into manageable work packages. It can also be further tailored once the specific technology solution is selected. This facilitates outreach to federal, local and tribal entities who may be interested in partnering with the state to develop regional deployment plans that incorporate assets (tower sites, transport systems, frequencies, etc.) from these entities into the proposed system. This outreach should be done as

early as possible to enable the appropriate level of capacity planning to take place.

Several regions would transition each year in order to meet the overall six-year implementation plan. The determination of when each region would transition would be made during the initial planning period.

For operational consistency, each agency's regional operations would migrate to the proposed system once the required components are fully implemented in that region. Each regional phase can operate as a standalone system with the appropriate interoperability connections to legacy systems in other regions or areas.

Each regional implementation phase includes similar tasks such as:

- Assessing and/or upgrading tower sites and digital transport systems to support the proposed system deployment in each phase.
- Installing base stations, site interfaces, RoIP capabilities and antenna configurations.
- Installing new radio dispatch consoles and interface equipment.
- Connecting the system equipment to digital transport systems.
- Connecting all equipment back to the radio network control centers.
- Programming and installing subscriber voice and data radio equipment.

The installation sequence ensures that local or regional interoperability needs can be addressed as quickly as possible and that their connectivity to the system is available early in the implementation process. It also facilitates an easier migration from existing legacy systems to the proposed system.

In either case, users that need to operate on both existing systems and the new wide area radio system will require interim communications capabilities including:

- Existing audio gateways
- New RoIP gateways
- Mutual aid channels
- Console patches
- Direct base-to-base interface connections

Planning practices

The plan includes the following considerations and best practices to ensure quality and mitigate the risk during the system implementation phase:

- A formal and rigorous acceptance process is suggested for the selected implementation approach, and to also provide a quality assurance review for the overall project at that point.

- Exit strategies can be developed prior to each phase, or at periodic project review intervals, to provide the state with a contingency plan if for any reason the implementation process is delayed or needs to be stopped.

- Safe stopping points are built into the schedule after the implementation of the RoIP capabilities and the mutual aid expansion. This will allow the project to be stopped after either or both of these efforts; but stopping at these points would have little adverse impact on the existing state agency systems. In fact, significant benefits would be available in both cases.

- At the conclusion of each implementation phase of the proposed system, a testing process and conditional acceptance of the system for that phase would occur.

- Final acceptance would occur when the entire system is completed and proven to function as designed for the multiple subsystems.

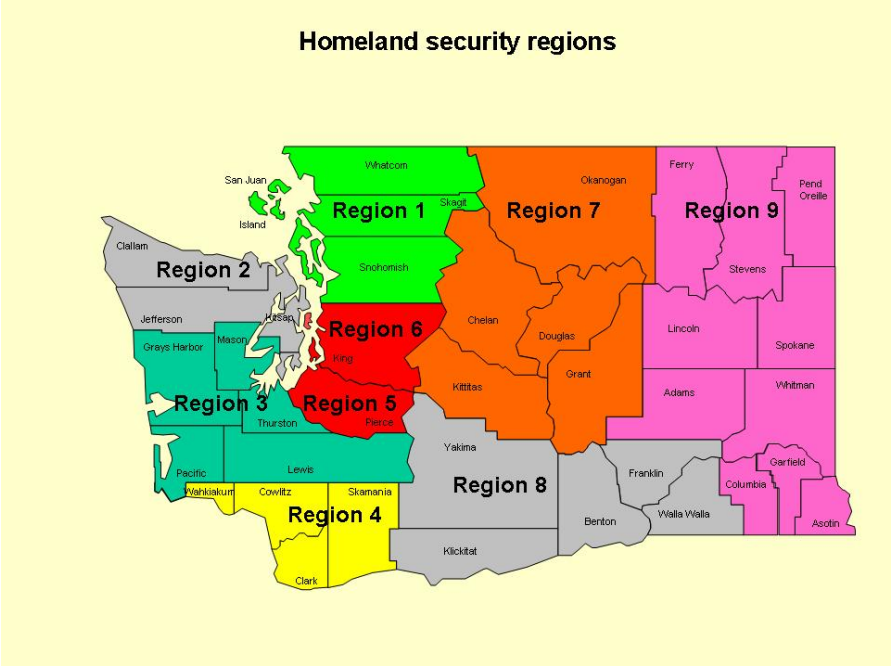


Figure 6.1 – Homeland security regions

Integration and testing

Once all implementation phases are complete, a combined system-wide testing process would begin to ensure that all resources designated for statewide operation function properly and within the parameters established in the contract(s) with the system vendor. This process is likely to take six months or more depending on the levels of testing conducted in prior phases. Once the system-wide testing is complete and accepted by the state, the implementation portion of the project would be closed out.

Operations and maintenance

The operations and maintenance phase is expected to cover the ten-year projected system life cycle, which begins upon the completion of the initial implementation phase. Operating and maintaining the system begins as each phase is completed, and the systems within each phase are activated for use by state agencies. Operations and maintenance is a day-to-day management function and includes network monitoring and system diagnosis, preventive maintenance and emergency repairs, upgrading software applications and network provisioning. Above and beyond just daily operations and maintenance, this phase also includes the evaluation of intermediate technology refreshes that may extend the overall lifecycle or enhance the capabilities of the system.

6.3 Implementation schedule

The radio system manager, or designated project manager, will be responsible for planning the work and managing execution of the tasks in conjunction with the participating agencies and lead agency. The work breakdown structure (WBS) displayed in Figure 6.2 lists the major tasks and related activities to complete the work identified for the project phases. This WBS is a preliminary plan and is only intended to identify the major tasks, time durations, and estimated implementation year to complete the phases of the project. It is expected that this task plan will be updated based on the final system solution and vendor implementation preferences.

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ID	Task Name	Duration
0	Proposed system implementation schedule	2590 days
1	System planning phase	340 days
2	Identify and establish the governance structure	160 days
3	Develop business plan/funding approach	180 days
4	Inventory tower sites and licensed spectrum	140 days
5	Initial interoperability improvements	400 days
6	Confirm interoperability priorities	40 days
7	Assess candidate technologies	40 days
8	Select and procure solution	80 days
9	Implement solution in trial area	80 days
10	Evaluate and expand solution statewide	160 days
11	Mutual aid enhancements	480 days
12	Planning	60 days
13	Procurement	80 days
14	Implementation	340 days
15	Architecture proof of concept	360 days
16	Planning and procurement	140 days
17	Implementation	80 days
18	Operation and evaluation	140 days
19	System design development	120 days
20	Agency-based system design development & review	120 days
21	RFP development and award - central controllers and agency-based subsystems	220 days
22	Develop Request for Proposal (RFP)	60 days
23	RFP response period	100 days
24	Evaluate RFP responses	40 days
25	Vendor selection/protest period/contract negotiations	20 days
26	Implementation Phase	960 days
27	System testing and acceptance	160 days
28	System-wide testing	80 days
29	Issue resolution and final acceptance	80 days
30	Operations and maintenance	2190 days

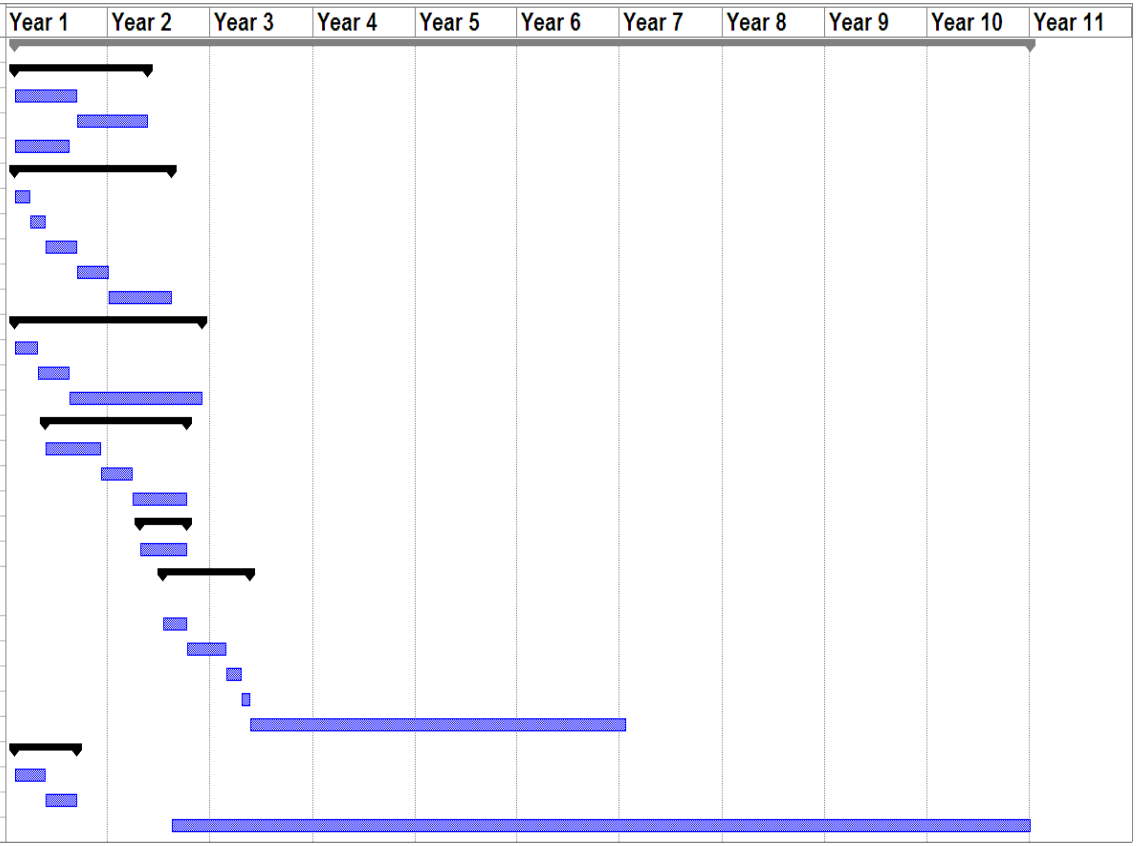


Figure 6.2 – Proposed system implementation timeline

6.4 Risk Management

Although this project has a high potential for dramatically improving public safety communications systems for state agencies, it also entails risks. A formal risk management process should be implemented throughout the phases of this project to address risk identification, quantification, response, and control. The first step of the following risk management process has been used to identify and describe the risks, impacts, and mitigation strategies listed in Table 6.1

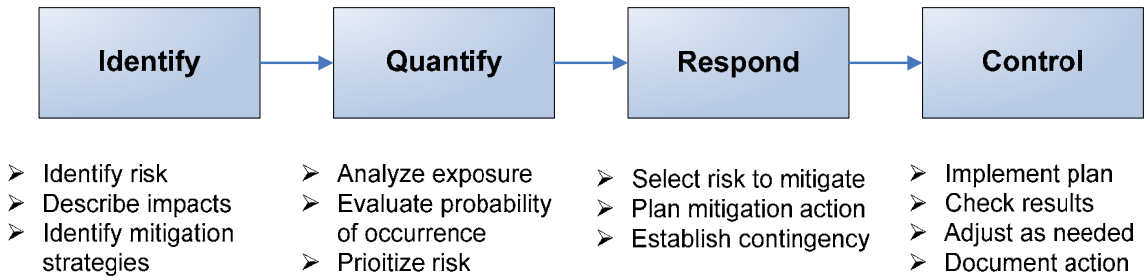


Figure 6.3 – Risk management process

In an effort to reduce uncertainty at this key stage of the project, the risk matrix presented in the *Alternatives Report* has been updated to identify current risks that could impact this project as it moves forward into the procurement and implementation phases.

A summary of risks, impacts, and mitigation strategies is presented in Table 6.1. These are not presented in a prioritized order, although one of the next steps to be taken would be to further refine and prioritize these risk areas.

Risk type	Description of impact and mitigation strategies
Agency participation	Impact: Other agencies may not participate due to a lack of funding to implement and support the system. Mitigation: Once the system is operating for state agencies, the SIEC will take the lead in encouraging other agencies to partner with the state to leverage their resources and share use of the state system.
Cost estimates	Impact: If the cost assumptions or information used to develop the cost estimates is inaccurate, the quality of estimates may be less than the stated 20 percent. Mitigation: The costs for the multiple system business and technical solution were revised throughout the planning process. The equipment estimates are based on current vendor pricing models and were verified through three SIEC reviews. Final system cost proposals will be submitted by vendors during the procurement process. These proposal estimates will provide decision makers with the most accurate system costs.
Coverage limitations	Impact: Coverage (mobile and portable, in-building and other) has been identified as the main impediment to achieving interoperability. If coverage can not be provided in high priority areas for any of the agencies the effectiveness of the solution will be limited and the project may be perceived as not meeting the goals. Mitigation: Meeting the coverage requirements will be assigned a high priority during the procurement phase of the system. Vendor solutions will be evaluated and tested to ensure the selected solution meets the coverage specification for agency radio voice and data applications.

Risk type	Description of impact and mitigation strategies
Spectrum reconfigurations	Impact: Federal Communications Commission (FCC) mandated spectrum reconfigurations may impose resource conflicts for state and local agencies. Agencies impacted by the rebanding and narrowbanding efforts may be limited in their ability to participate in the statewide system planning and implementation process due to lack of resources. Mitigation: State agencies involved with rebanding will be required to coordinate their efforts with the implementation team to avoid resource or system conflicts. The SIEC, or a designated working group, should oversee scheduling for both rebanding and system implementation, and monitor status of projects. Local government and tribal nation coordination should also be considered. Assigning a dedicated project implementation team will reduce resource conflicts.
Frequency availability	Impact: The lack of available frequencies in the VHF and 800 MHz band may preclude a hybrid architecture approach. Mitigation: Frequency planning and coordination in the VHF high band and 800 MHz is vital for the state to implement the number of channels required by the multiple subsystems architecture. State licensed spectrum should be inventoried, pooled, and redeployed as required to implement the proposed system. A centralized frequency management team should actively pursue additional spectrum though partnerships with regional planning committees, the Federal Communications Commission (FCC) and the appropriate frequency coordinators as well as partnerships with local, federal and tribal entities.
Funding	Impact: The lack of state funding and/or reductions in federal grant funds will delay the system purchase. Mitigation: The SIEC or approved governance board will assign the SAFE Group (or similar entity) with responsibility to manage federal grant appropriations and monitor payments. State funding will be managed through the appropriate oversight agency.
Governance	Impact: New legislation that inhibits the ability of the proposed governance structure to function; or limits the ability of the SIEC to govern the process will adversely affect the plan. Mitigation: The state must formalize the governance structure prior to moving forward with the procurement of the system.

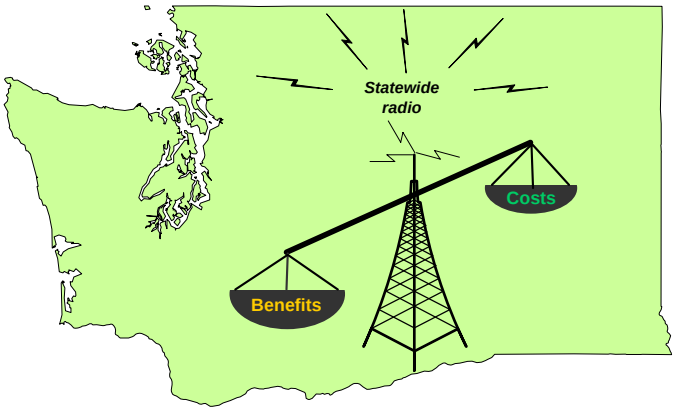
Risk type	Description of impact and mitigation strategies
Leading edge technologies	Impact: New technologies based on Internet Protocol (IP) and network-centric packet switching technologies are relatively new, and may be difficult to implement on the state's network. Mitigation: Evaluate and select only proven technologies from vendors with requisite experience to install and warranty IP-based solutions. State will allocate budget to ensure that technical staff is properly trained to operate and maintain the system.
Canadian border issues	Impact: Frequency availability and management issues related to Canadian spectrum use affect the capabilities of the system. Extended delays in frequency coordination are not uncommon for locations along the Canadian border which must coordinate spectrum use with both US and Canadian regulatory agencies. Mitigation: The centralized frequency management team should engage with the regional planning committees and the appropriate frequency coordinators to perform a spectrum analysis for frequencies that may be needed for the state system in the affected areas. This issue has been escalated as a next step and a high priority for the state frequency management planning team.
Network capacity	Impact: The multiple subsystems architecture depends on a stable and reliable (i.e., high quality of service) backbone network to transport voice and/or data traffic. Lack of sufficient capacity would impede deployment and affect the quality of service. Mitigation: A network capacity analysis will be conducted as part of the detailed system design that is scheduled to occur during the vendor and system procurement phase. A network requirement specification will be produced detailing the minimum capacity needs and availability requirements to support the voice and data network.

Risk type	Description of impact and mitigation strategies
Program management challenges	Impact: Building out the system will be a multi-year effort and migrating state agencies to the proposed system may be complex. Maintaining state agency involvement and coordinating resources from various agencies and vendors will impose project management challenges. Mitigation: The state will follow a formal project management approach administered by the ISB; assign an experienced project manager with full authority to execute the plan; and commit appropriate skilled resources as a dedicated project team for the duration of the implementation.
Technology standards	A shift in the current suite of standards would require a reassessment of the technology architecture. Delays in completing the P25 standards for Inter RF Subsystem Interface (ISSI), Console Interface (CSI), and Fixed Station Interface (FSI) could delay implementing various standards-based components for P25 systems. Mitigation: The SIEC should appoint the SAW or lead agency to study the P25 standards and identify any pending actions that could affect the proposed technical architecture or phased implementation schedule.
Implementation schedule	The six-year implementation schedule could create technology compatibility issues between the agencies that transition in the early years, and other state agencies that migrate in later years of the project. Mitigation: The detailed implementation plan that will be prepared once the system is procured and a vendor is selected, should be targeted to specifically address the risk of technology migration over the six-year schedule. The final plan should also include provisions for technology refresh for agencies that migrate to the proposed system in the early years.

Table 6.1 – Risks and mitigation efforts

7 Financial implications

This plan does not attempt to justify the cost and benefits for the proposed system using traditional return on investment (ROI) analysis techniques. Research conducted for this project concluded that traditional business economic justification models do not accurately predict returns for public safety radio systems. The traditional approach requires a high degree of confidence in the subjective interpretations of the benefits, which leads to an inaccurate assessment of savings.



Weighing benefits and costs of the proposed system

But decision makers want to know answers to these and other similar questions:

- How do you quantify the benefit of a trunked radio system?
- What's the net productivity increase for first responders as a result of having statewide roaming capabilities?
- What are the savings to the state by reducing the risks to the general public through better communications?

The economics of these questions are very difficult to answer. Although the benefits are mostly tangible, any attempt to measure the savings as a dollar value ends up being a guessing game.

A common sense cost estimating approach is used for this evaluation. It recognizes the cost to buy and build the system – system acquisition costs; and the cost to operate and maintain the system once it's operational – recurring costs. The cost estimates presented in this report are based on the information available from the Request for Information (RFI) process completed in March 2005, and pricing that is available through the Western States Contracting Alliance (WSCA).

Because the system design presented in this plan is conceptual, the estimates are within 20 percent of what could be expected as a result of a formal procurement process. The ten-year period used for estimating the costs was determined by the state at the beginning of the project to be the appropriate planning horizon.

The potential benefits to be gained as a result of operating the proposed system with voice and data communications capabilities are both tangible and intangible. The benefits are generally recognized by the industry to be achievable for this type and size communication system investment. The most visible benefits to end users include:

- Enhanced coverage
- Improved signal and voice quality
- More system functionality
- Easier to use
- Real-time and on-demand interoperability with other state, federal, and local government agencies and tribal nations.

7.1 Cost estimate summary

The cost estimates are as accurate as can be achieved at this stage of the process. These estimates will need to be re-evaluated and adjusted based on responses to a formal procurement process. Based on the final detailed system design, the selected vendor will provide a more accurate estimate of the final costs for implementing the system.

Acquisition costs are one-time expenditures incurred for purchase, installation, and initial maintenance of the proposed system's equipment and services; and also the disposition of debris and equipment in preparation for the proposed system.

Acquisition costs total …… $257,481,000

Recurring costs are expenditures for operation, maintenance, and licensing of systems and equipment components. The largest component is personnel costs. This total below represents the estimated annual costs of the new radio system once the system is implemented and all regions are operational. These costs are projected to escalate upward from year one and increase as each region is migrated to the proposed system during the six-year implementation period. The maximum total annual amount is listed below and is not expected to be reached until the implementation phase is complete.

Annual recurring costs total after full implementation $25,433,000

7.2 Cost estimate details

These assumptions were used to estimate the system acquisition and annual recurring expenditures:

- Costs for system planning, requirements analysis, and initial design and engineering expenditures are considered investments that are not recoverable and, therefore, are not factored into the cost estimates.
- Costs are estimated for a ten-year period beginning at the start of the system procurement tentatively set for February 2007.
- Operations and maintenance expenditures are considered as annual recurring costs that begin during implementation and are carried through to year ten.
- The Information Services Board has approved a $30 million improvement for the WSP microwave system as part of the Integrated Wireless Network (IWN) project. This amount will be reimbursed by the federal IWN project and is not included in the cost estimates.
- Costs associated with not undertaking this project or other alternatives are not considered in this analysis.
- Cost of capital, inflation and any other annual cost escalation multipliers are not factored into this evaluation.
- End-of-life replacement costs for infrastructure and subscriber equipment are not included in the cost estimates.

7.2.1 System acquisition costs

Table 7.1 displays the system acquisition costs itemized by system components for the proposed system. The system acquisition cost assumptions are included in Appendix E. The detailed cost estimates for each system component are provided in the August 2005 *System Architecture Report*[33].

[33] Available at http://www.isb.wa.gov/committees/siec/publications/SAR_Final_081005.pdf

System acquistion costs	These are nonrecurring capital expenditures for procuring infrastructure and site equipment, microwave backbone upgrades, base stations, mobile and portable radios, and system integration and project management services.		
System component	**Unit cost**	**Quantity**	**Extended costs**
Nework control centers	$5,931,000	2	$11,862,000
Personnel and support	$1,125,000		$1,125,000
Infrastructure	$30,150,000		$30,150,000
Low density site	$140,000	30	$4,200,000
Medium density site	$412,000	105	$43,260,000
High density site	$1,102,000	15	$16,530,000
Small dispatch center	$305,000	27	$8,235,000
Medium dispatch center	$736,000	12	$8,832,000
Voice subscriber system	$82,295,000		$82,295,000
Data subscriber system	$60,079,000		$60,079,000
Subtotal			$266,568,000
Legacy reuse (equipment reuse credit)			($9,087,000)
Total acquistion costs			**$257,481,000**

Table 7.1 – System acquisition cost estimate

7.2.2 System component descriptions

Cost estimates have been prepared according to these main system components:

- **Network control centers**: two voice and data network controller/switch centers are estimated for the architecture, with one center located in the Olympia area, and one in Yakima.
- **Personnel and support**: costs are allocated for the existing personnel and 20 additional personnel required to support the network control centers, and mutual aid and mobile data systems. Personnel costs also include annual training costs for operating and maintaining dispatch consoles, base station and infrastructure equipment, and subscriber units.
- **Infrastructure**: is primarily for microwave upgrades including additional hops, site improvement work, equipment spares, and installation costs. Infrastructure costs associated with the Federal Integrated Wireless Network (IWN) program, and updates to existing state digital transport systems as a result of the IWN work, are not included in the cost of the system architecture.
- **Variable density radio sites**: are the RF and RoIP equipment at radio tower sites, which are categorized by low, medium, and high amounts of equipment. The typical radio equipment configuration for the radio sites is defined in the glossary. Full descriptions of the site equipment configurations, along with diagrams for low/medium/high density sites, are provided in the *System Architecture Report*.

- **Dispatch centers**: include backroom equipment, control stations, and consoles for RF and RoIP equipment for small and medium sized centers. Center size is based on the number of radio dispatch console positions: a small center is one or two voice radio dispatch console positions, and a medium center is three to eight radio dispatch consoles.
- **Voice subscriber equipment**: includes P25 portable and mobile radios and equipment spares; along with installation, maintenance, and first-year support costs.
- **Mobile data subscriber equipment**: includes data terminals, modems, software, installation, equipment spares, and maintenance and first-year support costs.
- **Legacy reuse**: is a credit subtracted from the system acquisition cost to account for existing equipment that should be reused in the new architecture.

7.2.3 Recurring cost estimates

Table 7.2 displays the summarized system recurring costs for the proposed system. The total yearly recurring costs (i.e., $25,433,000) will be reached when the system implementation is complete at the end of year nine. For years two through nine, the recurring costs are expected to increase each year until the maximum cost of $25 million is reached at the beginning of year ten.
The system recurring cost assumptions are included in Appendix E.

Recurring costs	**Recurring costs are the estimated annual expenditures for operation and maintenance, supplies, site leases, utilities, support agreements, and personnel. The total annual recurring costs will be incurred after the ssytem is fully implemented at the end of year nine.**		
System component	**Unit cost**	**Quantity**	**Extended costs**
Network Control Centers	$796,000	2	$1,592,000
Personnel and support	$12,161,000		$12,161,000
Infrastructure	$90,000		$90,000
Low density site	$50,900	30	$1,527,000
Medium density site	$57,000	105	$5,985,000
High density site	$61,000	15	$915,000
Small dispatch center	$40,000	27	$1,080,000
Medium dispatch center	$97,000	12	$1,164,000
Voice subscriber system	$531,000		$531,000
Data subscriber system	$388,000		$388,000
Total annual recurring costs			**$25,433,000**

Table 7.2 – Recurring cost estimate

7.3 Life cycle cost estimates

Lifecycle costs are also projected over a ten-year period. Following the typical lifecycle expenditure model for large radio system enhancement projects, the state should expect that the procurement and installation phases will require the largest capital investment. Likewise, the operations and maintenance period will require a sustained flow of funds to maintain optimum system performance. Expenditures incurred to date for system planning activities are considered non-recoverable, and are not factored into the system ten-year estimates. The lifecycle cost estimates for system acquisition and the recurring cost yearly expenditures are order of magnitude calculations and may vary depending on how and when the system is implemented.

7.3.1 System acquisition lifecycle costs for the proposed system

The timeline for procuring and installing the proposed system is projected to span the first six years of the ten-year lifecycle. Based on the phased implementation plan, the assumption is that the capital expenditures will occur as the system is purchased and installed in years two through six. The proposed system acquisition costs displayed in Table 7.3 were calculated based on the implementation of Radio over IP and mutual-aid enhancements by the end of year two and the remaining multiple subsystems capabilities equally in years three through six. The primary and backup network control centers were planned for years three and four respectively.

Year	Proposed system acquisition costs	Cumulative acquisition costs
1		
2	$22,891,000	$22,891,000
3	$62,035,000	$84,925,000
4	$62,473,000	$146,398,000
5	$55,541,000	$201,940,000
6	$55,541,000	$257,481,000
7	$0	$257,481,000
8	$0	$257,481,000
9	$0	$257,481,000
10	$0	**$257,481,000**

Table 7.3 – Proposed system estimated acquisition costs for years one through ten

7.3.2 Recurring costs for the proposed system

These are the assumptions for estimating recurring costs:

- The current annual recurring costs for the five participating state agencies combined are approximately $12.5 million.
- The annual recurring costs for the proposed system are estimated to be approximately $25.4 million per year once the system is fully implemented, which occurs at the end of year six.
- Beginning at year two, and continuing through year six, the annual recurring costs will be somewhat less than the estimated total of $25.4 million.
- For the first six years the recurring costs will be incurred based on a combination of expenditures for both the existing and proposed system.
- The subset of agencies' users that have not yet migrated to the proposed system should expect recurring costs to be similar to the current projected amounts.
- There will be a gradual increase in annual recurring costs as the proposed system is implemented in phases.
- The cost analysis does not include annual increases due to inflation, labor, or other cost escalation factors.

Table 7.4 displays the estimated recurring costs for the state agencies over the ten-year period. As indicated in the table, as the agencies migrate to the proposed system, the total annual recurring costs will gradually increase up to a maximum of $25.4 million at year ten.

Year	Proposed system annual recurring cost estimates
1	0
2	$4,118,000
3	$9,912,000
4	$15,616,000
5	$20,525,000
6	$25,433,000
7	$25,433,000
8	$25,433,000
9	$25,433,000
10	$25,433,000
Total	**$177,336,000**

Table 7.4 – Proposed system annual recurring cost estimates

7.3.3 System acquisition and recurring costs expenditures

Table 7.5 below displays the estimated total system acquisition costs and recurring costs to procure, implement, and operate and maintain the proposed system over the ten-year period. As indicated in the table, the first six years include both acquisition and recurring expenditures. As the agencies migrate to the proposed system, the total annual recurring costs will increase up to a maximum that will be reached at year seven.

Year	System acquisition total costs	Recurring total costs	Annual system acquisition and recurring costs	Cumulative costs
1	0	0	0	0
2	$22,891,000	$4,118,000	$27,008,000	$27,008,000
3	$62,035,000	$9,912,000	$71,947,000	$98,955,000
4	$62,473,000	$15,616,000	$77,089,000	$176,044,000
5	$55,541,000	$20,525,000	$76,066,000	$252,110,000
6	$55,541,000	$25,433,000	$80,975,000	$333,085,000
7	$0	$25,433,000	$25,433,000	$358,518,000
8	$0	$25,433,000	$25,433,000	$383,951,000
9	$0	$25,433,000	$25,433,000	$409,384,000
10	$0	$25,433,000	$25,433,000	$434,817,000
Totals	**$257,481,000**	**$177,336,000**	**$434,817,000**	

Table 7.5 – System acquisition and recurring costs

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7.3.4 Summary of the costs to implement a new radio system

The assumptions used are as follows:

- The estimated total system acquisition costs for the proposed system are $257 million; and total system recurring costs for the ten-year period are estimated at $177 million.

- The total system acquisition costs included in the ten-year budget for state agencies are $219 million. These expenditures are for planned improvements to the existing systems; and are expected to be used by state agencies to keep existing systems upgraded during the proposed system implementation period.

- Annual existing recurring costs for state agencies are budgeted at approximately $12.5 million per year; and over ten years this totals $125

million. This expenditure is expected to be used during the system implementation period.

7.4 Benefits

Table 7.6 lists the potential tangible benefits as a result of implementing the proposed system. Achieving these benefits requires that the requisite governance structure and processes are implemented, and that staff are properly trained to operate and maintain the system throughout its life cycle.

Tangible benefit areas and practical applications
Cost avoidance can be achieved by implementing shared systems' arrangements between agencies to consolidate fixed assets and thereby reduce the amount of infrastructure, controllers, sites, and fixed equipment needed to operate the system. • **VHF agency users will consolidate some assets** under a single subsystem avoiding duplication of equipment and infrastructure assets and avoid redundancy of maintenance and support services. • **Decreased equipment cost** because emergency vehicles need only one radio, thus eliminating duplicate training for multiple types of radios. • **Avoid system management and operational expenses** by sharing network connectivity, maintenance, leased lines fees, and land leasing fees. • **Economies of scale** gained by coordinating and consolidating equipment purchases to leverage purchasing discounts will save costs over the long term.
Increased productivity of first responders due to better coordination with other responders – a result of using a shared system that handles voice, data, and mutual aid needs during day-to-day and major emergency situations. • **Trunking channels** will increase availability and reduce wait times for voice communications. • **Mobile data** will reduce the need for voice communications and free up network resources; and provides field reporting capabilities and data messaging between system users. • **Mobile data subscribers units** will allow first responders to access information when needed on demand; for example to obtain vehicle registration, driver's license, or criminal background information. • **Mutual aid capabilities** will be enabled via switching technology, which is inherently more effective than patching or gateway interfaces.
Increased functionality statewide for all system users with wide area roaming for voice communications. Availability of secure voice and data channels when operating within the radio coverage area provided by the proposed system. • **Roaming** will permit agency users to communicate with coworkers statewide using the interconnected VHF and 800 MHZ subsystems.

Tangible benefit areas and practical applications
• **Voice quality** will be improved via digital technology, which removes interference that comes with analog signals. • **Trunking channels** will enhance usability through talk group conversations, sharing communications, or conversely isolating conversations. • **Emergency alerting features**[34] increase safety of first responders and the public with the capabilities to call for assistance on demand. • **Interoperability between the participating state agencies** (WSP, DNR, WSDOT, DOC, WSFW, and EMD) will become a native capability and available to use when needed. In addition, the RoIP interface will smooth the migration to the P25 standards-based system and provide additional interoperability with local and federal agencies. • **Interoperability with other agencies** and the option for other agencies to join the state system will provide additional channel sharing capabilities. • **Coverage** will be increased for most state agencies due to the expanded network of sites. • **Internet protocol (IP)-based architecture** provides a convergence of voice and data onto one network, which will reduce the overall cost of ownership.
Increase funding opportunities by implementing standards-based systems that are endorsed by DHS and comply with other grant provider agencies. • **Standards-based architectures** have a competitive advantage in the grant approval process as noted in SAFECOM's recommended guidelines publication: "Specifically, all new systems *should* be compatible with the ANSI/TIA/EIAA-102 Phase 1 (Project 25 or P25) suite of standards."[35]

Table 7.6 – Benefits

7.5 Procurement and funding options

Planning for the procurement of the proposed system should be focused on answering two initial questions:

1. How will the system be purchased?
2. How will the system be funded?

Answering these related questions is a work in progress and extends beyond the scope of this planning activity. So the purpose here is to identify the

[34] Emergency alerting features are only available when operating within range of the proposed system or other devices capable of receiving and displaying emergency alerts from subscriber radios.
[35] www.safecomprogram.gov, Recommended Federal Grants Guidance Public Safety Communications & Interoperability Grants, November 2004.

procurement options and issues for decision makers to consider. Since these procurement decisions are on the project's critical path, they have been listed as a next step.

7.5.1 How will the system be purchased?

At some point in the procurement process, the state needs to decide how and when the system will be acquired. Should the system be purchased as voice and data subsystems, by a combination of its components? Or can it be financed over time according to the multi-phase implementation strategy suggested in Section 6.

To some extent, the decision for how and when the system will be purchased will be determined by how the system is funded. For example, there may be funding restrictions that preclude a "buy it all at once" option. Similarly, the cost of buying and installing the core infrastructure components could exceed the funding available to the state and thus delay the project. Obviously, additional analysis is required to evaluate the technology needs in relation to the capital appropriations policies. A recommendation has been added to the list of next steps to include this evaluation as part of the business plan development.

Other factors to consider

Some other considerations related to acquiring the proposed system are as follows:

- The state's biennium budget cycle may impose limitations on how the system is purchased and therefore implemented.
- The timeline for procuring and installing the proposed system, based on the recommended implementation strategy, is projected to span nine years. The assumption is that the funds need to be available for purchasing the system at the yearly intervals displayed in Table 7.3.

7.5.2 How will the system be funded?

The SIEC Advisory Funding Enterprise (SAFE) Working Group's charter includes researching and advising the SAW Group on possible funding alternatives. The research conducted to date by the SAFE Working Group indicates a variety of funding options. This information has been combined with the original funding recommendations presented in the *High-Level Final Statewide Public Safety Communications Interoperability Plan*, December 2004. The list below includes state revenue sources as well as federal grants that are qualified to fund the costs for the system.

- Grants (including federal earmarks)
- Partnerships
- Fees: user, utility, subscriptions
- 9-1-1 surcharges
- Taxes/bonds
- Sale of public assets
- Seized assets
- Combination funding: partnerships + bonds + taxes + grants + local subscriber fees
- Alternative approaches including private ownership of the statewide system with state and local agency sharing arrangements. Appendix I presents two examples of states using creative financing to fund their statewide systems; (e.g., the State of Florida Statewide Law Enforcement Radio System; and the State of South Carolina Palmetto 800 approach).

A full analysis of the advantages and disadvantages of each of the funding options is beyond the scope of this plan. However, one of the deliverables of the SAFE Working Group is to create a business plan to support this Technical Implementation Plan. It is anticipated that the contents of the business plan will provide decision makers with enough detail to pursue the appropriate funding sources.

7.5.3 Recommendations for procuring and funding the system[36]

Recommendation for procuring the system: *The state should consider implementing the system in phases as described in Section 5. This strategy allows the initial system acquisition costs to be spread across a six-year period.*

Recommendation for funding the system: *The state should develop a business/funding plan, ideally as part of the SAFE Working Group's business plan deliverable, which will generate the resources necessary to support the costs associated with purchasing the proposed system.*

The supplemental business plan should outline all available annual sources of funding; define the application processes for each; and review the state's funding strategy for the proposed system. The plan should identify areas for saving/avoiding costs such as antenna consolidations, network sharing, and redistribution of older radios. The plan should also identify the process for other agencies to participate in the state network and suggest a fee for service arrangement for non-state agencies. Additional areas the plan should address include the following:

[36] This recommendation stated here is revised from the original statement presented in the *High-Level Final Statewide Public Safety Communications Interoperability Plan,* December 2004.

- Quality sources of funding in federal grants; state taxes, bonds, and 9-1-1 surcharges.
- Evaluate the potential of moving to a user fee-based system.
- Take advantage of vendor-offered public/private and leasing opportunities.
- Evaluate commercializing available state-owned tower space.

8 Critical success factors

Before the state begins to execute this plan, there are several high-priority actions that need to be taken to remove roadblocks and pave the way to move forward efficiently. The critical success factors described below identify the immediate and long-term concerns. By following the recommendations, most of the impediments can be resolved sufficiently for the state to execute this plan.

The four primary components of interoperability

8.1 What are the critical success factors?

Achieving the goals established for this initiative and successfully implementing the system described in this plan is dependent on the following:

1. **Establishing a governance structure**

   The system model proposed in this plan requires a more centralized management approach than is in place today. An effective management structure involves creating an executive leadership board that is accountable to the state Legislature, with the authority to set operation and system management policy, direct operational processes, establish funding priorities, and resolve disputes in the management of the shared infrastructure.

2. **Gaining commitment from the participating state agencies**

   State agency management and staff must become fully committed to the centralized shared system concept for this project to succeed. Any resistance to making the management, technology, and procedural changes within the agencies will delay and possibly eliminate the potential benefits of the proposed system. Commitment issues must be resolved early in the next phase, and particularly before beginning system implementation activities.

3. **Securing adequate funding**

   Without an influx of capital, this initiative will stall and achieving the goals will be very difficult. Adequate funding sources must be secured for these expenditures:

   - System acquisition funds must be made available by the state for purchasing equipment and services to build out the infrastructure as well as purchase state agency subscriber units.

- Additional annual recurring funds must be made available for operations and maintenance.
- To expand the system for use by other non-state agencies, the state must provide funding mechanisms to allow local and tribal agencies to join the states' communications network.

4. Overcoming technology constraints

Not having enough network capacity and frequencies are two limiting factors that will constrain the state's ability to implement a statewide network. Since the goal is to provide enough capacity to support the voice and data communications needs of state agencies as well as other local agencies, these limitations need to be resolved.

- **Network capacity:** The IWN project is a windfall to the state and will greatly expand the microwave transport system both east and west. But several questions remain regarding whether the expanded microwave network can support all the current and future needs. Is there enough to support the voice and data transport needs for the participating state agencies? Will there be any left over for other agencies to share the state system?

- **Frequency availability:** Without centralized frequency management, it is difficult to ascertain the current inventory of frequencies licensed by the state. Based on the requirements for the proposed system, it's obvious that additional frequencies (in VHF and 700/800 MHz bands) are required to meet the coverage needs for the voice and data systems. There will be additional demand for the already scarce frequency resources as the 800 MHz rebanding and VHF refarming/narrowbanding efforts become more widespread. Ideally, a statewide frequency management effort, including an assessment of state and local government frequency use, should precede the implementation. Frequency reallocation of state and local government agencies will permit proper frequency pairing and maximize spectrum efficiency.

- **Frequency coordination** with local agencies will certainly make the overall planning process easier especially if they are willing to share frequencies as part of their incentive to join in using the state's system. But the frequency management process should start with state agencies.

8.2 How does this plan help to achieve the goals?

By implementing the proposed system based on the multiple subsystems architecture, and installing the appropriate governance structure, the state is

positioned on a direct path to achieve the goals set by the SIEC in December 2004:

Goal 1: Establish statewide interoperability as a high priority for all stakeholders, including state, local, regional, tribal and federal agencies and entities.

- *By developing this plan, the SIEC has demonstrated a commitment to solving the interoperability problems facing the state. Because the proposed architecture is extensible enough to share with other agencies (i.e., local, regional, tribal and federal agencies), the state is in a position to promote this plan as a statewide solution. Knowing that solving the problem is a high priority for state government, should encourage other agencies to take similar actions.*

Goal 2: Maximize the improvements in interoperability by institutionalizing collaborative approaches across the state based upon common priorities and consensus at the regional level.

- *The implementation plan calls for a phased migration of the state agencies by region and incrementally adding agencies to the system based on priority and readiness. This approach can be replicated for other non-state agencies provided the state's network will support their needs.*

Goal 3: Create an architecture approach, which establishes a framework for interfacing between disparate systems, and promotes migration to new technologies in line with relevant standards platforms.

- *This goal will be accomplished within the multiple subsystems architecture by allowing the state to leverage existing radio systems operating in different bands, and providing a phased migration to common air protocols based on P25 standards. For example, a State Patrol officer investigating a landslide on a rural highway will be able to use his VHF portable radio to directly communicate with a WSDOT incident response team operating on their 800 MHz mobile radio network.*

Goal 4: Migrate to a technology that provides state, local, regional, tribal and federal systems with the level of interoperability that is appropriate for their missions.

- *The centralized architecture will support the appropriate range of interoperability for both state and non-state agencies. State agencies*

operating within the coverage areas of each subsystem will have the full voice and mobile data capabilities of a standards-based shared system. Other agencies will have access to the statewide mutual aid network with the addition of the specific frequencies to their dispatch console, and mobile and portable radios. Alternatively, other agencies can be connected to the statewide network via a RoIP interconnect gateway device.

Goal 5: Optimize the use of all funding sources at the state, local, regional, tribal, and federal levels.

- *This plan expands on the original recommendation to use the SIEC Advisory Funding Enterprise (SAFE) Working Group as the funding advisory resource for state and local agencies.*
    - *This working group should be put in charge of developing the funding plan that will generate the funding resources to pay for the statewide system.*
    - *Additional responsibilities should be given to the SAFE Working Group to aggressively search for and pursue federal grants that can be applied as payment for the system.*
    - *Plus, this group can serve a vital role in preparing grant submissions and assembling information for the state legislative funding request process.*

Goal 6: Maximize the use of "best current practices" approaches to improving interoperability.

- *In assembling the conceptual design of the system architecture, the design team followed best practice guidelines established by APCO, SAFECOM, and the Washington State Department of Information Services. By implementing this architecture, the state will be obligated to review existing procedures and, if necessary, reengineer processes to gain maximum operating efficiencies. For example, the trunked radio system will require a new set of operating procedures, as well as a comprehensive education and training program to develop end users' skills.*

Goal 7: Create a statewide backbone communications capability that would provide connectivity for state, local, federal, regional and tribal groups.

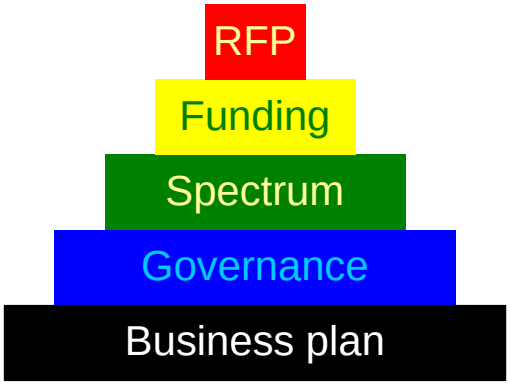
- *One of the main advantages of the multiple subsystems approach is that it provides centralized and consolidated control of a common shared infrastructure including microwave transport backbone, central controller, mutual aid network, and network management equipment. By design, this provides wide area connectivity and seamless roaming capabilities for state*

agencies. It is also a very expandable architecture and has provisions to allow local, regional, and tribal agencies to interconnect to the backbone if their subscriber and console equipment is P25 enabled and compatible with the state infrastructure. The details of how non-state agency connectivity is provided would be handled on an individual case basis with each interested local, federal, or tribal agency.

9 Next steps

Where should the state go from here?

In the nine months since completing the high-level plan, significant progress has been made by the SIEC toward achieving the goals established for this initiative. This plan was produced through the efforts of the SIEC, the SAW Group, the participating state agencies, local agencies, tribal nations and with valuable input from the vendor community. Now, by following this road map and recommendations presented in this plan, the state can take action and initiate the next phase of this project.



Five considerations in planning

It is recommended that the state take these next steps:

1. **Conduct a statewide interoperability summit.**
   - This plan will provide the information for this discussion.

2. **Implement a state agency governance structure.**
   - SIEC should evaluate alternative structures and recommend an appropriate governance structure.
   - Select the lead organization for the proposed system.
   - Establish the proposed system program organization structure and select the system manager.
   - Establish the system program team.

3. **Institute statewide spectrum management.**
   - Conduct a comprehensive inventory of all state licensed radio spectrum.
   - Conduct a comprehensive inventory and physical site condition assessment of all state-owned communication towers as a minimum, including local and tribal towers as an option.

4. **Develop the business plan.**
   - Assign responsibilities to the SAFE group to develop the plan for funding the system purchase.
   - Prepare funding report and documentation to secure funding.
   - Develop a long-term strategy for funding a system implementation spanning multiple years.

- Develop cost recovery/apportionment formulas to fund ongoing operations.

5. **Initiate the short-term interoperability improvements**
   - Complete the analysis and design of the short-term improvements
   - Select the appropriate technology solution, procure, and implement on a pilot basis
   - Expand statewide as the results of the pilot indicate.

6. **Initiate the agency-based design and procurement phase and begin developing an RFP.**
   - The proposed system program team would work with the Department of General Administration to develop a detailed procurement plan.
   - Develop a detailed Request for Proposal for the system and subscriber equipment including system implementation services.
   - Obtain technical assistance and support in finalizing the system design and further developing the project plan as needed.

7. **Continue implementing the interim plan recommendations as appropriate.**
   - The Interim Statewide Public Safety Communications Systems Plan, March 30, 2004 lists short and mid-term solutions; some of these are in progress, others are awaiting action.

Appendix A – Overview of the SIEC deliverables

This plan builds on the findings of all previous deliverables produced by the State Interoperability Executive Committee (SIEC) during the 2003-05 Biennium. These reports are available on the SIEC Web site at http://isb.wa.gov/committees/siec :

- *Inventory of State Government-Operated Public Safety Communications Systems*, December 2003
- *Interim Statewide Public Safety Communications Systems Plan*, March 2004
- *High-Level Final Statewide Public Safety Communications Interoperability Plan,* December 2004
- *Inventory of Public Safety Communications Systems Phase 2,* February 2005
- *Request for Information,* January 2005
- *System Capabilities and User Needs Report,* March 2005
- *Alternatives Report,* May 2005
- *System Architecture Report,* August 2005
- *Technical Implementation Plan,* October 2005

Appendix B – Description of the technical alternative solutions considered by the state

The purpose of developing and evaluating alternative technology solutions was to identify and study the various options for public safety wireless communication systems that meet the needs of the state. The team that performed this evaluation on behalf of the state consisted of members of the Department of Information Services (DIS), the SIEC Advisory Working Group, and Federal Engineering, Inc. (FE).

Following a structured evaluation process, the team initially selected and evaluated four alternatives (see Figure B.1). The characteristics of these four options were discussed with the SAW Group in April 2005:

1. Single frequency system – based on either VHF or 700/800 MHz spectrum on a single centralized network
2. Multiple subsystems – based on the "system of systems" approach (multi-band)
3. Networked system – based on Radio Over Internet Protocol (RoIP)
4. Stand alone systems – following the Interim *Plan* approach

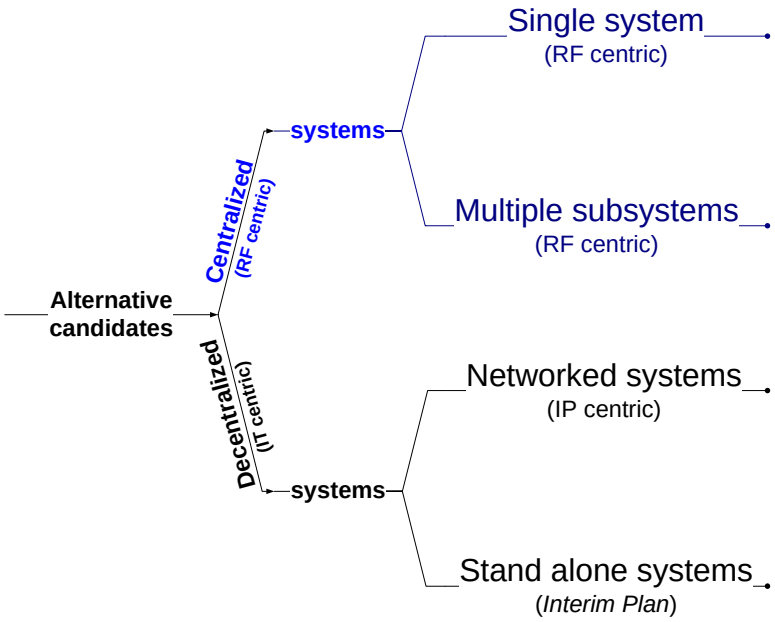


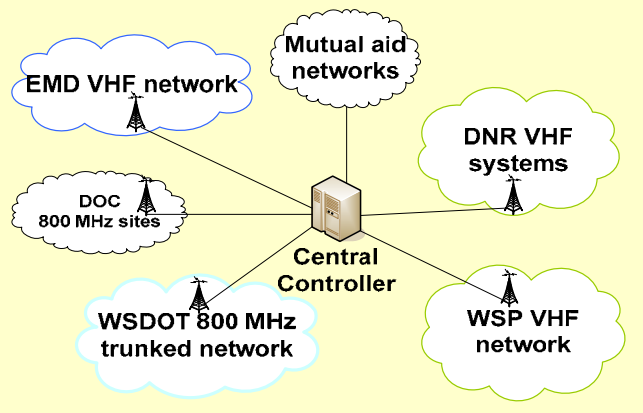
Figure B.1 – Initial four alternatives considered

Final alternatives for consideration

The single frequency system alternative was subsequently eliminated from further consideration, as the SAW group felt that it simply was not achievable in the ten-year planning horizon because of the magnitude of change required from the current set of systems in place. It was also strongly felt that a single-frequency solution was not necessary to achieve the desired level of interoperability.

This left three options, described below, that the state considered for improving voice radio and mobile data communications interoperability for state, local, tribal, and federal agencies, and other agencies. [37]

Alternative #1 – Multiple subsystems: is a centrally managed system-of-systems approach based on centralized radio systems architectures that are not restricted to a single frequency band.

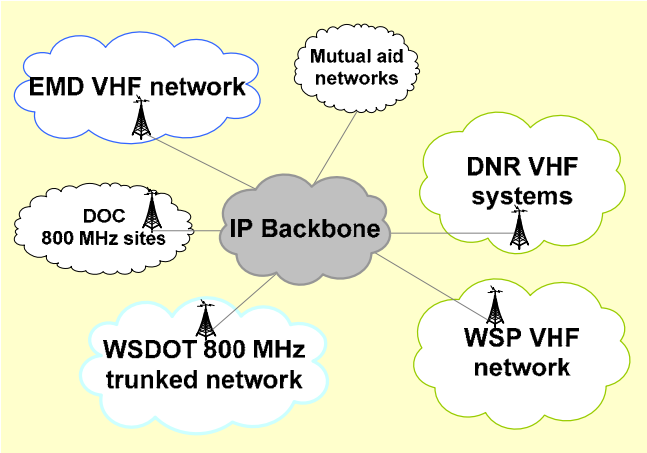


Multiple subsystems alternative

This method utilizes a network of radio sites, transport mechanisms, interfaces and audio switches connected together through one or more centralized control centers to provide direct interoperability between users on each subsystem. This approach will allow the state to leverage existing radio systems in the VHF and 800 MHz bands and provide a phased migration to standard common air protocols (i.e., P25).

[37] Other agencies include public and private utilities, hospitals, port districts, and private emergency service providers that are routinely involved in mutual aid situations.

Alternative #2 – Networked systems: is an architecture that is frequency independent and based on RoIP.

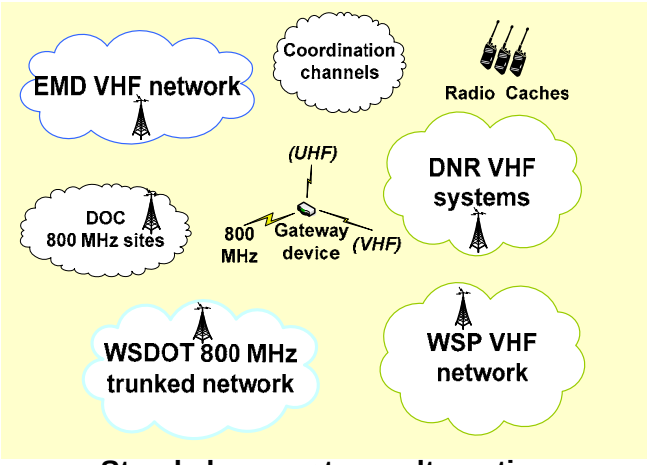


Networked systems alternative

This type of solution would be retrofitted to the existing site and system infrastructure. It would operate on a network of integrated routers and radio gateways that transmit audio data packets over the statewide network using Voice over Internet Protocol (VoIP) technology.

This approach will allow the state to leverage existing radio systems on VHF, UHF and 800 MHz bands, and provide a gradual migration to standard common air protocols (e.g., P25) should this be mandated by the SIEC at some point in the future.

Alternative #3 – Stand alone systems: This solution implies that the participating state agencies would continue operating stand alone systems following the strategy recommended in the *Interim Plan*.



Stand alone systems alternative

The *Interim Plan* directs state agencies to achieve these objectives during the next 12 months:

- Implement statewide VHF wide-band analog coordination channels.
- Identify additional VHF channels that can be used for statewide command and control.
- Identify those state agencies that have purchased gateway devices.
- Deploy a mini-cache of portable radios.

The stand-alone systems alternative, also referred to as the “business as usual” approach, assumes that the state agencies would continue to make incremental improvements to their existing land mobile radio and data communication systems.

Appendix C – An overview of Project 25 standards

The following is an excerpt from a white paper produced by the Telecommunications Industry Association (TIA) regarding the Project 25 standards. A full copy of this paper is available at: http://www.tiaonline.org/standards/project_25/.

Project 25, Public Safety Communications Interoperability – Frequently Asked Questions

The following Frequently Asked Questions address issues relating to the Project 25 Standards. Project 25 (or P25) is a full set of radio telecommunications standards that provides the basis for interoperable digital radio voice and data for public safety users, departments and agencies.

The Project 25 standards were developed with public safety and federal representatives and published by Telecommunications Industry Association (TIA), an American National Standards Institute (ANSI) accredited Standards Development Organization. This FAQ document addresses the current status of the Project 25 standard.

As new technologies and public safety needs evolve, the Project 25 standards continue to be refined. Phase 1 of the P25 standard is complete, with many vendors providing compliant equipment to public safety users.

Q. What is Project 25?

A. Project 25 (P25) is the interoperability standard for digital two-way wireless communications products and systems. The P25 standard was created by and for public safety and federal communications professionals to provide detailed standards for the design of communications systems so that all purchasers of P25 compatible equipment can communicate with each other.

The original goals of the Project 25 standards team and benefits are summarized by the Project 25 Technology Interest Group website (www.project25.org). These goals (and their benefits) are to:

- Allow effective, efficient, and reliable intra-agency and inter-agency communications … so organizations can easily implement interoperable and seamless joint communication in both routine and emergency circumstances.
- Ensure competition in system life cycle procurements … so agencies can choose from multiple vendors and products, ultimately saving money and gaining the freedom to select from the widest range of equipment and features.
- Provide user-friendly equipment … so users can take full advantage of their radios' lifesaving capabilities on the job – even under adverse conditions – with minimal training.

- Improve radio spectrum efficiency … so systems will have enough capacity to handle calls and allow room for growth, even in areas where the spectrum is crowded and it is difficult for agencies to obtain licenses for additional radio frequencies.

P25 is gaining worldwide acceptance for public safety, security, public service, and commercial applications. P25 compliant equipment is interoperable within the prescribed services described in the open, published standard.

Abilities include backward compatibility and interoperability with other compliant systems, across system boundaries, regardless of manufacturer or radio network infrastructure.

Q. Are there any Project 25 systems in operation today?

A. Yes. Today there are over 660 operational Project 25 networks in 54 countries worldwide providing interoperability for public safety and federal agencies in many areas from major metropolitan to rural areas.

Q. What agencies and associations have adopted P25 as their recommended interoperability method?

A. An ever-increasing list of agencies and associations have taken a stand in support of P25. In addition to local and state adoption of P25, the Federal Communications Commission chose the P25 suite of standards for voice and low-moderate speed data interoperability in the new nation-wide 700 MHz frequency band.

The National Communications System (NCS) was the first Federal agency to indicate support of Project 25. Now the U.S. Department of Defense has mandated P25 for new land mobile radio systems. The Department of Homeland Security specified P25 as the preferred standard for obtaining federal funding for interoperability grants.

The National Telecommunications and Information Administration (NTIA), which manages spectrum for the federal government, has mandated narrow banding (12.5 kHz) for Federal agencies. This mandate had an original effective date of 2005 for the VHF Hi bands (162-174 MHz), and 2008 for all other bands. While there has been Federal recognition of the importance of Project 25, users may select either a digital technology such as P25 or an analog narrowband technology.

Many US government agencies, including Treasury, Interior, Department of Homeland Security, National Communications System, and Department of Justice, and the Department of Defense have specified P25 for procurements of new radio communications systems and equipment.

Q. Is the Project 25 standard complete?

A. Project 25 work has two main phases. Of the eight originally envisioned interoperability standards, six have been completed and published. Five of these, which are referenced as Phase 1, also have compatible equipment from multiple vendors in service in many systems today. The sixth, the ISSI (Inter Subsystem Interface), continues to be refined as part of Phase 2, which also addresses three additional interfaces. The following chart provides an update on the status of the different interfaces and indicates where the previous completion of the interface has enabled manufacturers to bring compliant equipment to market.

Project 25 Interoperable Interfaces	Standard Published	Hardware Available	Hardware Procured by Public Safety Agencies	Testing completed to verify conformity with P25	Equipment in Service
`Phase 1 Interfaces					
Common Air Interface (CAI)	✓	✓	✓	✓ (independent)	✓
Telephone Interconnect Interface	✓	✓	✓	✓ (supplier/customer)	✓
Subscriber Data Peripheral Interface	✓	✓	✓	✓ (supplier/customer)	✓
Data Network Interface	✓	✓	✓	✓ (supplier)	✓
Network Management Interface	✓	✓	✓	✓ (supplier/customer))	✓
Phase 2 Interfaces					
Inter RF Subsystem Interface (ISSI)*	✓				
Console Interface					
Fixed Station Interface					
TDMA Operation					

* ISSI *Overview* and *Messages Definition* documents only. Additional documents in development.

Q. How many manufacturers of Project 25 equipment exist?

A. Currently there are fourteen manufacturers of Project 25 equipment, with many more who have announced equipment availability for later this year. The PTIG website (www.project25.org) lists contact information for many of the participating companies.

Q. What is in the future for Project 25?

A. Additional elements of the standard are being considered as part of the Project 25 standard technology that is being called Phase 2 and is focusing on these areas: Additional air interface specifications to provide further narrow banding operation, at 6.25 kHz equivalent bandwidth operation.

Further work on the interface standards including system, (Inter-RF Subsystem Interface [ISSI]), digital console and fixed station. Other standardization efforts in progress address a variety of additional public safety user requests, including data and over the air programming.

Q. When will Phase 2 be completed?

A. Phase 2 is a vehicle for users to bring additional requirements to the standards board. Some elements could be completed in the 2005-2006 timeframe.

The Phase 2 extensions, with the exception of the ISSI, console, and fixed base interfaces, will have very little impact on first responder interoperability. Rather, they provide another alternative for spectrum efficiency and expanded competition in the marketplace. They also facilitate improved communication at the P25 compliant network level. Finally, they will provide users in dense population areas additional standardized options to meet their long-term user needs within the limits of their existing spectrum allocations.

Will Project 25 Phase 2 replace Phase 1?

A. No, Phase 2 extensions build on the technology and features of Phase 1. Phase 2 requirements include backward interoperability with Phase 1. Communication agencies will continue to require the functionality of Phase 1 with Phase 2 expanding the capability of P25.

Q. Why shouldn't agencies wait to purchase Project 25 equipment until everything is completed?

A. Since interoperability and migration/backward compatibility are key tenets of Project 25, there is no practical reason for agencies to wait to take advantage of currently available Project 25 technology. Hundreds of systems are in place now and the benefits of the standard are being enjoyed already by thousands of users.

Appendix D – Examples of statewide radio systems

Colorado

(http://www.colorado.gov/dtr/)

- System Owner – Department of Personnel and Administration, Division of Information Technologies in partnerships with local and federal government agencies
- System Manager - Division of Information Technologies
- System Maintenance - Division of Information Technologies in partnership with local government agencies and private companies
- System Governance - Consolidated Communications Network of Colorado Inc. (CCNC) (http://www.ccncinc.org)

Oversight and authority for building a statewide public safety voice radio system was contained in the enabling legislation creating the Public Safety Communications Trust Fund in 1998. According to the information on the Colorado Web site, this Act placed the responsibility for administration of the trust fund with the Executive Director of the Department of Personnel and Administration, and set forth criteria to be considered by the Executive Director to consider when carrying out this function. The Executive Director was required to:

- Develop bid specifications for acquiring radio communications equipment for state entities.
- Adopt rules for the participation of state and local government agencies in, and distributions from the trust fund.
- Account for all activities in connection with the trust fund and report annually to the Governor, the Legislature, and state auditor.
- Adopt recommended standards for replacement of analog radio equipment with digital radio equipment in the Department of Public Safety.
- Adopt recommended standards and establish a timetable for the replacement of radio telecommunications equipment with a system that meets certain FCC requirements as they relate to the telecommunications needs of state agencies.

The act also required the Division of Information Technologies to develop and implement a digital two-way radio (Digital Trunked Radio (DTR)) system to provide interoperable voice communications for state, federal and local government agencies.

As of August 2005, the Division of Information Technologies has finished implementing five of the seven phases of the DTR project. DTR is planned and is being constructed in regional phases through partnerships with federal and local government agencies. DTR currently supports voice radio coverage based on

P25 standards and is being expanded to include mobile data communications in the future. Approximately 21,000 users from over 400 state, federal and local government agencies are currently operating on DTR which includes 100 radio tower sites and three radio network control centers. The total number of sites estimated to provide 95 percent mobile coverage throughout the state is 160.

DTR system management and maintenance for state owned resources are the responsibility of a dedicated team within the Division of Information Technologies, which includes:

- 6 engineers
- 4 system monitoring technicians
- 3 administrative personnel
- 38 technicians

System partners, and local and federal agencies, are often either self maintained or contract with private companies to support shared network components.

System governance is a collaborative effort between the state and the Consolidated Communications Network of Colorado Inc. (CCNC), The CCNC represents the interests of the users and agencies that operate on the DTR and is a multi-layer organization. Each participating user agency designates a representative to the CCNC and the user group meets monthly. Users also elect regional board member representatives based on discipline (Fire/EMS, law enforcement, other). These regional board members elect executive board members who manage the user group, coordinate the work of various subcommittees, review and recommend agency participation in DTR and mediate disputes among participants.

Michigan

http://www.michigan.gov/mpscs

- System Owner – Department of Information Technology
- System Manager - Department of Information Technology
- System Maintenance - Department of Information Technology
- System Governance - MPSCS System Advisory Board

Michigan's Public Safety Communications System (MPSCS) is operated by the Michigan Department of Information Technology (DIT). A MPSCS System Advisory Board composed of 19 member representatives acts as an advisory panel to DIT and the Governor. The MPSCS System Advisory Board is charged with advising DIT and the Governor on the following:

1. Best practices for implementing interoperability of wireless public safety communications, including data, in Michigan on a local, regional, and statewide basis.

2. Future trends in public and private sectors relating to public safety wireless communication, interoperability standards, and technology in support of providing public safety wireless services in the most effective and efficient manner.

3. Opportunities for effectively using the MPSCS as part of local, regional and statewide mutual-aid agreements, 9–1–1 dispatch operations, and incident command systems.

4. Best practices for using interoperability training on a local, regional and statewide basis.

5. Development and implementation of Michigan's interoperable communications plan

Key to the state and local relationship is the MPSCS Membership Agreement that details:

- System operations and performance levels
- State responsibilities, member fees and responsibilities
- Relationship management and dispute resolution

The MPSCS is a mature system that has worked through implementation and operational challenges, and can provide specific practical examples for Washington to consider.

The MPSCS currently has 24 management, administrative and clerical personnel, as well as five system engineers and 46 radio technicians located in nine regional radio shops throughout the State of Michigan.

Currently, there are over 400 federal, state and local public safety agencies with approximately 16,000 radios on the system.

Utah

http://uwin.utah.gov/index.html

- System Owner – Multiple agencies and entities
- System Manager - Multiple agencies and entities
- System Maintenance - Multiple agencies and entities
- System Governance – UWIN Board

In 2003, the Governor created the Utah Wireless Integrated Network Board which was charged with promoting and coordinating wireless interoperability among state, local federal and other agencies in Utah. Members of the board are appointed by the Governor from agencies with public safety, technology, or telecommunications expertise, and must include one or more representatives from local, state, federal, and other agencies. The board's executive committee consists of five members, one each from the Department of Public Safety, Department of Administrative Services, Department of Health, the Utah Communication Agency Network (UCAN), and a member representing local government.

The vision of UWIN is to create a wireless intergovernmental network that will leverage existing state resources to provide seamless, coordinated, and integrated communication for local, state, and federal agencies. UWIN's mission is to plan for and foster coordination and integration among wireless networks on a statewide basis to meet the requirements of local, state, and federal public safety and other state agency needs.

In 2004, UWIN published their Strategic Plan, which outlines a process to establish and maintain voice and data interoperability by leveraging existing infrastructure with emerging technologies. The principle state agency users of wireless infrastructure include the Department of Public Safety, Department of Administrative Services, Department of Transportation, Department of Natural Resources, State Tax Commission, Department of Health, Utah Communication Agency Network (UCAN) and the Department of Corrections. Local law enforcement and emergency response agencies, and federal partners are also key participants.

As a major stakeholder on this board, UCAN operates and maintains a ten-county 800 MHz system, covering one third of the state, serving 101 public safety agencies, connecting 44 remote sites and towers, and 17 Enhanced 911 centers, and serves over 10,000 radio users.

The Division of Information Technology Services (ITS) maintains two statewide VHF conventional wireless voice products. The State Repeater System (SRS) is used by ITS customers throughout Utah's geographic regions. The network enables two-way voice only radio communications for law enforcement, emergency services, and other local, state, and federal operations. ITS also operates and maintains the Law Enforcement System (LES) for use by the Department of Public Safety and other law enforcement organizations. This system is used primarily outside the areas not served by the Utah Communications Agency Network (UCAN).

The end goal of the plan is to create a combined IP network that will support wired and wireless communication on a statewide basis, integrating technologies

and resources from UCAN, LES, SRS, and the state's wide area network. This approach will push all communication over an IP backbone and gateway servers to facilitate interoperability.

The overall management and oversight strategy for UWIN hinges upon service provider involvement with key management areas and clearly defined roles and responsibilities. The UWIN management and governance organization is a "virtual" agency that integrates leadership from key agencies, includes participation from state and local public safety officials, as well as federal partners.

Florida

http://eits.myflorida.com/slers/

- System Owner – Enterprise Information Technology Services
- System Manager - Enterprise Information Technology Services
- System Maintenance – System Vendor
- System Governance – Joint Task Force (JTF) Board

Legislation provided the authority for building a statewide law enforcement radio system. It also directed the state's Enterprise Information Technology Services (EITS) to acquire and implement a new communications system to serve law enforcement units of state agencies, and to serve local law enforcement agencies through a mutual aid channel. This shared system provided an enterprise solution to facilitate communications among 17 state law enforcement entities. The goal of the Statewide Law Enforcement Radio System (SLERS) project was to provide state law enforcement officers with a shared 800 MHz radio system.

Agencies are included in the 800 MHz system by statutory reference or by acceptance into the Governor's Enterprise-wide Sharing of Resources Model. These agencies are statutorily referenced to comprise the Joint Task Force (JTF) on State Agency Law Enforcement Communications. Under Florida statute the Joint Task Force may also authorize other state agencies to use the 800 MHz system.

Florida entered into a public/private partnership for the Statewide Law Enforcement Radio System and developed a unique funding strategy. For providing the services specified in the system contract, the system vendor was paid a $40 million advance payment plus it receives the ongoing proceeds from a motor vehicle and vessel registration surcharge less certain stipulated expenses incurred by the state. This revenue stream to the system vendor provides for the system infrastructure (towers, antennas, system equipment, system maintenance, radio consoles for dispatch) and 800 MHz service. In return for the conveyance of various state tower and tower site assets, the system vendor also

extended credits to the state for radios and accessories. The contract also provides for revenue sharing between the state and the vendor from co-location on conveyed towers and third party system subscribers.

The Enterprise Information Technology Services (EITS) section manages this enterprise project along with the advisory Joint Task Force (JTF) Board. The eight statutory agencies appoint board members and the board has established various committees to assist in the development of polices and procedures for ongoing system operations and enhancements.

Also established by statute was the Law Enforcement Radio System Trust Fund within the Enterprise Information Technology Services section. Under the statute, the Enterprise Information Technology Services is responsible for the design, engineering, acquisition and implementation of the system. The EITS provides the project director, system manager and engineering and real estate staff to carry out the state's contract management responsibilities. The EITS team also coordinates and facilitates the various deployment activities involving the JTF member agencies, their technical staff and their system users. In carrying out its duties, the EITS works with the program and engineering staff of the involved agencies to ensure that the finished system will meet the needs of the user agencies.

South Carolina

http://www.cio.sc.gov/cioContent.asp?pageID=756&menuID=411

- System Owner – System Vendor
- System Manager – System Vendor
- System Maintenance – System Vendor
- System Governance – Palmetto 800 Users Advisory Committee

The South Carolina statewide 800 MHz radio and mobile data system is another example of a cost-shared public/private partnership between state government, local governments, power utilities and the system vendor. In operation since 1992, the original system contract was with SCANA Communications, Inc., a subsidiary of the energy services company SCANA Corporation. In 2001, the system vendor purchased the primary ownership and management of the system and entered into a contract to provide system services with the State of South Carolina.

Commonly referred to as the "Palmetto 800" system, it is one of the largest shared public safety radio systems in the nation with reported system users in excess of 18,000. Over 200 different agencies representing state, local and federal government, law enforcement agencies, fire services, EMS services and power utilities currently participate in the shared statewide 800 MHz system.

The statewide trunked 800 MHz radio system contract is administered by the South Carolina Budget & Control Board, Division of the State Chief Information Officer (CIO). Operational management of the system is provided under state contract by the system vendor. The state CIO's Office, the system vendor and an 800 MHz Users Advisory Committee work together to help provide cost saving and manage the costs of operating the statewide system. System oversight is provided by the Palmetto 800 Users Advisory Committee. Advisory committee members are elected to two-year terms by the system users. Advisory committee member positions represent: state law enforcement, local government, law enforcement, fire, EMS, emergency management, power utilities, large users (over 500 units), at-large state government and at-large local government system users. Operation and maintenance of the Palmetto 800 system is self supporting and funded by the users through monthly user fees.

Appendix E – Cost estimate assumptions

In order to develop the preliminary costing and implementation schedules for the TIP, several key assumptions regarding the types and distributions of radio sites were made. These assumptions were driven by a review of the estimated numbers of radio users operating in each region as identified by the participating state agencies.

Channel loading and site density

The average channel loading per region based on these user counts is three per band (VHF and 800), excluding DOC users. Except when traveling to and from facilities, DOC traffic would be limited to their own institution on their existing channels. Therefore the typical wide area site was populated as three voice channels per band and characterized as medium density. This is also consistent with other statewide system deployments (three to seven total voice channels per site)

None of these regions had a channel count higher than ten justified, based on user loading estimates, therefore a high density site was populated as three to ten voice channels per band. It is also likely that the user counts in some instances reflect potentially concurrent users (one user with both a mobile and portable). High density sites (three to ten channels per band) would likely only be warranted in highly urbanized areas or corridors.

Significant concerns were raised by state agencies regarding loading and power requirements at some remote state-owned sites. To address this, a low density site configuration was created that had a minimum level of wide area capabilities (one channel for voice/data in each band). Low density sites would be deployed in remote areas without the likelihood of high levels of daily radio traffic.

It was assumed that 30 remote sites (DNR and DOC) would likely be low density, and that the remaining 120 state sites (WSP, DOT and EMD) would be a mixture of medium to high density sites. Further estimates that no more than 10 percent of the total number of sites would likely support the loading or capacity requirements for high density sites led to the final specification of 105 medium density and 15 high-density sites. Channel capacity at any particular site may be modified at some sites based on operational requirements and transport bandwidth available at each site but this would be determined during a final design review process.

Personnel support

The total number of personnel required to support the proposed system was developed based on the current personnel count, as identified by the participating agencies that currently support the existing agency systems. In

addition to these personnel, seven full time employees were added to the personnel count to manage the radio network control centers and 13 additional technical personnel were also added to support the expanded mutual aid, RoIP and mobile data infrastructure components of the architecture.

System acquisition and recurring costs assumptions

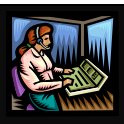
The summary of the assumptions used to estimate the system acquisition and annual recurring expenditures is shown below in Table E-1, Cost estimate assumptions:

Cost element	Quantifier	Description
Number of sites	150	Estimated number of sites required and based on estimates of the number of sites in use by all state agencies
Microwave hops	60	Estimated number of additional microwave hops requiring upgrades based on information provided by WSP
Radio network control centers	2	Two sites are planned: one located in Olympia, and one in Yakima
Channel capacity	-	Capacity is determined as follows: **(15) High-density site channels:** (10) 800 MHz P25 trunked (10) 150 MHz P25 trunked (2) 800 MHz mutual aid (2) 150 MHz mutual aid (1) VHF low band mutual aid (1) UHF mutual aid (2) 700 MHz data **(105) Medium-density site channels:** (3) 800 MHz P25 trunked (3) 150 MHz P25 trunked (1) 800 MHz mutual aid (1) 150 MHz mutual aid (1) UHF mutual aid (1) 700 MHz data **(30) Low-density sites:** (1) 800 MHz P25 voice/data conventional (1) 150 MHz P25 voice/data conventional (1) 800 MHz mutual aid analog (1) 150 MHz mutual aid analog
Multiple subsystems base stations (excludes mutual aid channels)	990	P25 base stations required to build subsystems.
Base stations - mutual aid channels	465	Creates a 6 channel overlay on 15 high density sites, 3 channel overlay on 105 medium density sites; 2 channel overlay on 30 low density sites; includes low band, VHF, UHF and 700/800 MHz channels

Cost element	Quantifier	Description
Dispatch center equipment	39	Number of dispatch centers identified by state agencies with an estimated total of 150 consoles
Mobile radios	8,247	Includes upgrade of all P25 capable mobiles and replacement of all non-P25 capable mobile radios
Portable radios	7,349	Includes upgrade of all P25 capable portables and replacement of all non-P25 capable portable radios
Mobile data (medium speed)	8,247	700 MHz modems and laptops (based on mobile radio count)
RoIP equipment	159	Included RoIP gateways at 120 sites and 39 dispatch centers (as identified by the state agencies)
Support personnel	94	Existing agency personnel counts were used for estimating voice radio system cost Additional personnel were added to support new mutual aid and mobile data systems for both alternatives
Support costs / per year	20%	Yearly maintenance costs, based on industry average percentage, calculated on equipment that is not maintained by state personnel
Implementation and project management (PM) costs	50%	This percentage applied to total equipment costs to account for all installation services including: PM services, system integration, system commissioning and testing
Equipment and supplies / per year	1%	Parts and supplies for the maintenance of the systems Calculated as a percentage of equipment costs
Training / per year	15%	Percentage of personnel costs estimated for annual education and training for all aspects of the system and operational process improvements
Subscriber unit pricing	-	High tier pricing was used for subscriber equipment Average equipment pricing was used for all other cost estimates
Encryption pricing not included	-	The multiple subsystems architecture supports encryption The cost does not include equipment for the management of an encrypted system, and does not include the option required to enable encryption on subscription equipment
Legacy equipment reuse credit	-	The credit is applied to existing base station equipment, after rework costs, when deployed in the system All existing base station equipment, regardless of age or condition, is considered eligible for reuse

Table E.1 – Cost estimate assumptions

Appendix F – Process change requirements

Critical operational changes	 **System management**	 **Dispatch center**	 **End user operator**
Capability	**Implementation requirements**		
Centralized system and network management will provide consistent functionality to users across subsystems and to dispatch centers.	Planning Policies Standard Operating Procedures (SOPs)	SOPs Training	Training
Operation and maintenance of the common shared infrastructure will be performed by a dedicated staff for the benefit of all participating agencies.	Policies SOPs		
Pooling of existing licensed frequencies and management of state-owned radio spectrum will be performed by dedicated staff for the benefit of all participating agencies.	Policies SOPs		
Sharing VHF and 700/800 frequencies among agencies will be determined by a system management team comprised of the technical system managers from participating agencies.	Policies SOPs	Policies SOPs	SOPs
Subsystems configuration management to provide required levels of radio coverage and monitor voice quality.	SOPs	SOPs	Training
Trunking channels will enable the use of shared, designated talk groups for daily operations, as well as large scale, multi-agency, mutual aid incidents.	Planning Policy SOPs	SOPs	Training
System encryption will be implemented to increase security and control.	SOPs	SOPs Training	Training
Radio feature sets will be implemented according to a defined plan for agencies users with various needs.	SOPs	SOPs Training	Training
Additional deployments of infrastructure, sub-systems and sites will be conducted on a planned coordinated basis as required and when funded.	Planning Policies SOPs	Training	Training
Roaming will be implemented across subsystems so that it is available and mostly transparent to individual radio users and dispatch console operators.	SOPs	Training	Training

Critical operational changes	 **System management**	 **Dispatch center**	 **End user operator**
Capability	**Implementation requirements**		
System access rights/priorities for different groups of users need to be established to manage system/site loading.	SOPs	Training	Training
Gateway interfaces will be implemented to enable interoperable communications across multiple frequency bands for fixed and tactical operations.	Planning Policy MOUs	SOP Training	Training
Mobile data offers a variety of applications for users (e.g., e-mail, text messaging, Automated Vehicle Location) that will need to be prioritized for implementation based on end user needs.	Planning Policy	SOPs	SOPs Training
Mutual aid and the six channel multi-spectrum overlay system offer non-state agencies an interoperability solution that may require a special team to implement and manage.	Policy MOUs	SOPs Training	SOPs Training

Table F.1 – Process change implementation requirements

Appendix G – Glossary of terms and acronyms

Agency Term that applies generically to any local, state, federal entity or organization, including: a department, division, city/town, or bureau. This includes government, quasi-government, and private groups.

Analog A type of radio signal that uses continuous changes in the amplitude or frequency of a radio transmission to convey information.

Backbone A backbone is a larger transmission line that carries voice and data gathered from smaller lines that interconnect with it.

Backhaul In wireless network technology, backhaul refers to the capability to transmit voice and data traffic from a radio site to a switch, i.e., from a remote site to a central site. In satellite technology, backhaul means to transmit data to a point from which it can be up linked to a satellite.

Band The spectrum between two defined limited frequencies.

Bandwidth The capacity of a telecom line or channel to carry signals. The necessary bandwidth is the amount of spectrum required to transmit the signal without distortion or loss of information. FCC rules require suppression of the signal outside the band to prevent interference. Common signal capacities used are:

DS0: A single 64 Kbps channel, the building block of a T1 transmission line.

T1 (DS1): A digital carrier of 1.544 Mbps. Twenty-four DS0 channels make up one T1 channel.

OC1 (DS3): A digital carrier of 45 Mbps bandwidth. One OC1 channel can carry 28 DS1 channels.

OC3: A digital carrier of 135 Mbps bandwidth. One OC3 channel can carry 3 OC1 channels.

Base station A fixed station in the land mobile service operating in a manner that communicates directly to field subscriber units.

Cellular Mobile/wireless telephone communications is geographically broken into relatively small cells.

Channel	A connection between initiating and terminating nodes of a circuit. A single path provided by a transmission medium via an electrical separation, such as by frequency or frequency pairs.
Communications	Information transfer among or between users.
Communications interoperability	The ability of public safety agencies to talk across agencies and jurisdictions via public safety communications systems, exchanging voice and/or data with one another on demand, in real time, when needed.
Console patch	A control center subsystem that permits a mobile or portable radio on one channel to communicate with one or more radios on a different channel through the control center console.
Conventional	Radio system with dedicated, single-purpose analog channels (can be shared between several users with different operational needs; *i.e.,* fire and police), operator must select the specific channel to be used.
Coverage	The geographic area included within the range of a wireless radio system.
Cross-band	A repeater that receives in one frequency band and retransmits in a second frequency band (see repeater).
Digital	Radio transmission method, replacing analog FM systems, that transmits binary 1's and 0's much like a computer. Generally digital signals are more effective than analog signals in fringe areas (better coverage), however once the signal levels are below a certain threshold minimum no communications are possible. As data is normally digital, data transmissions are very compatible with digital radios.
DIS	Washington State Department of Information Services (DIS).
DS	Digital Signal (DS) is a classification of digital circuits. The DS technically refers to the rate and format of the signal, while the T (trunk) designation refers to the equipment providing the signals. In practice, "DS" and "T" are used synonymously; for example, DS1 and T1, DS3 and T3.
Encryption	Encoding (and decoding) or “scrambling” of transmissions to provide secure/private communications that can only be unlocked by the intended/authorized recipient(s).
Enterprise Architecture	Enterprise Architecture identifies the main components of an organization and how they function together to achieve the business objectives. These components include personnel, business process, technology, financial information, and other resources.

Federal agencies Includes any agencies under the jurisdiction of the U.S. government.

First responders Individuals who are responsible for the protection of life and property. They normally are the first professionals called to an incident or emergency to provide immediate support services during prevention, response and recovery operations.

Frequency bands The spectrum of transmission space where public safety land mobile radio systems operate in the United States. They are (from low-high):

Spectrum	Frequency range
High HF	25-29.99 MHz
Low Band or VHF-LO	30-50 MHz
VHF or VHF-HI	136-174 MHz
UHF	450-470 MHz
UHF T-Band	470-512 MHz
700 MHz	764-776 & 794-806 MHz
800 MHz	806-869 MHz
4.9 GHz	4940-4990 MHz

Gateway A device that can transparently interconnect radio audio paths so that agencies can patch into each other's radio channels in real time. This can be done at the baseband level or using IP. A gateway provides interconnection between two networks with different communications protocols.

Grants Funding made available to local agencies from state and federal government agencies, as well as from private sources such as foundations.

High speed data High speed mobile data networks use new technology and spectrum to provide initial data rates above 264 Kbps and also requires separate radio modems and infrastructure. Coverage would be comparable to medium speed data networks although at reduced data rates as units move away from the data base station transmitters. Typical applications supported would include the sending and receiving of static images, transmitting and receiving field reports, intranet and Internet access. These higher data rates are expected to be achieved in the 700 MHz band using aggregated wideband channels to support bandwidth intensive applications such as mobile and remote video transmissions. The use of 4.9 GHz spectrum dedicated to public safety is also expected to be utilized to provide office LAN type bandwidth in metropolitan areas as an enhancement to mobile data networks and for use on an “ad hoc” tactical basis. Trials of the 4.9 GHz systems are currently underway in several cities.

Infrastructure	Infrastructure refers to equipment, physical facilities, networks or other communications components required to move or transmit information between end points.
Interference	Extraneous energy, from natural or man-made sources, that impedes the reception of desired signals.
Internet Protocol	Internet Protocol (IP) is a data-oriented protocol used by source and destination hosts for communicating data across a packet-switched internetwork.
Interoperability	Ability of public safety personnel to communicate by radio with staff from other agencies, on demand and in real time.
Interoperability coordinator	An individual or individuals tasked with bringing together issues, solutions, policies, plans, and strategies relative to communications operability. The position focuses on improving interoperability communications at the local, state, and federal levels of government.
IP	See Internet Protocol.
ISB	Washington State Information Services Board
Jurisdiction	The geographic territory where authority and operations are exercised.
Land mobile	A public or private radio service providing terrestrial two-way communication, service paging and radio signaling.
LMR	Land mobile radio (LMR).
Local agency	Includes any or all local city, county, and regional entities, tribal governing bodies.
Low speed data	P25 Phase 1 voice radios and systems include support for low speed data transmission, either piggybacked with voice or in other modes limited to the full single channel rate of 9600 bps. Use of this feature in P25 voice systems does provide a basic low speed data system footprint equivalent to the voice network. This may be useful for low bandwidth applications such as querying license plates and driver's license databases, sending officer dispatches or text messages and transmitting location and status information. However, it is strongly recommended that voice and data service not be aggregated on narrowband channels except on a limited and strictly defined basis.
Medium speed data	Medium speed data networks use conventional, standalone, wideband radios to provide mobile data rates of up to 264 Kbps in accordance with the wideband data standards established by the Telecommunications Industry Association (TIA) in the TIA 902

	series of documents. These systems require separate radio modems and infrastructure, and typically provide wide area coverage and support applications such as transmitting fingerprints, sending and receiving mug shots, sending field reports, limited intranet access, and automatic vehicle location.
Microwave	Communications systems that use frequencies from about 1 gigahertz upward for point-to-point and point-to-multipoint communications, including common carriers, cable TV operators, broadcasters, and private operational fixed users. In this context, it is the technology that is used to connect the radio transmission sites together.
Mutual aid	Generally describes a situation where a major emergency or incident requires a large number of agencies, including agencies from remote locations, working together to mitigate the crisis.
Mutual aid channel	A radio channel specifically allocated for use during emergency mutual aid situations.
Narrowband	In LMR systems, the FCC has mandated reducing channel bandwidths from 25 kHz to 12.5 kHz by 2013, thereby potentially doubling the number of available channels. Narrowband operations will be mandatory by January 1, 2013, when all public safety users must cease operation of wideband equipment.
OC	Optical Carrier (OC) is the transmission speeds defined for use in a synchronous Optical Network (SONET) or the international standard Synchronous Digital Hierarchy (SDH) network.
On demand	Immediately available when mission requires. Must be available under any circumstances.
P25	TIA Project 25 (P25) is a digital radio interoperability standard adopted by federal government agencies, many law enforcement/public safety agencies, and all users of the 700 MHz band. After a slow start, more and more manufacturers are producing P25 compatible base station and subscriber equipment. More work remains to be done in developing additional standards such as intersystem and dispatch console communications between different manufacturers. The Phase I over the air standard has been in place since October 1995 but other parts of the standard are still not yet complete. Phase II will extend Phase I standards into 6.25 kHz channels and Time Division Multiple Access (TDMA) transmission. The goals of Project 25 include: interoperability (greater safety and productivity with enhanced mutual aid), choices (suppliers), longevity (of technology/equipment), flexibility (to expand as resources and needs require), and economy (towards competitive sources).

Public safety services	For the purposes of the SIEC, public safety agencies provide services that protect and preserve life, health, property and natural resources. Public safety agencies can include state, federal, local or other government entities or non-governmental organizations that are authorized by a government entity to provide such services.
Radio communications equipment	Telecommunications equipment refers to one or more radio transmitters and/or receivers and/or parts for use in a fixed, mobile or portable application. It can be operated with ancillary equipment but if so, is not dependent on it for basic functionality.
RoIP	Radio over IP (RoIP) refers to the use of IP networks as the backbone to carry the voice traffic (VoIP) between radio base stations and console equipment. Today, IP networks can carry both voice and data for public safety.
Real time	When there is no noticeable delay between the time information is sent and when it is received.
Receiver	The component(s) of a radio device that converts the radio waves into audible signals.
Repeater	Special receiver/transmitter combination that receives a signal on one frequency and retransmits a new signal on another frequency, usually within the same frequency band, sometimes referred to as a relay station.
Roaming	Use of a wireless phone or public safety mobile communications (PSMC) equipment outside of the "home" service area defined by a service provider or system. Allows a user to travel statewide and communicate as if they were still in within their local area.
SAFECOM	SAFECOM is managed by the Department of Homeland Security (DHS) Science and Technology (S&T) Directorate's Office for Interoperability and Compatibility (OIC). Its mission is to serve as the umbrella program within the federal government to help local, state, tribal, and federal public safety agencies improve public safety response through more effective and efficient interoperable wireless communications - allowing public safety agencies to talk across disciplines and jurisdictions via radio communications systems, exchanging voice and/or data with one another on demand, in real time, when needed as authorized.
Satellite	Radio relay station (repeater) that orbits the earth. A complete satellite communications system also includes earth stations (and portables/mobiles) that communicate with each other via the satellite. The satellite receives a signal transmitted by an

originating earth station and retransmits that signal to the destination earth station(s)/receiver(s). Satellites are used to transmit telephone, television and data signals originated by common carriers, broadcasters, distributors of cable TV program material and for PSMC use into areas of coverage dead spots.

Spectrum The range of electromagnetic radio frequencies used in the transmission of sound, data and television.

Subscriber unit Equipment associated with a person or vehicle in the field. All mobile and portable equipment, including but not limited to portable radios, mobile radios, mobile data computers (laptops, terminals, etc.), pagers, cellular and satellite phones, and hand held data equipment such as personal digital assistants (PDAs).

Talk group Users assigned to a specific group that normally communicate with each other. Primarily preprogrammed into a trunk system, but can be assigned on-the-fly to add other users to interoperate with the group during emergencies or joint operations.

Trunking Radio system with a group of channels available and assigned as needed to specific "groups" or uses. All channels are automatically system assigned while in-use, then released for other users. Maximizes traffic in a minimum number of channels. FCC preferred method of operation (especially for new systems).

UHF Ultra High Frequency (UHF), the part of the radio spectrum from 300 to 3000 MHz, which includes broadcast TV Channels 14 and higher, lower frequency microwave and some marine, aviation and land mobile services.

Variable density radio sites The proposed system architecture consists of a mixture of low, medium and high density radio sites for voice and data. Each radio site would consist of multiple radio channels operating in either an analog or digital mode or a trunked or conventional manner with typical equipment configurations as displayed in the chart below.

Equipment / bandwidth	Site density and equipment quantities		
	Low	Medium	High
VHF P25 trunked repeater stations	-	3	3-10
800 MHz P25 trunked repeater stations	-	3	3-10
VHF P25 conventional repeater station	1	-	-
800 MHz P25 conventional repeater station	1	-	-

Equipment / bandwidth	Site density and equipment quantities		
VHF wideband analog mutual aid base stations	1	1	2
UHF wideband analog mutual aid base station	-	1	1
800 MHz NPSPAC analog mutual aid repeater stations	1	1	2
Low band analog mutual aid base station	-	-	1
700 MHz wideband mobile data base stations	-	1	2
RoIP interfaces supporting connections		1-4	1-8
DS0s of transport bandwidth	2-4	5-9	10-17

VHF Very High Frequency, the part of the radio spectrum from 30 to 300 MHz, which includes broadcast TV Channels 2-13, the FM broadcast band and some marine, aviation and land mobile services.

VHF high band Frequencies between 150 and 174 MHz.

VHF low band Frequencies between 30 and 50 MHz, also known as low band.

VoIP Voice over Internet Protocol (VoIP) is a standards-based technology that enables voice and audio signals to be transported over an Internet Protocol (IP) network. VoIP is capable of carrying both radio and traditional telephony calls. The audio is encoded using standard signal processing standards such as International Telecommunication Union (ITU) G.711 or ITU G.729, and is encapsulated in a standard transport protocol such as Real-Time Transport Protocol (RTP) or Secure RTP (SRTP).

Wideband In LMR systems, most channels are of 25 kHz bandwidth for voice communications.

Appendix H – Analysis of governance alternatives

The following analyses were performed in order to understand the governance model alternatives fit with the Enterprise Architecture principles and the SIEC Guiding Principles.

Analysis of governance alternatives relative to the Enterprise Architecture principles

The Enterprise Architecture (EA) approach, which the Information Services Board (ISB) adopted,[38] was used to provide a high-level analysis of the characteristics of each governance model. These principles are as follows:

- The Commonality Principle – Should be common where there is a clear business case; once designated as common, justification is required to deviate.
- The Business Alignment Principle – Should align projects and investments based upon Priorities of Government (POG).
- The Natural Boundaries Principle – Should be designed around natural boundaries.
- The External Linkage Principle – Should facilitate linkages with external partners.
- The Scalability Principle – Should be scalable to support different size organizations and loads, and handle growth or decline in business levels.
- The Security Principle – Should protect assets.
- The Customer Viewpoint Principle – Should be designed around the customer's viewpoint and provide a consistent customer experience.
- The Business Ownership Principle – Should have a clear business owner.
- The Business Continuity Principle – Should be designed and implemented in a way that minimizes interruptions to service.
- The Interoperability Principle – Should enable interoperability.

Each governance alternative was mapped to each EA principle and given a score that ranges from zero to two.

- A score of zero meant that there was little to no fit between the governance alternative and the EA principle.
- A score of one was used when a moderate fit was present.
- A score of two was used to identify a strong fit.

[38] [38] http://www.isb.wa.gov/committees/enterprise/principles.aspx

There were no forced distributions, in that each alternative was scored on its own relative to the scale, not to each other. The details of this analysis are included below.

The results of this analysis are shown in Table H.1:

EA PRINCIPLE	Current approach	Lead agency	Governing board
Commonality	1	2	2
Business alignment	0	2	2
Natural boundaries	1	2	2
External linkages	1	2	2
Scalability	1	2	2
Security	2	2	2
Customer viewpoint	0	2	1
Business ownership	0	2	1
Business continuity	1	2	2
Interoperability	1	2	2
TOTAL	**8**	**20**	**18**

Table H.1 – Assessment of alignment of governance alternatives with EA principles

The analysis, by principle, is as follows:

- The Commonality Principle – Should be common where there is a clear business case; once designated as common, justification is required to deviate.

  Current approach (1): The commonality across the current agencies is driven mostly by the SIEC in terms of standards and other policy issues. However, the agencies appear to be driven by what is right for them and for their business mission first, with commonality as a secondary consideration.

  Lead agency (2): Commonality will be a fundamental principle of this approach, but also providing the forum (through the SIEC) to enable different approaches when necessary.

  Governing board (2): This approach also is based on a strong commitment to commonality but has the dynamics of an ad-hoc organization that may slow decision making.

- The Business Alignment Principle – Should align projects and investments based upon Priorities of Government.

The state, through the ISB and the SIEC, has adopted a Priority of Government that focuses on public safety communications. The priorities of the SIEC are outlined in the Governing Principles, referenced in several parts of this document. These principles were considered as an overall set of priorities in developing the scoring below.

Current approach (0): The ability to communicate within each agency is well-established for most areas of the state. However, progress has been slow in achieving interoperability between agencies and with local, federal, and tribal agencies. Continuing the current approach is likely to only show minimal incremental improvements in this area.

Lead agency (2): The lead agency will be accountable to both the SIEC and to the agencies that it supports for its priorities, investments, and plans. Thus, the alignment of these factors will be a natural outcome of the relationship with the SIEC.

Governing board (2): This approach also has full accountability to the SIEC and the characteristics are similar to what is described for the lead agency above.

- The Natural Boundaries Principle – Should be designed around natural boundaries.

  Current approach (1): There are open standards set by the SIEC that guide the intersystem relationships, but in the current approach the business modeling takes place at the agency level.

  Lead agency (2): This approach provides the ability for tight coupling within the proposed system, and will facilitate business planning at the enterprise level due to the oversight of the SIEC.

  Governing board (2): This approach has a similar structure as the lead agency approach above.

- The External Linkage Principle – Should facilitate linkages with external partners.

  Current approach (1): The current approach has provided the existing mutual aid capabilities and provide for some degree of external linkage relative to federal, local, and tribal agency interoperability.

Lead agency (2): This approach provides a consistent interface with the external partners and fosters a potentially higher level of interoperability through a single operational point of contact.

Governing board (2): The Governing Board provides similar capabilities as the lead agency approach.

- The Scalability Principle – Should be scalable to support different size organizations and loads, and handle growth or decline in business levels.

  Current approach (1): The scalability using the current approach is limited to the agency-specific capabilities and to some degree the common/shared capabilities. The current approach does not provide for a single overall view of scalability from planning, operations, or funding standpoint.

  Lead agency (2): The lead agency provides the single point of focus for looking at overall scalability. Solutions will balance the needs of each agency with the overall goals of the SIEC for interoperability.

  Governing board (2): This approach provides a similar focus on scalability as the lead agency approach does.

- The Security Principle – Should protect assets.

  This principle has not been explicitly identified in any of the SIEC Guiding Principles but since much of the mission supported by the SIEC relates to law enforcement and homeland security, it is an important aspect of the governance process.

  Current approach (2): Security at the agency level is provided with the current approach. However, there is not a consistent approach to security that is driven by the current approach which could cause additional difficulties in larger, inter-agency situations.

  Lead agency (2): Security is also strongly fostered in this approach, and it will provide a consistent approach to security across the agencies

  Governing board (2): Security is similar with this approach as with the lead agency approach. Slightly more effort may be required across the varied membership to get consensus on a common plan.

- The Customer Viewpoint Principle – Should be designed around the customers viewpoint and provide a consistent customer experience.

  Current approach (0): In the current approach, the customers, whether they are other state agencies or local, federal, or tribal agencies will each have a different experience with each agency. While some high-level issues such as policies and standards will still be driven by the SIEC, the majority of the funding, operations, and planning will occur by agency.

  Lead agency (2): The lead agency approach will provide a consistent, standardized customer interface across the funding, planning, policy and operations aspects of public safety communications.

  Governing board (1): This approach will also provide a high degree of consistency but it is possible that the interfaces with the board itself may be less consistent than with the lead agency approach.

- The Business Ownership Principle – Should have a clear business owner.

  This is also a principle that was not explicitly addressed in the SIEC's governing principles, although it certainly supports the principles as they have been constructed.

  Current approach (0): This approach has no clear business owner. The planning, funding, and operations are driven by several different agencies.

  Lead agency (2): The lead agency, almost by definition, provides a clear business owner. There is a single point of accountability for all processes and customer interfaces.

  Governing board (1): This approach provides for a single ownership concept, although it is a group that is the focus rather than the individual lead agency.

- The Business Continuity Principle – Should be designed and implemented in a way that minimizes interruptions to service.

  Current approach (1): In the current approach, business continuity planning is done primarily at the agency level and with consideration for the services that each agency provides to others. However,

currently there is not a clear coordinated approach across the various enterprise-wide priorities.

Lead agency (2): This approach would coordinate business continuity issues across all agencies and provide a single point of focus for planning, prioritization and action.

Governing board (2): The governing board approach also provides a single point of contact for business continuity issues.

- The Interoperability Principle – Should enable interoperability.

  Current approach (1): Interoperability is enabled with the current approach through a great deal of coordination and is driven by the SIEC rather than the fundamental planning processes of the agencies.

  Lead agency (2): Interoperability is integrated into all planning, funding, and operational aspects of this governance approach.

  Governing board (2): This approach would provide similar benefits as the lead agency model.

Analysis of governance alternatives relative to the SIEC Guiding Principles

A similar approach was taken with regard to analyzing each governance alternative relative to the SIEC Guiding Principles. The results of this analysis are shown in Table H.2:

SIEC PRINCIPLE	Current approach	Lead agency	Governing board
Build once, share often	1	2	2
Spectrum natural resource	0	2	2
Open standards	2	2	2
Topography/population	2	2	2
Sharing assets	1	2	1
Enterprise view	1	2	1
Lifecycle	1	2	2
TOTAL	**8**	**14**	**12**

Table H.2 – Assessment of alignment of governance alternatives with SIEC Guiding Principles

The analysis of the fit of the governance alternatives with the SIEC guiding principles is as follows:

- Build wisely, build once and share often.

  Current approach (1): In most cases, agencies build their systems to their internal requirements. There is some sharing of resources such as towers, microwave backbone, and buildings/land, but these are primarily based on the specific needs of the contracting agency rather than on a collaborative planning effort.

  Lead agency (2): This approach will drive a fully integrated planning and implementation process.

  Governing board (2): As with the lead agency approach, this will enable a consolidated approach to planning and implementation.

- Spectrum licensed by the state should be maintained as a natural resource and, to the greatest extent possible, be shared and maintained to provide the greatest return on investment.

  Current approach (0): Planning for spectrum is done primarily on an agency-specific basis. There is some coordination at the 800 MHz and 700 MHz regional committees but this is fostered by an outside organization rather than the state.

  Lead agency (2): This approach will provide a single point of contact for this capability.

  Governing board (2): This alternative provides the same capabilities as the lead agency approach.

- Communications solutions should be based upon non proprietary "open" standards when possible.

  Current approach (2): The SIEC currently addresses open standards.

  Lead agency: (2): This approach supports the SIEC's existing practice to address open standards.

  Governing board (2): This approach supports the SIEC's existing practice to address open standards.

- Topography and population density may dictate the appropriate use of radio frequencies technologies.

Current approach (2): Frequency management would be done centrally as currently planned, even with the current approach.

Lead agency (2): This approach provides for central frequency management and would support this principle.

Governing board (2): This approach provides for central frequency management and would support this principle.

- All solutions for state-funded radio systems should consider the sharing of assets between state and local governments when possible.

  Current approach (1): This principle is not well supported by the current approach, from either the funding or physical asset standpoints. While there is limited sharing, most funding and implementation processes are based primarily on each agency's specific internal requirements.

  Lead agency (2): The sharing of assets and possibly funding (with appropriate legislative changes) is a fundamental component of this approach.

  Governing board (1): As with the lead agency approach, this is a fundamental component of this approach but may result in a more difficult implementation given the absence of a single point of accountability other than at the board level.

- All solutions using state funds should be planned with an enterprise view towards connectivity and interoperability with state communications assets.

  Current approach (1): State agencies are beginning to work together in some planning processes, particularly for backbone communications capabilities. The level of funding included in these joint planning processes is limited, in some cases by legislation or federal mandates, and in others by choice.

  Lead agency (2): This alternative will provide enterprise-wide planning and solution development.

  Governing board (1): This alternative will provide enterprise-wide planning and solution development, although the absence of a single point of accountability may lead to more difficulty in prioritizing the use of funds.

- All equipment shall have a lifecycle strategy to assist in planning and management.

  Current approach (1): This approach is in use to a moderate degree but not across all planning and management processes.

  Lead agency (2): This approach would have an enterprise-wide lifecycle strategy as a fundamental component.

  Governing board (2): This approach would have an enterprise-wide lifecycle strategy as a fundamental component.