Washington State Auditor's Office

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Performance Audit

Washington State Patrol's Radio Narrowbanding Project

August 8, 2016

In 2004, the Federal Communications Commission (FCC) required all public safety agencies to convert their wideband radio systems to narrowband technology by 2013. In 2011, the Washington State Patrol decided to meet this mandate by merging its radio system with the U.S. Department of Justice's (DOJ) Integrated Wireless Network (IWN) radio system, built by Motorola. The Patrol worked with the Department of General Administration (now the Department of Enterprise Services) to award the contract to Motorola, for both infrastructure and radio equipment, without seeking competitive proposals. Although sole source contracts were allowed for purchases that were clearly and legitimately limited to a single source, seeking competitive proposals could have provided meaningful market intelligence, such as the viability of alternative vendor approaches and products.

Historically, the Patrol's system has been a mix of older equipment installed without an engineering study. We found the Patrol could have benefited from the knowledge provided by such a study before designing its narrowband system or entering into agreements with Motorola and the DOJ. It could have given the Patrol the information needed to ensure the proposed system design would be the best option to meet its needs and stakeholders' expectations. As a consequence, the Patrol had to significantly revise its narrowband system design, in turn adding years to the project and shifting responsibility for mitigating coverage issues for a large part of the system from Motorola to the Patrol.

The Patrol has likely maintained or improved coverage in some areas of the state that already had good coverage. However, it has likely seen a loss of coverage in areas that already had poor coverage but which nonetheless allowed troopers to communicate with one another. The Patrol successfully partnered with other public safety agencies, which has helped reduce the amount of additional funding the Patrol will likely need to address the coverage issues.

Until recently, the Patrol did not fully communicate the system's current challenges and future risks to legislative members, but project reports are now available online, increasing project transparency. The audit recommends the Patrol work with the Governor's Office and the Legislature to establish a long-term plan to address the system's challenges.

Audit Number: 1015481

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Executive Summary

In 2004, the Federal Communications Commission (FCC) announced that all public safety agencies must migrate their VHF/UHF radio systems to more efficient narrowband technology by January 2013. Agencies failing to meet this deadline were threatened with penalties and fines. The FCC offered agencies an extension application process in July 2011, and approved the nation's first extension in February 2012. The migration rolls out in two phases; the second will require improvements beyond those needed to meet the first narrowbanding phase.

In order to meet this mandate, the Washington Legislature approved $40.1 million in 2011 for the Washington State Patrol to upgrade its radio system. In 2012, the Patrol entered into an agreement with the U.S. Department of Justice (DOJ) to merge its system with the DOJ's Integrated Wireless Network (IWN). The Patrol determined that in order to merge with the IWN system, it was necessary to enter into a sole-source contract with the IWN system vendor, Motorola.

Legislators, the Washington State Patrol Troopers Association and competing vendors all expressed concerns about how the Patrol's radio narrowbanding project was planned, the benefits of the merger with the DOJ's IWN system, how the contract was awarded, and whether more project funds were needed for a successful transition. They also had concerns about whether funding requests to the Legislature may have received unnecessarily rushed consideration in order to meet the FCC's narrowbanding deadline.

This audit examined how the Patrol's narrowbanding project planning, funding requests, and procurement and contracting approaches have affected its radio system performance and troopers' use of that system. The audit sought to answer these questions:

- Was the Washington State Patrol effective in its planning to determine the type and amount of equipment and infrastructure needed to cost-effectively meet the FCC mandate, and in its procurement and contracting for that equipment and infrastructure?
- Has the Patrol been transparent about the outcomes resulting from its planning, procurement and contracting of that equipment and infrastructure?

How the Patrol's approach to the narrowbanding project aligned with leading practices

One of the first steps the Patrol took in the narrowbanding process was to assess its existing equipment to determine what needed to be replaced. This is a leading practice that helps entities determine equipment needs when narrowbanding. However, the Patrol was unable to quickly obtain state funding for the radio system replacements needed to meet the FCC's narrowband deadline. The Patrol formally submitted a $60 million request for a digital radio system in fall 2010. The $53 million that was eventually approved consisted of a 2011-13 appropriation for $40.1 million and an additional $12.5 million in planned appropriations for 2013-15. The state's Office of Financial Management (OFM) and legislative transportation committees had expressed expectations that the new system would maintain troopers' existing radio coverage.

Narrowbanding allows more users onto the public radio spectrum in the same way a highway can add a lane of traffic if the other lanes are narrowed.

Once the project budget was known, the Department of General Administration (merged into Department of Enterprise Services (DES) in October 2011) and the Patrol began drafting a solicitation for competitive proposals for the digital system. Outside of the Puget Sound area where it sought a trunk system, its solicitation was primarily limited to replacing and upgrading older equipment with narrowband-capable equipment at its existing radio system sites.

Before scoping a solicitation for a narrowbanding project, baseline measurements and engineering studies are typically used to determine the new equipment needed to maintain or extend existing coverage. Although the Patrol's $60 million budget request referenced a need for an engineering study and plans to conduct one, a study was not performed. When $40.1 million of that request was approved to spend in July 2011, the FCC deadline was just 18 months away.

The Legislature also approved funding for engineering in the 2011 budget with the expectation that it would be completed upfront before the project was awarded. However, the Legislature and the Patrol did not have a common understanding about the upfront engineering, and consequently it was never conducted. With the knowledge provided by an engineering study, the Patrol may have better understood its system needs before entering into a sole-source contract and submitted a more detailed and persuasive budget request. Further consequences of not performing an engineering study are detailed in a subject matter expert's written assessment (**Appendix I** in the report).

The Patrol knew its existing wideband analog coverage was poor in parts of the state. Industry literature available during the project's planning said narrowbanding in digital will likely result in reduced coverage in rural, hilly and mountainous areas or other areas that had lower-quality coverage, unless sufficient radio tower sites or other infrastructure were added. Industry literature published subsequent to the start of the project also supports this. The Patrol nonetheless believed its replacement-based approach toward a digital system would achieve coverage equivalent to what it had in wideband.

In September 2011, DOJ invited the Patrol to merge its soon-to-be-upgraded system with DOJ's own; the latter provides coverage primarily along interstate highways I-5 and I-90 as well as I-82 and SR14 along the Columbia River. The Patrol accepted this opportunity without first clearly defining its own system needs and without knowing DOJ's system capacity or how much coverage it would get. Because the DOJ system was built by Motorola, the Patrol and DES believed that taking advantage of the merger required the Patrol to award Motorola a sole-source contract for its system and radios, which was signed in December 2011. The Patrol already shared microwave infrastructure with DOJ. The additional move to merge systems was expected to extend the Patrol's coverage and capacity for less cost than other options and enable it to meet the FCC deadline. For the rest of the state, the Patrol planned to replace its older conventional equipment to make it digital capable.

In response to concerns about its decision to sole-source this work, the Patrol told legislators and media sources that its merger with the IWN system would enable it to narrowband for the initial $40.1 million appropriation. Nor would it need the roughly $12 million planned for the following biennium, which it characterized as savings attributable to the merger. The Legislature's continuing concerns about the suitability of the IWN merger prompted legislation in 2012 that would have required the Patrol to conduct an engineering study, but it was vetoed by Governor Gregoire.

A trunk system, which can be digital or analog, consists of added software and infrastructure that takes each of those 'lanes,' divides it into segments (channels), and assigns callers to segments in order to optimize efficient use of the system.

What were the outcomes?

After merging its system to DOJ's, the Patrol's utilization of IWN capacity and coverage is less than what was originally proposed by Motorola. The Patrol could not obtain information about the IWN radio system's actual capacity until after it had signed an interagency agreement with DOJ, which it did in February 2012. The Patrol also did not recognize upfront that Motorola's proposed system design would not enable it to communicate with some local law enforcement agencies. Once these factors were finally understood in June 2012, both the project period and project design were significantly revised through contract Amendment No. 2, adding more than $3 million to the contract. These and other changes suggest the $12 million the Patrol reported as savings from the merger will not be fully realized.

The Patrol has seen a loss of the lower-quality radio system coverage its troopers once relied on to communicate with one another. Amendment No. 2 shifted responsibility for mitigating this loss from Motorola to the Patrol and significantly delayed the project's completion. Additional losses of coverage are anticipated in those rural, hilly and mountainous areas where the Patrol has not yet narrowbanded. The Patrol acknowledges it will likely need to spend more money to correct these problems.

Some stakeholders told us they were dissatisfied with the amount of information they had received from the Patrol. For example, the Patrol has not presented to the Joint Transportation Committee since January 2015. However, starting in 2016, the Patrol's project management reports have been posted on the Office of the Chief Information Officer's (OCIO's) website for the public to view, which has increased project transparency.

After the significant system redesign, the Patrol applied for its first extension to the FCC deadline in November 2012. After receiving its third extension, Patrol officials say they now believe the project will be finished by December 2016, nearly four years after the original FCC deadline.

Project successes

Even though the Patrol has experienced project challenges, it has successfully worked with the redesigned system. For most areas of the state where the Patrol started off with good coverage, it has likely maintained that coverage, and in some instances, improved it. The Patrol was also effective at mitigating its coverage problems by successfully partnering with public safety agencies across the state for use of their radio infrastructure. This mitigation strategy has likely helped reduce the amount of additional project funding needed. The Patrol is also now attempting to identify coverage gaps before narrowbanding its remaining districts and is mapping each district's actual coverage after it has converted to narrowband.

The Patrol will need to continue these activities as the current narrowband project continues as well as when it prepares for the second phase of the FCC's narrowband mandate.

Recommendations

Before the second phase of narrowbanding arrives, we recommend the Patrol:

1. Over the short-term, mid-term and long-term, assess whether it is advantageous to stay merged with the IWN system
2. Work with the Governor's Office to establish the minimum acceptable statewide coverage
3. Work with the Legislature to approve funding for needed upfront engineering studies, then conduct the studies to determine how much it will cost to achieve that coverage
4. Using the studies, work with OFM to establish an informed long-term plan and budget request for future project work
    a) Connect this long-term plan to the upcoming phase-two narrowbanding effort and the subsequent vendor contracts that will support that effort
    b) Make sure its request for funding for the second phase includes project management and procurement costs that were not included in the budget for the first phase
5. Using the studies and long-term plan, work with the Legislature to help it decide the amount of project funding
6. Prepare monthly online reports that disclose the status of its phase-one and future phase-two narrow-banding projects to make sure all stakeholders receive timely information

Once project funding is established for the FCC phase-two narrowbanding, we recommend the Patrol:

7. Establish needed project management tools and resources before signing any contracts for goods and services
8. Establish contract coverage requirements that match what the Governor's Office has agreed to, and are based on engineering studies and available funding

In the immediate term, we recommend DES:

9. Work with the Patrol to:
    a) Establish each agency's roles and responsibilities in a written agreement
    b) Assure the proper scoping of future contracts and contract amendments
    c) Identify criteria for determining when the contract is complete and each agency's part in making that determination

Introduction

During large scale emergency incidents such as the 9/11 terrorist attacks, public safety communications systems can overload and fail due to large numbers of users attempting to communicate at once. To mitigate this risk, the Federal Communications Commission (FCC) announced in 2004 that all public safety entities must migrate their wideband radio channels to a more efficient narrowband technology by January 2013.

The Washington State Patrol was in its initial planning phase for this project in 2005 and had begun sharing microwave and radio infrastructure with the U.S. Department of Justice (DOJ). By September 2011, the Patrol had decided to merge its radio system with DOJ's Integrated Wireless Network (IWN), which is a Motorola built system. The Patrol worked with the Department of General Administration (now the Department of Enterprise Services (DES)) to award the contract to Motorola, for both infrastructure and radio equipment, without going through a competitive bidding process. Although sole source contracts were allowed for purchases that were clearly and legitimately limited to a single source, seeking competitive proposals can provide meaningful market information and identify alternative vendor approaches and products.

Why we did this audit

News media, legislators and other stakeholders expressed interest in whether the Patrol's approach to narrowbanding effectively served the state's best interests. Stakeholders said they had concerns about how the project was planned, the benefits of the merger with IWN, how the contract was awarded, and whether more project funds were needed. They also had concerns about whether funding requests to the Legislature may have received unnecessarily rushed consideration in order to meet the FCC's narrowbanding deadline – a deadline that has since been extended three times at the Patrol's request. The project is now nearly three and a half years past the original project deadline and a fourth extension is likely needed to stay in compliance with FCC rules.

This audit examined how the Patrol's project planning, funding requests, and procurement and contracting approaches to meeting the FCC's narrowbanding mandate have affected its radio system performance and troopers' use of that system. We conducted this audit to answer these questions:

- Was the Washington State Patrol effective in its planning to determine the type and amount of equipment and infrastructure needed to cost-effectively meet the FCC mandate, and in its procurement and contracting of that equipment and infrastructure?
- Has the Patrol been transparent about the outcomes resulting from its planning, procurement and contracting of that equipment and infrastructure?

Background

Roughly 600 troopers of the Washington State Patrol safeguard Washington's state and interstate highways, covering territory divided into eight districts (see **Exhibit 1**). They frequently assist other agencies, and respond to general crimes in progress (such as calls about domestic violence).

State troopers – along with other federal, state and local safety providers, such as police and fire departments – rely on their radios to receive and send messages clearly. Their radio systems, called land mobile radio (LMR) systems, use blocks of radio spectrum called channels. An extensive network of radio base stations, repeater beacons atop towers or tall buildings, receivers and other hardware is essential to keep these necessary conversations clear and comprehensible and as free as possible from static and "dead zones" of limited transmission. When emergency responders experience coverage loss in a dead zone, they cannot call for backup assistance, compromising their safety and that of the public at large.

Historically, LMR systems have used 25 kHz-wide channels, but the number of slots available for these channels is fixed. As the number of safety providers grows, there is more and more competition for this fixed spectrum. However, if users operate on narrower radio channel bandwidths, there is room for more users. Transitioning from 25 kHz wideband involves a process called narrowbanding.

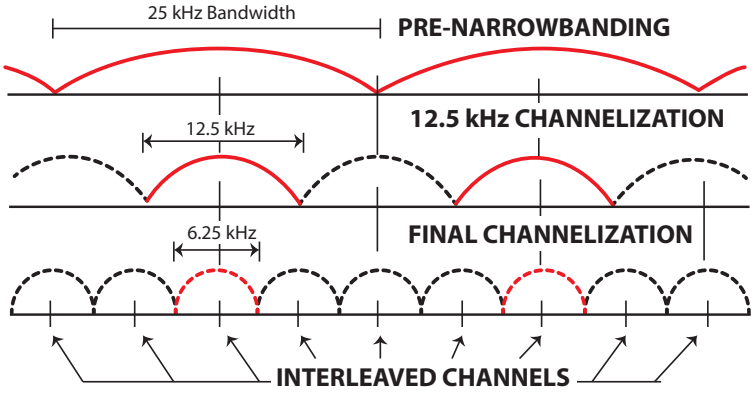
Exhibit 1 – The State Patrol's eight districts and the cities where regional operations are based

Source: Data obtained from Washington State Patrol.

Federal law now requires all public safety agencies to narrow the radio bandwidth they use

To improve agencies' responses to public emergencies, the FCC mandated in December 2004 that all LMR users move to narrower and more efficient 12.5 kHz channel bandwidths by January 2013. The FCC's intention is to eventually require agencies to narrow their bandwidth further, to 6.25 kHz, but the FCC has not set a deadline for that process. **Exhibit 2** illustrates these transitional steps from wideband to narrowband.

Exhibit 2 – Narrowbanding permits additional users to use the available radio spectrum



Source: FCC NARROWBANDING MANDATE: A Public Safety Guide for Compliance, published in 2006 by the International Association of Fire Chiefs and the International Municipal Signal Association.

Two technologies are available to meet the FCC's narrowbanding mandate

To meet the narrowband mandate, LMR users choose between two technologies – analog and digital – or a combination of the two. Each has its advantages and potential problems, especially in the matter of coverage.

Coverage: The area or distance from the base station in which users experience high versus poor quality reception.

Analog (wideband or narrowband) – Analog radios process sounds into patterns of electrical signals resembling sound waves. Analog systems are normally less complicated and easier to implement than digital systems. Under certain conditions, analog is more reliable and is still used by many organizations. Analog radios are not capable of meeting the FCC's future phase-two narrowbanding requirements.

Digital (narrowband) – Digital radios work by picking up a processed signal that turns sound into patterns of digits (numbers) rather than radio waves. Digital radios can achieve clearer sound quality in flat areas without tall buildings. Digital allows for encrypted communications, which cannot be overheard by the public; analog cannot do this without adversely affecting the sound quality. Digital radios are significantly more expensive than analog radios.

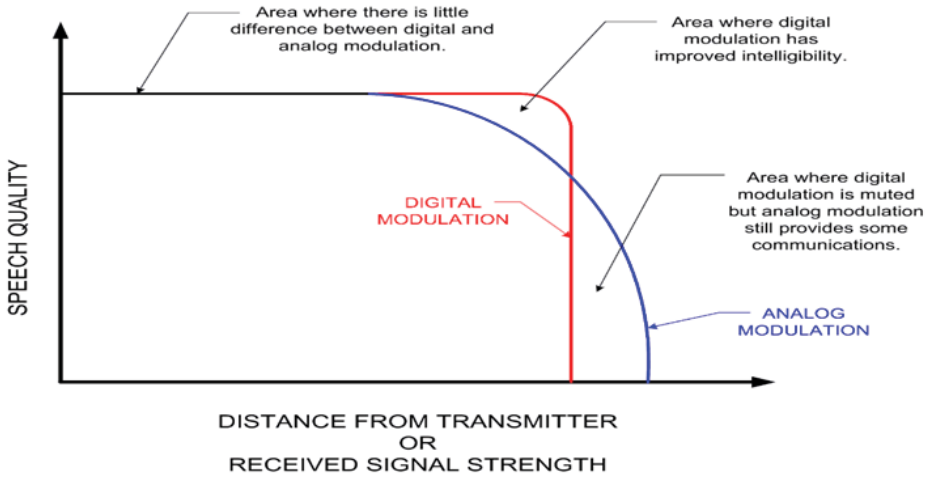
The key similarities

Whether moving from wideband analog to narrowband analog or to narrowband digital, system owners typically require additional radio towers and infrastructure to avoid coverage loss. Radio tower sites cost about $1 million.

The key difference

Digital radio communications require a more extensive network to receive an adequate signal over long distances and mountainous terrain. Digital systems are more prone to coverage gaps and thus require more repeaters than analog systems. This is because analog signals tend to fade over distance while digital signals can cut out completely. Although more susceptible to signal interference, narrowband digital typically achieves more consistent sound quality than narrowband analog. **Exhibit 3** illustrates several of the key differences between these two types of technologies.

Exhibit 3 – Comparison between analog and digital signal



Source: "Narrowband Conversion and Digital Modulation," by William F. Ruck, page 8, Figure III, ©2010. Used by permission of CSI Telecommunications, Inc., San Francisco, CA.

The communications industry measures radio sound quality on the Delivered Audio Quality (DAQ) scale set out in **Exhibit 4**. Analog provides greater signal distance than digital, but some of that distance occurs at a sound quality that falls below the mid-point rating of 3.0-3.4, which is the public safety industry standard. In areas with weak signal levels that fall under this standard, analog transmissions are still understandable (with great effort) while digital radio is mute. However, narrowband analog can provide coverage in areas that started with poor wideband coverage, including rural, hilly or mountainous areas or urban areas with numerous high-rise buildings where digital fails or is less reliable.

Exhibit 4 – The Delivered Audio Quality (DAQ) is the most common signal quality measure for public safety radios

DAQ	Definition
1	Unusable. Speech present but not understandable.
2	Speech understandable with considerable effort. Requires frequent repetition due to noise or distortion.
3	Speech understandable with slight effort. Requires occasional repetition due to noise or distortion.
3.4	Speech understandable without repetition. Some noise or distortion present.
4	Speech easily understandable. Little noise or distortion.
4.5	Speed easily understandable. Rare noise or distortion.
5	Perfect. No distortion or noise discernible.

For Public Safety, the accepted objective is to provide DAQ 3.0-3.4 over the service area. A lower DAQ (for example 2.0) may require excessive speech repetition, while a higher value (for example 4.0) may require a prohibitively high level of infrastructure investment.

Source: http://www.p25bestpractice.com/specifying/coverage-needs/#sthash.7OyOBPvn.dpuf.

When converting from wideband analog to narrowband digital without adding infrastructure, agencies typically lose any lower quality coverage that falls below DAQ 3.0. See Appendix C for more background on radio systems, and a discussion of coverage issues that arise when transitioning from a wideband analog system to a narrowband digital system.

The U.S. Department of Justice's digital radio system

The Department of Justice (DOJ) administers the Northwest's Integrated Wireless Network (IWN), an emergency radio system built with digital technology that is used by the FBI, Bureau of Alcohol Tobacco, Firearms and Explosives, U.S. Marshals and other federal agencies in Washington, Oregon and Northern California. In Washington, the IWN system primarily runs along the two interstate corridors: I-5 north-south and I-90 east-west, but it also covers I-82 and SR14 along the Columbia River. While IWN was primarily built for federal law enforcement use, it now also serves as the primary communications system for local law enforcement agencies in the Blaine, Ferndale and Sumas areas along the northwestern international border.

DOJ's Inspector General expressed concerns about the IWN system in 2007 and 2012, focusing primarily on a failure to fund planned project costs and a lack of coordination among federal agencies. Consequently, the Obama administration ended any additional investments to expand the IWN system. This means that the system equipment will continue to be used by subscribers, and maintained by the DOJ, but there will be no federal funding for future system upgrades or expansion. Moreover, because of a recent vendor protest, DOJ has stopped purchasing services, equipment and infrastructure from Motorola.

How Washington state laws address the move to narrowband radio

Although not necessary to meet current federal narrowbanding requirements, under Washington state law, any agency that purchased radios after 2006 (with the exception of the 2011-2013 biennium) must comply with the Project 25 (P25) interoperability standard. P25 standards were established by the Association of Public Safety Communications Officials and adopted by numerous law enforcement agencies across the nation. The intent of this law is to ensure investments in communications equipment are advantageous to interoperable communications between agencies throughout the state. This means all P25 radios should communicate effectively with one another, regardless of the manufacturer. This is one reason the Patrol decided to narrowband in digital instead of in analog: no analog-only radios are P25 compliant.

Neighboring states and other local governments with more project funding have started or, in some cases, completed the move to narrowband radio

Oregon, which also relies on IWN infrastructure but did not merge its multi-jurisdictional system with IWN as Washington's State Patrol did, started its $230 million project in 2011. It plans to complete the project in the summer of 2016.

On a smaller scale, within Washington, Spokane County started its $47 million project in 2010 and completed it in early 2014. Pierce County started its $56 million project in late 2011 and completed it in early 2014. King County is just now starting its $270 million project. In contrast, the Patrol's project funding totaled about $41 million; it started in December 2011 and is expected to be completed in December 2016.

During the course of our audit work, we examined these projects to learn more about their experience compared to that of the State Patrol. See **Appendix D** for additional information on these comparison projects.

State Patrol's capital projects are overseen by the Legislature's transportation committees

Because the Patrol serves the state's transportation system, it is largely funded by state transportation monies. The House and Senate Transportation committees consider the state's transportation budget, which includes funding for the Patrol. The Joint Transportation Committee (JTC), which is made up of the chairpersons and ranking members from the House and Senate Transportation committees, reviews the state's transportation programs, including the Patrol's, so it can inform state and local government policymakers, including legislators.

The State Interoperability Executive Committee (SIEC) is also interested in radio system issues. This broad coalition of agencies and municipalities works to coordinate use of the state's limited radio spectrum; optimize the use of state, local and federal funding; and increase interoperability through a "system of systems" approach. The Patrol has been a key participant in the SIEC since its inception in 2003.

Scope and Methodology

In conducting this audit, we explored these questions:

- Was the Washington State Patrol effective in its planning to determine the type and amount of equipment and infrastructure needed to cost-effectively meet the FCC mandate, and in its procurement and contracting for that equipment and infrastructure?
- Has the Patrol been transparent about the outcomes resulting from its planning, procurement and contracting of that equipment and infrastructure?

Leading practices applicable to narrowbanding projects and how we determined whether they were followed

To answer these questions, we identified leading practices applicable to narrowbanding projects and the benefits that result from them, then determined if the Patrol followed these practices. We also reviewed the Patrol's internal project status reports, interviewed State Patrol vendors and staff, reviewed project status presentations to the State Interoperability Executive Committee (SIEC) and reviewed records from a Washington State Department of Labor & Industries (L&I) investigation to learn about the project's status and the system's actual and anticipated performance. We compared what we learned to the project updates the Patrol has given the state's legislative transportation committees.

The U.S. Department of Homeland Security and industry sources recommend that agencies use sound project management practices to successfully meet the FCC's narrowbanding mandate. Many of the practices we identified in our research are broadly applicable to all capital projects and are widely available from sources such as the Guide to the Project Management Body of Knowledge. Other practices are more particular to the process of transforming a radio system from wideband to narrowband; they were published and promoted by the FCC and other public service organizations at various times after the mandate was announced. These leading practices, their sources, the resulting benefits, and how we determined whether the Patrol followed them are listed in **Appendix B**.

We gave the Patrol a draft of our report in December 2015. After reviewing that draft, the Patrol requested we hire a subject matter expert to review our findings and conclusions. In early April 2016, the State Auditor's Office signed an intergovernmental agreement with the Port of Seattle to use its Radio Systems Administrator to perform this review. The Patrol agreed that the Port's Radio Systems Administrator was qualified to perform this review. We have edited our final report to reflect the Radio System Manager's written assessment, included in **Appendix I**.

Audit performed to standards

We conducted this performance audit under the authority of state law (RCW 43.09.470), approved as Initiative 900 by Washington voters in 2005, and in accordance with Generally Accepted Government Auditing standards (December 2011 revision) issued by the U.S. Government Accountability Office. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives. See **Appendix A**, which addresses the I-900 areas covered in the audit. Appendix B contains more information about our methodology.

Next steps

Our performance audits of state programs and services are reviewed by the Joint Legislative Audit and Review Committee (JLARC) and/or by other legislative committees whose members wish to consider findings and recommendations on specific topics. Representatives of the State Auditor's Office will review this audit with JLARC's Initiative 900 Subcommittee in Olympia. The public will have the opportunity to comment at this hearing. Please check the JLARC website for the exact date, time and location (**www.leg.wa.gov/JLARC**). The State Auditor's Office conducts periodic follow-up evaluations to assess the status of recommendations and may conduct follow-up audits at its discretion.

Audit Results

Objective 1: Was the Washington State Patrol effective in its planning to determine the type and amount of equipment and infrastructure needed to cost-effectively meet the FCC mandate, and in its procurement and contracting of that equipment and infrastructure?

Answer in brief

The State Patrol could have been more effective in its planning for the narrowbanding project by implementing leading practices that recommend measuring the existing system's coverage and conducting an engineering study. These leading practices were not implemented, in part due to a misunderstanding between the Legislature and the Patrol about the use of project funding as well as the quickly approaching FCC deadline. The Patrol also could have benefited from implementing other general project management leading practices earlier in the project. Specifically, the initial project team lacked clearly defined roles and responsibilities, and a project plan, led by a professional project manager, was not established early in the process.

Because these leading practices were either not implemented at all or not implemented until after the project had been scoped, the Patrol had to make significant changes to the proposed system design after it had already entered into agreements with Motorola and the U.S. Department of Justice (DOJ) for use of its Integrated Wireless Network (IWN). The Patrol has also experienced unanticipated system coverage problems in parts of the state and significant project delays.

Even though the Patrol experienced these project challenges, for most areas of the state where the Patrol started off with good coverage, it has likely maintained that coverage, and in some instances, improved it. The Patrol has also been effective at mitigating its coverage problems by successfully partnering with public safety agencies across the state to use their radio infrastructure. The Patrol is now attempting to identify gaps in coverage before narrowbanding its remaining districts and is mapping each district's actual coverage after it has completed the conversion to narrowband. The Patrol will need to continue these activities as the current narrowband project continues and when preparing for the second phase of the FCC's narrowband mandate.

Issue 1: Patrol would have benefited from a deeper understanding of its current system and available technology

After inventorying its existing equipment, the Patrol decided its best option would be to narrowband using digital technology.

In accordance with leading practices, the Patrol planned for its conversion to narrowband by taking an inventory of its existing system's equipment and evaluating it to see if it could be used in a narrowband system. This inventory revealed a wideband analog radio system composed of equipment made by different vendors, much of which was nearing the end of its useful life. The Patrol was already scheduled to replace expensive infrastructure components, including its 35 to 40 dispatch consoles, 286 base stations, 60 receivers and repeaters.

Although most of the Patrol's 2,800 original analog radios could be upgraded to the FCC's 12.5 kHz bandwidth requirement, they could not be further upgraded to the future 6.25 kHz requirement. Also, more than a quarter of these radios did not comply with the P25 requirement imposed by state law in 2006. Replacing these radios made up about half of the Patrol's narrowband project costs.

Along with its equipment evaluation, the Patrol also considered the choice of narrowbanding in analog or in digital, which are both allowed by the FCC to meet the phase-one narrowband mandate. The Patrol initially considered narrowbanding in analog, as the Department of Natural Resources (DNR) had done in the early 2000s, but the Patrol identified significant drawbacks to that approach. For instance, narrowbanding in analog would not permit the Patrol to meet the future narrowbanding phase and the Patrol's forecasts and industry sources showed that narrowbanding its existing analog system without constructing new radio tower sites would have resulted in a 15 percent to 33 percent reduction in coverage. **Exhibit 5** sets out the factors the Patrol considered when making its decision on which technology to use.

Exhibit 5 – Factors the Patrol considered when it decided to narrowband in digitial: Why choose digital?

Drawbacks to narrowbanding in analog	Benefits to narrowbanding in digital
To restore "lost coverage" 25 to 35 sites would need to be added at an estimated cost of $40 million.	RCW 43.105.330 requires all new radios or radio systems purchased by state agencies be P25 (digital) capable.
Would not be able to add sites before deadline of January 1, 2013.	P25 is standard based technology which provides a common interface system for sharing and integration with other agencies.
Narrowbanding in analog does not allow for transition to future 6.25 kHz narrowband mandate.	Digital equipment purchased would be capable of transitioning to the future 6.25 kHz narrowband mandate.

Source: Documents from a January 2011 presentation made by the Patrol to the Senate Transportation Committee.

When considering these factors and its need to replace older equipment, the Patrol decided that using digital technology to narrowband would allow it to achieve the most benefit while still adhering to state law and the project schedule.

Instead of conducting an engineering study, the Patrol relied on coverage forecasts to determine the scoping of its project.

In addition to evaluating existing equipment for narrowband capability, it is a leading practice to measure your existing system coverage as part of an engineering study. With radio system projects, a preliminary engineering study enables system owners to identify baseline coverage, anticipated coverage gaps, equipment needs, and user needs. Identifying these system needs before finalizing the system design allows agencies to more clearly see the scope, schedule and cost trade-offs, and successfully plan the project.

Software-generated coverage forecasts are an essential element of an engineering study. However, a full engineering study also includes measuring existing signal strength at locations where coverage challenges are anticipated; one way to do this is to place vehicles in different locations to gauge the actual and anticipated coverage at those locations. The reach of coverage shown in a forecast is affected by the sound quality desired by the forecast technician. While such forecasts by themselves can be accurate in flat terrain, they predict poorly what will happen to signals in mountains, hills and valleys, or in areas with many tall buildings, where sound waves can be erratically reflected. Many areas of Washington are therefore difficult to model using forecasts alone.

While the Patrol had planned to conduct an engineering study, for reasons detailed below, it was not completed before the agency entered into agreements with Motorola or DOJ. Rather than take actual measurements of signal strength and reception for all its districts, the Patrol relied on coverage forecasts to determine the scoping of its project.

We interviewed the Patrol's radio manager, project manager, technicians, and quality assurance advisor, and all acknowledged an engineering study would have helped inform the Patrol's project and equipment funding needs. Most of them told us such a study would have cost between $500,000 and $2 million and taken about a year to perform; radio personnel at a second state agency and Motorola concurred.

We identified two main reasons why an engineering study was not completed prior to system design:

1. The Legislature and the Patrol did not have a common understanding about whether the approved project budget funded an upfront engineering study.
2. The Patrol assumed upgrading its existing conventional sites to narrowband digital would give it coverage that was equivalent to what it had in wideband analog and therefore believed an engineering study was not necessary.

In the following sections, we discuss these two reasons in more detail.

The Legislature and the Patrol did not have a common understanding about whether the approved project budget funded an upfront engineering study.

The state had a number of opportunities to fund an engineering study, but for a variety of reasons, a study was never completed. For example, in October 2008, the State Interoperability Executive Committee (SIEC) made a $500,000 budget request for a statewide engineering study that would have identified ways to increase interoperability between law enforcement agencies throughout the state. This request was turned down by the Legislature in 2009. While a study of this scope would have assisted in the planning of the Patrol's narrowbanding project, it would not have been a replacement for a more thorough study of just the Patrol's system.

In the fall of 2010, the Patrol formally submitted a $60 million request for a digital radio system. The request included a statement that referenced a need for an engineering study of the Patrol's system and plans to conduct one. As detailed in **Exhibit 6**, the request stated in part that the project would require significant engineering to determine anticipated coverage gaps, identification of potential new tower locations, and upgrades to existing tower infrastructure. However, it did not contain a budget line item for this engineering. Instead, it contained a line item for System Integration and Engineering Services (SIES). According to the subject matter expert we engaged, SIES is generally a line item one would expect to find in an "Offer for Sale" from a vendor. These are the costs that cover such tasks as detailed design review with vendor engineers, factory staging of equipment, field installation, programming and optimization, project management, and factory and field test acceptance procedures. SIES is not equivalent to a detailed engineering study.

Exhibit 6 – The Patrol's September 2010 budget request describes a need for "significant engineering" to identify coverage gaps

Digital Microwave and Site Upgrades:

There are communication rings, comprised of communication towers with microwave dishes and transmitters, throughout the state. Some are already narrowband compatible and will need very little infrastructure improvements to be fully compatible with the FCC narrow-banding mandate. Others will need to be enhanced to ensure communication gaps do not exist with the transition to narrowbanding. This will include significant engineering to determine the anticipated coverage gaps, identification of potential new tower locations, and upgrades to existing tower infrastructure (power, grounding, stubs, and spurs) in support of the Land Mobile Radio (LMR) system.

Source: The Patrol's September 2010 budget request to OFM.

In 2011, a draft appropriations bill containing detailed requirements for an engineering study was removed as the budget was finalized. In conversations with two legislators and a House Transportation Committee staff member, we were told it was removed based on legislative members' understanding that the Patrol had agreed to complete the upfront engineering study before the project's contract award.

When the Legislature ultimately approved an initial $40 million of the Patrol's $60 million budget request in 2011, the budget specified that some of that money was to be used for "engineering services." However, it did not contain language that specifically required an engineering study to be conducted before the start of the project. House Transportation Committee staff told us legislators assumed that since the original budget request included language stating "significant engineering" would be performed, and that the approved funding included the language "engineering services," the Patrol would use the project funding for an upfront engineering study. However, the Patrol believed that since the approved budget did not specify funding for an engineering study, one was not funded. Therefore, we determined there were likely misunderstandings between some legislators and the Patrol on what the budget required.

Later, in 2012, when the Legislature realized the Patrol had awarded the project contract without conducting the engineering study it expected, the Legislature adopted a bill that would have required the Patrol to conduct the study. The bill was also a response to the legislature's concerns about the suitability of the IWN merger. This bill was passed after one House member told other legislators he had

obtained assurance from the FCC that it would give the Patrol an extension to the January 2013 deadline. This bill was later vetoed by Governor Gregoire based on her understanding that a technical review had already been completed. These legislative proposals and the Patrol's original plans to obtain an engineering study are discussed in more detail in **Appendix E**.

When we considered the options open to the Patrol between 2008 and 2011, we looked for opportunities for alternative actions the Patrol might have taken to achieve the study without delaying the project contract. A timeline of the narrowbanding project including these opportunities is in **Appendix F**.

The Patrol assumed that upgrading its existing conventional sites to narrowband digital would give it coverage equivalent to what it had in wideband analog and therefore believed an engineering study was unnecessary

The Patrol's changing understanding of digital technology affected its decision to forgo the engineering study. The Patrol's September 2010 budget request for $60 million shows it had once anticipated that it would need to conduct an engineering study. Its request included language suggesting that officials initially anticipated that narrowband digital would result in a loss of coverage (shown in the highlighted text in Exhibit 6).

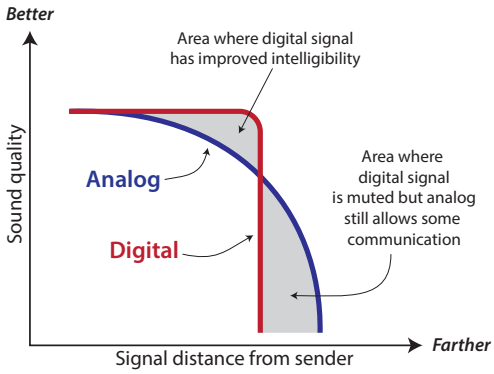
Subsequently, the Patrol and Motorola each developed coverage forecasts that showed little to no anticipated public safety grade coverage loss when moving from wideband analog to narrowband digital. These forecasts helped convince the Patrol that narrowbanding with digital technology would give it coverage equivalent to wideband analog.

In a presentation given to the Senate Transportation Committee in January 2011, the Patrol stated that narrowbanding in analog would require 25-35 additional sites to restore lost coverage and this could not be done in time to meet the January 2013 deadline. The Patrol also reported that by converting to digital it would be able to narrowband while addressing these concerns.

Although it was a reasonable expectation that the Patrol could avoid loss of coverage in most places where that coverage equaled or exceeded DAQ 3.0 sound quality, it did not account for the loss in lower-quality coverage which the troopers relied on to communicate with one another. As the **detail of Exhibit 3** shows, digital signals are clearer at a greater distance, but analog signals – though not as clear – provide greater coverage range. In addition, the Patrol did not account for the loss in coverage that can occur in higher-quality coverage areas where there is extreme topography such as hills, mountains or tall buildings (which all exist in Washington). Industry literature says without sufficient additions of infrastructure, you lose coverage in these areas when moving from wideband analog to narrowband digital (discussed further in Appendix C).

The Patrol's understanding of digital, along with a rapidly approaching FCC deadline, appears to have eliminated any further interest it had in pursuing an engineering study to inform its 2011 procurement.

Detail of Exhibit 3



Issue 2: Patrol could have benefited from further analysis of the proposed merger with IWN to see if it provided the best benefit to the state and required Motorola for all equipment and radios

The Patrol made two decisions in its narrowbanding project that are closely entwined: merging its radio system with the DOJ's IWN system and, to make that merger as easy as possible, choosing Motorola as its vendor through a sole-source contract. In the sections that follow, we review the Patrol's rationale for making these decisions and the results.

The Patrol has benefited from past DOJ partnerships

For many years, the Patrol has used and supported the DOJ's IWN communications system infrastructure. For instance, during the mid-2000s, Patrol partnered with the DOJ to build digital microwave connectivity along I-5 and I-90, on the peninsula, and in the Columbia River Gorge; this project used between $40 million and $70 million in federal funding. In exchange for this assistance, the Patrol now owns, operates and maintains this infrastructure, and DOJ, the Patrol and the Washington State Department of Transportation (WSDOT) each use one-third of it. The Patrol told us it recognized at the time that if DOJ had not paid for this infrastructure, it would have had to do so on its own, as part of its narrowbanding project.

The Patrol thought at the time that merging its system with the IWN system was its best option

Before requesting state funding to transition to a narrowband radio system, the Patrol contacted DOJ and discussed the possibility of expanding its participation in the IWN system by merging the two systems. The Patrol believed such a merger would cost less than an upgraded, standalone, State Patrol system. However, at various times in 2010 and 2011, DOJ expressed concerns that such a merger would compromise its encryption and security if DOJ allowed access to other state agencies who at the time utilized the Patrol's system. DOJ's apprehensions raised uncertainty at the Patrol about whether the merger would ever be a viable option.

The Patrol eventually concluded that because the other state agencies that relied on its system for their communications would not have access to a DOJ merged system, expanding the partnership with DOJ was no longer an option. Thus, in June 2011, the Patrol began working with the Department of General Administration (merged into the Department of Enterprise Services (DES) in October 2011) to prepare a solicitation for competitive vendor proposals for the infrastructure upgrades needed for a digital narrowband system. In September 2011, the Patrol's Chief Batiste authorized DES to proceed with the solicitation for this system, and the two agencies continued work on the draft solicitation through the end of the month.

Unexpectedly, in late September 2011, DOJ reversed its previous decision and agreed to allow other state agencies using the Patrol's system, such as DNR and the Department of Fish and Wildlife, access to its system. The Patrol immediately decided to merge its system with the IWN system in a partnership with DOJ.

The Patrol decided to do this without a formal analysis to determine the pros and cons. Instead it relied on the perception of the IWN system it had developed through its previous successful partnership and assumed that the merger would result in the following benefits:

- Cost savings
- On-time project completion
- Improved interoperability with federal partners

We examine each of these assumptions below. In Issue 3 of the report, we explore whether these assumed benefits were fully realized.

Cost savings. The Patrol believed the IWN system had capacity and coverage where the Patrol had none and by merging the systems the Patrol would avoid additional infrastructure costs. However, baseline coverage and capacity of the IWN system was not measured before the start of the project. The Patrol told OFM, legislative staff, local media organizations and others that the merger would enable it to avoid about $12 million in equipment and infrastructure it would have needed if it decided to develop a standalone system. However, the Patrol could not provide cost schedules, formal documented analysis or competing proposals to support these savings.

The Patrol described the savings to three state legislators – Representatives Ann Rivers and Ed Orcutt and Senator Joe Zarelli – who had expressed concerns about the Motorola sole-source contract. In the November 22, 2011, response (excerpted below), the Patrol wrote that rather than use the $53 million in approved and planned appropriations across two biennia, the Patrol could complete the project using only the $40.1 million that had been approved for 2011-13.

> *"DES took the lead in negotiating with the approved vendor for the WSP's Narrowbanding effort. The legislation passed last year directing the WSP to become narrowband compliant and meet Project 25 standards for our radios. We are still following this directive by the approach with DOJ and intend to save a future ask in the 13-15 biennium of 12 million dollars. The current negotiations we believe will result in us completing the project this biennium by taking advantage of this partnership."*

Source: Emails provided to auditors by the Patrol.

The Patrol described these savings to us as follows:

> *"WSP originally requested $60 million for the project in the 2011-13 Capital Budget. The Legislature reduced the project to $53 million at the time, funding $40.1 million in the 2011-13 Transportation/Operating budget with Certificates of Participation, and planning to fund an additional $13 million for portable radios in the 2013-15 budget.*
>
> *In contract negotiations with Motorola in 2011, the DES/WSP received a cost reduction of $13,801,995 or "Subscriber, infrastructure, and system discounts." The WSP used that $13 million discount to purchase the portable radios in the 2011-13 which were planned to be purchased in the 2013-15 budget. The savings is a combination of using the IWN infrastructure to provide improved coverage (rather than building additional sites); [and] the contract savings negotiated with Motorola by DES reflecting the system discounts [obtained].*

Source: April 22, 2015 email to auditors from the Patrol.

At Issue 3 and in **Appendix G**, we discuss the likelihood that the Patrol will achieve fewer cost savings related to the anticipated coverage and capacity from the merger than was expected.

On-time completion. The Patrol believed that because of the amount of DOJ system infrastructure already in place, merging the two systems would have a positive impact on the Patrol's narrowbanding project schedule. Patrol officials also believed the partnership would allow it to complete the project in the 2011-13 biennium rather than waiting to upgrade radios in the 2013-15 biennium. However, this assumption was never verified by the Patrol; it did not perform an analysis of IWN's existing infrastructure and its own system requirements to determine the merger's impact on its project schedule. At Issue 3, we discuss the project delays that have occurred.

Improved interoperability with federal partners. By merging its system with IWN, the Patrol understood it would increase interoperability with its federal partners that used IWN. We were told by the Troopers Association that while interoperability with federal partners is important, troopers do not interact with them on a regular basis. Interactions are limited to instances when a dignitary, such as the President of the United States, is visiting the area or when a federal agency requests the Patrol's assistance. However, troopers do need to communicate daily with the Patrol's local law enforcement partners that do not use IWN. While the Patrol appropriately considered the interoperability benefits with federal partners, it did not sufficiently consider how the IWN partnership would affect its interoperability with these local governments that relied on the Patrol's conventional system. This is discussed further in Issue 3.

Risks in the merger that, if considered, might have affected the Patrol's decision

In addition, the Patrol did not consider other risks associated with the IWN merger. The Patrol's interagency agreement gives DOJ approval over system configuration, which the Patrol's quality assurance advisor described to us as a risk because it limits the Patrol's control over vendor selection and who can use the system.

The Patrol's quality assurance advisor also noted the Patrol's dependence on DOJ makes it more vulnerable than if it had pursued partnerships with the local governments it interacts with far more extensively. This advisor told us there is a risk that DOJ could one day remove its equipment and withdraw from the agreement. While the Patrol has taken steps, such as building its own master site, to ensure that the Patrol could continue to operate in the event that it or DOJ withdraws from the merger, the Patrol has not completed an analysis to determine the exact impacts.

The merger also limits the Patrol's control over its system design. In its September 2014 report, the Patrol's quality assurance advisor noted the interface to IWN is likely one of the highest risks to project success because of the inability to control how the IWN system is operated and administered. For example, the Patrol technical staff cannot make changes directly to its system without first getting DOJ's approval. These changes must be typically made to both the Patrol's system and to DOJ's.

Likewise, the Memorandum of Understanding (MOU) between IWN and the Patrol states the preferred method to connect the two systems is not through a core-to-core merger as was done, but instead through an inter-switching system interface (ISSI). The MOU states: "… the link shall be transitioned to the ISSI protocol within six months of the commercial availability of ISSI that meets the requirements for data functionality …" That functionality likely exists now with Motorola's ISSI-8000, which supports seamless voice and enhanced data roaming between two Motorola cores. According to the subject matter expert we engaged, a transition such as this is not trivial with regards to cost, effort and risk. The Patrol must pay the full cost for this transition.

Moreover, a recent vendor protest against the DOJ has resulted in the Patrol having to pay for all system upgrades, without any financial assistance from DOJ.

The Patrol could have benefited from further considering other vendor approaches and products to verify that the merger with DOJ's IWN system required contracting with Motorola for all infrastructure and radios

DES records show that after the Patrol learned the DOJ merger was a viable option, Chief Batiste immediately determined that, to make it work well, the Patrol should purchase its infrastructure and new radios from DOJ's IWN supplier, Motorola. These records show that on September 29, 2011, the Patrol justified the need to sole-source its narrowbanding project as follows:

> *"…Chief Batiste had made the decision that…in order to meet the Federal Communication Commission's (FCC) January 1, 2013 deadline for narrowbanding…a sole source negotiated contract with Motorola would have to be established because the DOJ system already was standardized on Motorola equipment, [and] software..."*

Source: DES procurement records.

DES prepared the Patrol's formal sole-source justification on October 13, 2011, and began negotiating with Motorola. On November 4, 2011, the Patrol and DES met with Motorola to review its proposal. Four days after this meeting, DES notified potential contractors of this sole-source procurement through the state's bid notification system.

DES and Motorola signed the contract on December 9, 2011. The Patrol and DOJ signed an agreement to merge the two radio systems three months later in March 2012.

The Patrol believed the merger with IWN required it to use Motorola for all infrastructure and radios for several reasons

The Patrol believed that if it were to join the IWN system, its new infrastructure would have to be built by Motorola because Motorola had built IWN. The DOJ agreement that followed the Patrol's Motorola contract award simply states that any equipment that the Patrol brought onto the DOJ system must meet DOJ security standards. But Patrol staff, and former and current DOJ officials, told us that even though DOJ did not write a clause in the agreement, DOJ made it clear to the Patrol that it strongly preferred the Patrol use Motorola exclusively for both infrastructure and radios.

Sole-source laws

At the time of the contract, state laws allowed agencies to bypass the competitive bidding process for "purchases which are clearly and legitimately limited to a single source of supply and purchases involving special facilities, services, or market conditions, in which instances the purchase price may be best established by direct negotiation."

RCW 43.19.1906

They offered two reasons for this strong preference:

- IWN is a trunk system. Trunk systems are proprietary at the network core level. This makes it difficult for one vendor's infrastructure to interface with another's on the same system.
- DOJ had difficulty mixing vendors in the past. From April 2007 through January 2011, DOJ experienced difficulty making Harris infrastructure work with Motorola radios in the Washington, D.C., area and did not want to repeat this experience.

The Patrol decided that, in addition to infrastructure, it would purchase its radios through a sole-source contract with Motorola. This was viewed as a sensible option by both the Patrol and DOJ for several reasons:

- Motorola radios had features that the Patrol could not get with other vendors' radios if operated on a Motorola system. These features include over-the-air programming, over-the-air re-keying, and geographic information system (GIS). The Patrol's use of other local government's proprietary Motorola systems, along with specific dual-band radio features that were required or initially required by those systems, also required its purchase of Motorola radios. However, such proprietary restrictions can also exist with other vendors.
- Tests the Patrol conducted in 2010 showed Motorola radios had better performance on a Motorola system than other vendors' radios. The tests were not documented by the Patrol and therefore we were unable to verify the conclusions.
- The Patrol thought it could more easily manage one vendor for both the infrastructure and radios, which would make it easier to meet the deadline. Both the Patrol and DOJ believed that if problems arose, they did not have to worry about vendors blaming one another.
- After radios were added to the contract, DES was able to obtain discounts that totaled about $5 million. DES told us that these discounts made the price for the radios less than what was offered on a multi-state contract with Motorola. We found that once these discounts were factored in, the price the Patrol paid for its radios was comparable to what other public safety agencies in state and out had paid.
- The Patrol had also experienced problems getting support for radios from a different vendor. Patrol officials told us they considered this when deciding to go with Motorola radios.

However, a DOJ official told us that although it may not have offered the Patrol support to resolve technical difficulties, had the Patrol insisted on a different vendor for the radios, it would have likely still partnered with the Patrol. Moreover, even though the Patrol had reasons for using Motorola infrastructure and radios for the trunk portion of its radio system it merged with IWN, it did not fully explore other vendor approaches and products for the conventional layer of its radio system.

Alternative vendor approaches, infrastructure and radios were not fully considered

Seeking competitive proposals gives buyers information that can help them assess alternative project approaches before committing to a sole-source contract. These proposals could have supplied the Patrol with the market research needed to verify its assumptions. For instance, because competing vendors were not allowed to bid on this project, it is unknown if another vendor could have completed the project for less money.

To confirm that the most cost-effective approach was its partnership with DOJ and the sole-sourced contract with Motorola, the Patrol could have sought competitive proposals under different scenarios. For example, the Patrol could have sought proposals for a statewide narrowband system that was merged with DOJ's IWN system and one that wasn't. It could have also solicited proposals for District 2, consisting of a trunk system that would be merged with DOJ's, and separate proposals for a conventional system for the remaining districts. Lastly, it could have solicited a proposal for the system as a whole and another for the radios. A competing vendor told us it had been awaiting the Patrol's solicitation and would have submitted a proposal for any of these possibilities. It anticipated the Patrol would require additional towers and infrastructure to avoid coverage loss associated with converting to a digital narrowband system. Alternatively, the Patrol could have conducted a conference call with interested vendors, allowing it to explore the viability of different scenarios.

The Patrol did not pursue a competitive solicitation in part because the FCC narrowbanding deadline was quickly approaching. DES told us a competitive procurement could have taken as little as three months, and meeting notes from a competing vendor show it had been told that the Patrol had planned to award the contract within 90 days of the solicitation. At the time it decided to sole-source, there were no known instances of FCC granted extensions. However, as shown in the timeline in **Appendix F**, although it did not know its legislatively approved project funding until May 2011, the Patrol knew the amount of project funding that had been included in the Governor's December 2010 budget proposal and could have started drafting competitive proposals then.

In summary, by not seeking competitive proposals, the Patrol was unable to consider other vendors or alternative project approaches. Consequently, the Patrol could not verify it had the best match for its coverage, capacity, and schedule needs. It also could not compare costs to determine if the Motorola discounts resulted in the lowest price possible.

Issue 3: Stronger project and contract management may have minimized project delays, system performance issues and likely budget over-runs

The Patrol could have benefited from hiring a professional project manager at the beginning of the project. Without one, key management tools were not in place until two years after the start of the project.

Industry literature and leading practices say that a successful radio communications system conversion plan includes a realistic project schedule that identifies individual tasks and deadlines, a project charter and a risk management plan. Project owners should assign a manager with appropriate experience and resources to measure and manage project performance, and establish clear roles and responsibilities for other project team members and partner agencies at the outset. We found these critical project management tools were not implemented until nearly two years after the project contract was signed. For instance, the first project charter was not finalized until late 2013, and the Patrol's plan for bringing the narrowbanded system online (often called a "cutover plan") was not established for its first district until late 2014.

Because implementation of these critical project management tools was delayed, the Patrol was unable to recognize at the outset the intrinsic difficulties in its DOJ partnership. Among the most urgent problems were system access, capacity constraints and configuration challenges involved with using the IWN radio system, which were not discovered until after the contracts with Motorola and DOJ were signed. Below we discuss the reason for the delay in establishing these management tools. Later in the report, we discuss the consequences of project management decisions.

The Patrol assumed it had the in-house expertise to manage a contract of this size

We determined that the main cause for the delay in establishing these project management tools was the Patrol's assumption that it had the expertise, resources and time to manage the project in-house. From November 2011 to August 2013, the Patrol assigned in-house staff with varying degrees of project management experience to act as part-time project managers, while they continued to perform their normal duties. As the project became more and more complex, these in-house project managers became overwhelmed by the scope of their duties.

Shortly after signing the contract with Motorola in December 2011, the Patrol hired a firm to provide project quality assurance. In February 2012, this firm advised the Patrol to adopt a detailed project deliverables schedule, a risk schedule, a staffing analysis and a project management charter. The firm reported to the Patrol that without these tools, the Patrol could not effectively control the project. In August 2013, nearly two years after it signed the Motorola contract, the Patrol hired a professional project manager. The Patrol and its project advisors acknowledge that not hiring a professional project manager sooner prolonged the project.

We examined the ways other organizations managed their projects. Spokane County had a professional project manager in place before it signed its radio-system contract, while Pierce County hired a professional project manager within a month of signing its system contract. Although Pierce County's project

encompassed a smaller geographical footprint, it started its more expensive $56 million narrowbanding project at about the same time that the Patrol did, but finished its project in February 2014.

While the original contract included a statewide coverage guarantee, a subsequent amendment shifted this responsibility for the conventional system from Motorola to the Patrol

Project management literature recommends that organizations make contract scope, coverage requirements and other deliverables as clear as possible so they can effectively monitor the completion of project deliverables. A competing vendor told us it is typical industry practice to establish a minimum coverage guarantee in contracts for these types of projects. This vendor and a Puget Sound radio system owner both told us that unless the contract establishes a coverage guarantee, operators cannot hold the contractor accountable for the system's performance. Other radio system owners who recently narrowbanded had such contract conditions, including Pierce County and Spokane County.

After awarding a sole-source contract to Motorola, a contract amendment that redesigned the system and added more than $3 million to the original contract was approved. A consequence of this amendment was that responsibility for mitigating any conventional system coverage loss shifted from Motorola to the Patrol.

Our review of the Patrol's October 24, 2011, draft statement of work (shown in **Exhibit 7**), which it shared with Motorola, shows the Patrol had planned for a vendor-provided statewide coverage guarantee.

Exhibit 7 – The Patrol's October 2011 draft statement of work shows the Patrol had planned for a statewide coverage guarantee

12.0 RADIO SYSTEM COVERAGE

12.1 COVERAGE ANALYSIS

Coverage analysis shall follow TIA/EIA TSB-88 (latest release) recommendations and will be referred to in this document as TSB-88. All designs shall comply with FCC rules and regulations.

Motorola shall predict P25 voice coverage using all existing WSP and DOJ system sites. Motorola shall provide with their proposal coverage maps illustrating the guaranteed 97% Covered Area Reliability (CAR)(per TSB-88.1-C Table D-6) with a Delivered Audio Quality (DAQ) of 3.4 (per TSB-88.1-C Table D-7) as recommended for public safety.

Motorola shall predict P25 data coverage using all existing WSP and DOJ system sites that will use P25 data operations as defined by WSP.

Source: The Patrol's October 24, 2011, draft statement of work in anticipation of the November 2, 2011, Motorola proposal.

From Motorola's November 2, 2011, proposal (**Exhibit 8**), which became the statement of work in the December 9, 2011, contract, we see Motorola's commitment to 97 percent painted (forecasted) area coverage for both the trunk system and the conventional system:

Exhibit 8 – Coverage guarantee per Motorola's November 2, 2011, proposal, adopted in December 2011 contract as Statement of Work

8B.3 OVERVIEW

This Coverage Acceptance Test Plan (CATP) is designed to verify that the 700 MHz and conventional VHF mobile designed radio systems implemented by Motorola meet or exceed the Washington State Patrol (WSP) coverage requirements. The coverage requirement for the 700 MHz and VHF conventional radio system is 97% painted area reliability for WSP.

Source: Motorola's November 2, 2011, proposal, submitted to the Patrol.

Contract amendment No. 2 (**Exhibit 9**) later eliminated the coverage guarantee for the conventional system. Thereafter, Motorola was only held to a coverage guarantee for the 700 MHz trunk system.

Exhibit 9 – Amendment No.2 eliminated the statewide coverage guarantee (now only applies to the trunk system in Puget Sound Area)

5A.5.1.2 COVERAGE DESIGN

Motorola's overall design provides equipment and costs for implementing new 700 MHz P25 trunk sites to enhance the coverage currently provided by the DOJ Trunk System.

The Motorola design assumes that any new trunked RF sites will be located at existing customer (WSP owned or agreements in place with partners) site facilities. Motorola understands that some of these sites may not be owned by the WSP. Our assumption is all sites are currently constructed and no civil/tower/site work is required for any of these sites. This includes both 700 MHz trunk sites as well as sites which will house Quantar/ GPW/GTR P25 Conventional Site upgrades. Motorola assumes all new trunk sites will utilize 700 MHz spectrum. If new VHF Trunk sites are required, through the change order process Motorola will work with WSP to provide an updated design and SOW.

As described in the updated Coverage Acceptance Test Plan (CATP from Design Review), Motorola will be testing RF coverage only in the new 700 MHz digital layer of the design.

Source: Contract Amendment No. 2, dated February 2012, amending the December 2011 contract with Motorola by removing the statewide coverage requirement.

The statewide coverage guarantee in the original contract was eliminated when the Patrol realized it needed to upgrade far more conventional sites

When we looked into why such a key deliverable was removed from the contract, we were told by the Patrol's project advisors that to secure a statewide coverage guarantee that matched what it had for the Puget Sound area, the project would have required far more infrastructure. Under the original December 2011 contract, Motorola was responsible for the installation of a 700 MHz trunk system in the Puget Sound area and for replacements and installations at 28 of the Patrol's 60 conventional sites. But as discussed later in the report, this system design would not have allowed the Patrol to effectively communicate with local law enforcement agencies. Consequently, the Patrol realized in early 2012 that it needed to upgrade all 60 of its conventional sites.

Contract amendment No. 2, signed in June 2012, reflected this significant and needed change, but it also increased the project's overall costs. The Patrol had told the Legislature in fall 2011 that it did not need about $12 million of the $53 million in planned and appropriated project funding. To help it stay within the smaller $40.1 million project budget, the Patrol decided that rather than replace all 60 of its conventional sites, it would only upgrade its repeaters at each of these sites. The Patrol also decided it would perform the upgrades and reprogramming of these repeaters itself instead of Motorola. Under such circumstances, vendors are reluctant to provide coverage guarantees for equipment they did not install.

As shown in Exhibit 8, the original contract indeed included coverage guarantees for both the trunk and conventional radio systems. As discussed later in the report, the removal of the conventional system coverage guarantee means the Patrol and not Motorola is now primarily responsible for providing the resources needed to mitigate any unanticipated coverage losses. After that guarantee was removed, the Patrol's quality assurance advisor reported concerns about how the Patrol and Motorola would know whether Motorola had fulfilled its conventional system contract deliverables.

In 2014, the Patrol eventually negotiated a process with Motorola to prioritize its conventional system coverage in areas where it expected to see some coverage loss. Under this process, the Patrol's project manager and technicians work with Motorola to perform an engineering-based analysis of each district to determine which technology type and placement that provides the best coverage. The team then presents options and recommendations to district captains and commanders, who approve the best system configuration. Using this process, gaps in coverage are prioritized.

DES and the Patrol lacked a written agreement that clarified each agency's contracting roles and responsibilities

The Patrol and DES did not enter into a written agreement before contract negotiations started and therefore did not clearly establish the roles and responsibilities of each agency. Although the Patrol's management acknowledged DES consults with them when it negotiates contract amendments, the Patrol told us it believed DES had primary responsibility for negotiating Amendment No. 2 (as set out in RCW 39.26). Conversely, DES told us it relied on the Patrol's judgment during the negotiations of Amendment No. 2.

This lack of clarity in the roles of the two agencies continues. For example, DES also told us there are questions about which agency should accept the work as finished. The contract assigns this responsibility to DES, but the Patrol has signed off on those districts that have been narrowbanded to date.

What are the results of the decisions made during planning and procurement of the narrowband project?

The delay in establishing key project management tools had these consequences:

1. Control and risk over the finished system's performance has shifted from the vendor to the Patrol.
2. The Patrol experienced unanticipated coverage problems in the areas that started out with lower-quality coverage and those that have extreme topography. It also experienced system complexities in some of the more populated areas.
3. The Patrol's IWN utilization is less than what was expected.
4. The Patrol successfully leveraged other agencies' infrastructure, which likely reduced the amount of funding it will need to address coverage loss and other issues.
5. The Patrol obtained three deadline extensions and currently does not plan to complete the narrowbanding project until December 2016, nearly four years after the original deadline.

We address each of these issues below.

1. Risk of the conventional system's performance has switched from the vendor to the Patrol

Amendment No. 2 shifted responsibility for the conventional system's coverage performance from Motorola to the Patrol. Even though subsequent amendments reassigned some of this responsibility back to Motorola, the Patrol still will not have the same conventional system coverage that was once guaranteed by Motorola in the original contract. The Patrol told us it was unlikely any vendor would have guaranteed statewide coverage because it would not want to be held accountable for a conventional system consisting of upgrades and legacy equipment built by different vendors. Although this is true, an upfront engineering study would have enabled the Patrol to recognize it needed more project time and funding for more extensive conventional system replacements, potentially allowing it to obtain a conventional system coverage guarantee as specified in the original contract.

2. Unanticipated coverage problems and system complexities

An important consequence of not performing an engineering study was that the Patrol lacked hard data on the changes in coverage it would experience by simply updating its older conventional system equipment to make it digital capable, or the nature and extent of any additional conventional system equipment it would need to provide troopers with coverage equivalent to what they had when using wideband analog.

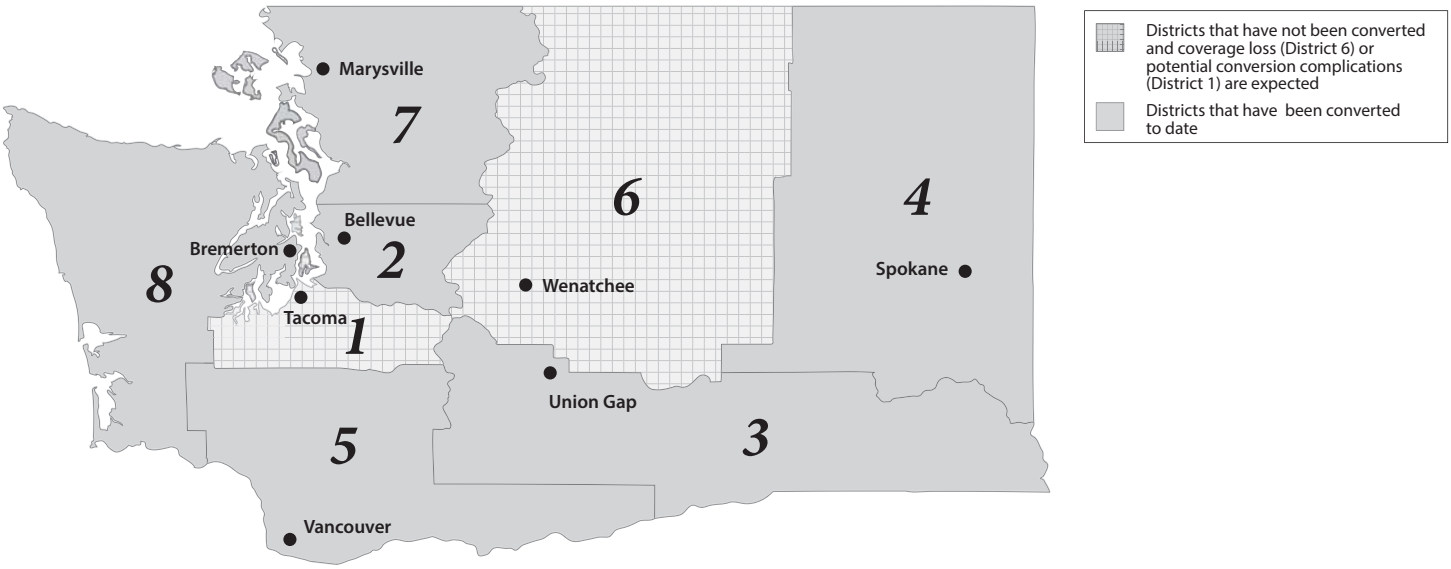
Since the Patrol did not take a baseline measurement of pre-existing coverage, the Patrol will never be able to precisely determine how coverage has changed in the districts now converted to narrowband. However, through interviews with the Patrol's radio technicians, project manager, quality assurance advisor, other Patrol officials, and Labor & Industries investigators, we were able to determine it is likely the Patrol has gained coverage in the more populated King County and Spokane County areas. Consistent with these representations, a troopers' survey showed a high level of satisfaction with the new system's coverage in King County.

However, consistent with industry literature, we were also told coverage worsened in areas where troopers relied on lower-quality radio system coverage to communicate with one another. Troopers Association representatives told us that in districts where the Patrol no longer operates in wideband analog, troopers have observed a significant increase in "dead spots." The Patrol's analog wideband coverage was already known to be poor in parts of the state. Patrol radio technicians and vendors anticipate more coverage problems in the more rural, hilly and mountainous parts of the state as the conversion continues. Consistent with written project management reports, the project's quality assurance advisor told us a loss in system coverage was one of the project's biggest risks.

During our audit, the Department of Labor & Industries was investigating a claim by the Troopers Association that its members experienced problems with the digital radio system. See page 31 of this report for more details.

The Patrol has not yet converted Districts 1 and 6, highlighted in the map in **Exhibit 10**. Additional coverage problems in District 6 and potential conversion complications in District 1 are expected.

Exhibit 10 – The Patrol anticipates coverage loss or potential conversion complications in two districts that have not yet been converted



Source: Auditor conversations with State Patrol officials and reports from the Project Quality Assurance Advisor and Project Manager.

In addition to coverage problems, the system is now complex for the troopers to use. The Patrol's radio system consists of both trunk and conventional technology. Troopers must interact with numerous local government systems that use different types of communication technology and are at various phases of narrowbanding. During its 2015 monthly progress reports, the Patrol's quality assurance advisor warned about the mix of technology adding complexity to the system.

The new system is difficult for troopers to use. Depending on their location, they must manually switch radios back and forth between conventional and trunk systems. The Patrol's quality assurance advisor and its project manager said that on the old analog system, troopers might have to choose from four radio-use alternatives to maintain coverage as they drove from one area to another. Now they must switch across 15 alternatives in some parts of the state. Troopers must know where to make these manual switches, sometimes doing so while conducting high-speed pursuits on the interstate.

Some issues in manual switching might be resolved through upgrades

Troopers have to make manual switches when they move from the Patrol's trunk system (defined in Appendix C) to a county trunk system, which can only occur if the two are tied together. If the Patrol upgrades the hardware and software that make up these tie-ins to the latest version, troopers using the Patrol's trunk system will be able to more easily roam onto the various county systems that also use Motorola.

State Patrol told us that upgrading its existing tie-ins would also enable troopers to use a two-way interface and hear communications from both the Patrol's system and the county systems at the same time.

The Patrol believes that under its agreement, DOJ is unlikely to share in these costs, which can be about $2 million per tie-in.

The problems with coverage and added system complexity associated with narrowbanding prompted the Troopers Association to file a safety grievance with the state's Department of Labor & Industries (L&I) in 2015.

In a letter sent to L&I, the Troopers Association claimed that since the switch to the digital system, troopers and sergeants experience many more interoperability issues such as an increased number of dead spots and garbled transmissions. During its review, L&I investigators were told by numerous troopers, sergeants and radio technicians that there are more dead spots where the digital system is in place than in the past.

Investigators also learned that troopers are increasingly relying on personal cell phones as a backup form of communication when they encounter a dead spot in the radio system. Trooper reliance on cell phones carries safety risks. Although troopers may be able to successfully use cell phones for isolated, small-scale events, this approach may not work during a major disaster if public callers overwhelm public cell phone towers. This is a risk the FCC hoped to avoid by implementing narrowbanding.

L&I's investigation resulted in the Patrol being cited for one general violation of not having procedures in place "for the use of backup communication or backup patrol when entering known dead zones." The Patrol admitted to not having these policies and has since implemented them to resolve the citation. Even though the Patrol and L&I both consider this citation resolved, the Troopers Association told us it does not agree the added policies have fully addressed all its safety concerns regarding the new system's coverage. In a letter written to L&I, the Troopers Association states that "WSP troopers and sergeants remain at risk of serious physical harm or death even under WSP's proposed policy."

3. The Patrol's IWN utilization is less than what was expected

Originally, the Patrol planned to use the IWN trunk system along I-5 and I-90. However, the Patrol did not realize until after signing the contract with Motorola that this would decrease interoperability with local law enforcement agencies across the state. Troopers need to communicate daily with the Patrol's local law enforcement partners, but these county and city law enforcement agencies do not use IWN. While some law enforcement agencies can communicate with the Patrol through the Tri-County Radio Interoperability System (TRIS), the system is only in the Puget Sound area.

For this reason, troopers cannot use IWN to the extent described in Motorola's original proposal. Consequently, through Amendment No. 2, the Patrol had to upgrade all its conventional system locations in order to maintain the same level of interoperability with local law enforcement agencies that it had on the wideband analog system.

Now, the Patrol utilizes IWN as its primary coverage at a few King County locations and potentially others near Vancouver and Union Gap. Because the Patrol has not utilized the DOJ's system as originally planned, it appears the $12 million the Patrol reported the merger saved will not be fully realized. See Appendix G for further details regarding the utilization of the IWN system.

The Patrol expects to have a documented long-term plan to identify a minimum coverage level, and how and when it will achieve it, by 2016.

A long-term vision and financial plan are needed to address the problems described in our report. Without them, the Patrol will have more difficulty when it estimates the additional resources needed to pay for a fully functioning system. The Patrol told us in July 2015 it will have plans in place by the middle of 2016.

The Patrol has established a process to log the dead spots that troopers identify in the districts already narrowbanded, and it is also measuring the coverage that results from its narrowbanding efforts. When coupled with an engineering study, the log of dead spots and the baseline coverage it is now establishing should help the Patrol develop its long-range plan.

4. The Patrol has successfully leveraged other agencies' infrastructure, which likely reduced the funding necessary to address coverage loss and other issues

Through agency interoperability agreements, the Patrol is leasing tower space in areas where other agencies have spare capacity. Patrol officials told us these agreements are usually cheaper in the short term. For example, the Patrol avoided building a tower in Kelso where it lacked coverage by entering into a lease agreement to use Clark County's tower for $12,000 a year. As a result, the Patrol only had to buy about $40,000 in equipment. It has also recently connected to other local governments' towers in Districts 1 and 8, with plans to do the same in District 6. Similarly, DNR staff told us DNR is allowing the Patrol to use some of its capacity in the Kelso area. (See other examples of the Patrol's local government partnerships in the subject matter expert's report in Appendix I.) By comparison, a new radio tower site in these areas would likely have cost about $1 million. Even with these successful efforts to minimize coverage loss, Patrol staff told us that the agency may still need to spend more on radio tower sites.

Echoing concerns reported by its quality assurance advisor, the Patrol's project manager raised budget concerns in spring and summer 2015. For example, in one report, the manager wrote,

> *"The major risk confronting the project at this time continues to be the project budget. The project's contingency budget is, for all practical purposes, exhausted. Should additional requirements arise as we move into the remaining districts, this could become a challenge."*

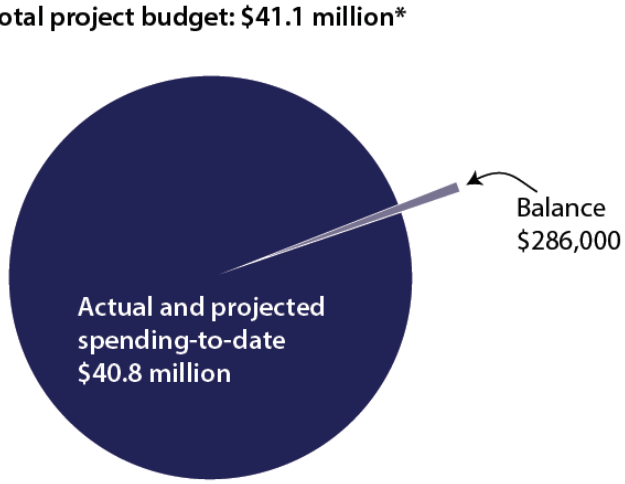
In another 2015 report, this advisor discusses how the project's complexity may not be able to be addressed within the funding.

These concerns likely arose because the Patrol had yet to convert three of its eight districts, but had already spent most of its slightly increased $41.4 million in project funding, leaving little to pay for additional infrastructure to avoid coverage loss. At the time, Patrol officials told us it had already purchased all equipment it believed it needed to meet the narrowband mandate, and did not anticipate exceeding the project budget.

Since then, the Patrol has spent at least $615,000 on labor, equipment and services to address coverage challenges in District 1, which its project manager described as the most complex to narrowband, and in Districts 6 and 8. As of March 2016, the Patrol reported it still has $286,000 in remaining project funds. But in that same month, the District's project manager reported that the scope for District 6 could potentially increase beyond expectations, impacting the overall project schedule and budget. **Exhibit 11** shows a breakdown of the project's $41.4 million budget, but it excludes other project costs. Since 2011, the Patrol has also spent an additional $4.75 million for project staff time, quality assurance advisor fees, and professional project manager fees. The majority of these project costs were paid through the Patrol's Electronic Services Division's operating budget.

Exhibit 11 – The balance in the Patrol's narrowbanding project budget is unlikely to meet its emergent needs

Project budget as of March 30, 2016



Note: The Patrol's reported $41.4 million project budget exceeds the $40.1 million in appropriated project funding as it includes additional 2013-15 appropriations.

Source: Performance-to-budget data presented in October 2015 to the SIEC (unaudited).

5. The Patrol has obtained three deadline extensions and does not currently plan to complete the project until December 2016

In 2011, two of the Patrol's justifications for merging with the IWN system were that doing so would allow for considerable savings and would speed up the Patrol's ability to meet the federal deadline of January 2013. However, the Patrol continues to operate two of its eight districts in wideband analog.

Amendment No. 2, signed in June 2012, significantly revised the scope of Motorola's proposed design, and shifted work for the conventional side of the system from Motorola to the Patrol. Since then, the Patrol has received three FCC extensions. Its latest extension allows the Patrol to complete the project by June 2016. The Patrol now anticipates completing the project in December 2016. However, reports from the Patrol's project manager in early 2016 warn about the potential for further delays.

See **Appendix H** for other observations related to the Patrol's past and future planning, procurement and contracting for its narrowband project.

Objective 2: Has the Patrol been transparent about the outcomes resulting from the planning, procurement and contracting of that equipment and infrastructure?

The U.S. Government Accountability Office's Government Audit Standards state that legislators and the public need to know whether "government programs are achieving their objectives and desired outcomes." To determine whether the Patrol kept legislators and the public informed of project outcomes, we interviewed legislative members and reviewed SIEC meeting minutes and the Office of the Chief Information Officer's website. From our review, we found:

- The Patrol has effectively communicated with its public safety partners throughout the project.
- While other stakeholders expressed concerns about the amount of project information available in the past, project transparency has recently improved.

The Patrol effectively communicated with its public safety partners throughout the project

During the planning and administration of the project, the Patrol made regular presentations to the SIEC communicating budget and schedule status, project challenges and major milestones. SIEC meeting minutes and the Patrol's presentation documents are posted to the SIEC's website for the public to see.

While some stakeholders have expressed concerns about how much project information has been made available, project transparency has recently improved

Past presentations the Patrol made to legislative transportation committees included updates on the project budget and conversion progress. Since then, the Patrol has not mentioned its recently discovered challenges, such as the possibility of additional funding needs or the problems it has had trying to maintain the lower-quality coverage troopers previously relied on. The Patrol has not met with either the Senate Transportation Committee or the Joint Transportation Committee to discuss the narrowbanding project since May 2014.

When the Patrol last presented to the House Transportation Committee in January 2015, the lead Committee staff member told us the presentation focused largely on the project budget, which was characterized as on track, and not about coverage loss. The Patrol told us they have been reluctant to discuss recently identified coverage problems with legislators until the full extent of the new system's coverage can be measured.

The Patrol also told us it sends the quality assurance advisor's and project manager's reports to various stakeholders. While we believe this is a good way to keep stakeholders updated on project status, we found that until very recently, these reports were not being sent to all stakeholders and they were not publicly available online. For example, the Patrol only sent the project manager's monthly reports to one House Transportation Committee lead staff person, but did not send Transportation Committee staff or members the more detailed system assessments described in the quality assurance advisor's reports.

Other government organizations have dealt with the issue of transparency differently. For example, the Oregon Department of Transportation posts monthly updates on its website so the public can follow the progress of its narrowband project. In 2016, Washington's Office of the Chief Information Officer also began posting the Patrol's most recent project management and quality assurance reports online to help the Patrol make sure all stakeholders receive timely information.

Recommendations

Before the second phase of narrowbanding arrives, we recommend the Patrol:

1. Over the short-term, mid-term and long-term, assess whether it is advantageous to stay merged with the IWN system
2. Work with the Governor's Office to establish the minimum acceptable statewide coverage
3. Work with the Legislature to approve funding for needed upfront engineering studies, then conduct the studies to determine how much it will cost to achieve that coverage
4. Using the studies, work with OFM to establish an informed long-term plan and budget request for future project work
    a) Connect this long-term plan to the upcoming phase-two narrowbanding effort and the subsequent vendor contracts that will support that effort
    b) Make sure its request for funding for the second phase includes project management and procurement costs that were not included in the budget for the first phase
5. Using the studies and long-term plan, work with the Legislature to help it decide the amount of project funding
6. Prepare monthly online reports that disclose the status of its phase-one and future phase-two narrow-banding projects to make sure all stakeholders receive timely information

Once project funding is established for the FCC phase-two narrowbanding, we recommend the Patrol:

7. Establish needed project management tools and resources before signing any contracts for goods and services
8. Establish contract coverage requirements that match what the Governor's Office has agreed to, and are based on engineering studies and available funding

In the immediate term, we recommend DES:

9. Work with the Patrol to:
    a) Establish each agency's roles and responsibilities in a written agreement
    b) Assure the proper scoping of future contracts and contract amendments
    c) Identify criteria for determining when the contract is complete and each agency's part in making that determination

Agency Response

STATE OF WASHINGTON

August 2, 2016

The Honorable Troy Kelley
Washington State Auditor
P.O. Box 40021
Olympia WA 98504-0021

Dear Mr. Kelley:

Thank you for the opportunity to respond to the State Auditor's Office (SAO) performance audit report on efforts by the Washington State Patrol (WSP) to comply with the Federal Communication Commission's (FCC) mandate to narrowband its radio communications system. The Office of Financial Management (OFM) worked with WSP and the Department of Enterprise Services to provide this consolidated response.

The stated objectives of the SAO's performance audit were to: (1) determine if WSP was effective in planning, procuring, and contracting the equipment necessary to meet the FCC's mandate, and (2) to determine if WSP has been transparent about the outcomes of its planning, procurement, and contracting of that equipment. Although the audit took two years to complete and resulted in a very lengthy report, several clarifications are necessary due to factual or contextual inaccuracies presented in the report.

FCC mandate and the Great Recession

To accurately assess whether the WSP made sound decisions during the narrowbanding project, one must recall the fiscal environment of the state at the time these decisions were made. In 2010, WSP was faced with the need to meet the FCC requirement to change its radio system from 25 kHz channels to 12.5 kHz. The initial, best cost estimate WSP shared with the Governor's Office and OFM was between $60 and $80 million.

The WSP radio infrastructure was nearing the end of its useful life, and large portions were past end of life and no longer supported by vendors. At the same time, the state was facing a significant budget shortfall. The WSP was directed to scale back its budget request to the bare minimum and defer some of its request to the 2013-15 budget cycle. This meant WSP would have to reuse as much equipment as possible and replace equipment that could not be narrowbanded. The WSP received $40.1 million in the 2011-13 budget, with the understanding that an additional $13 million would be received in 2013-15.

The scope of the narrowbanding project has always been to convert WSP's radio system to narrowband compliance while providing the best coverage possible. Deploying a new statewide digital radio system, as suggested by the SAO report, has never been the intent of this project. This is reflected by both the approach the agency has taken and the project budget.

The $41.1 million appropriated would never have been sufficient to deploy a new statewide radio system. For comparison, the state of New York spent $2.2 billion and the state of Oregon spent $230 million to implement their respective statewide digital radio systems. Additionally, county-wide digital radio system projects in Washington have ranged in cost from $45 million in Spokane County to $273 million in King County.

SAO audit report questions WSP's decision to partner with U.S. Department of Justice's Integrated Wireless Network (IWN) system

The WSP and the U.S. Department of Justice (DOJ) have an established working relationship on communication systems dating back to 2003. Over this period, DOJ has provided WSP more than $75 million in infrastructure and construction services to improve WSP's microwave network, which carries its radio communications. In addition to helping WSP to meet the narrowbanding mandate, the DOJ partnership represents an opportunity to enhance WSP's radio system at little cost and improve interoperability between state and federal law enforcement.

While there is always risk involved in giving up a measure of autonomy and control by partnering with another governmental entity, WSP determined that the potential benefits of significant equipment savings, better system coverage, and greater interoperability far outweighed potential risks of partnering. The partnership with the IWN system has resulted in substantial cost savings to the state and provided both more coverage and capabilities for WSP, the Washington Department of Fish and Wildlife, and other system users. Additionally, the IWN/WSP system in the Puget Sound region has been used on multiple occasions for seamless interoperable communications across all levels of law enforcement for large events, such as the U.S. and Chinese presidential visits, the U.S. Open golf tournament, public protests, and homeland security exercises. Prior to integration with the IWN system, events of this significance experienced poor interoperable communications resulting in major disruptions to agency dispatching operations.

WSP's transparency

The WSP has been open and transparent throughout the narrowbanding project. Prior to receiving funding, WSP briefed legislative staff and stakeholders on plans to migrate to Project 25 (P25) digital radio standards as part of the narrowbanding effort. This comported with applicable state laws, followed guidance of the State Interoperability Executive Committee (SIEC), and aligned with agency technical expertise and the experiences of other communication system owners. WSP has also briefed the SIEC at each of its meetings since the project's inception. The agency has met regularly with the Washington Association of Sheriffs and Police Chiefs, the Washington State Patrol Troopers Association, media, legislative staff, and interested persons to discuss project status and issues, including ten briefings in 2012.

The WSP has answered all questions openly and in a timely manner, and continues to do so. Project status reports have been provided monthly to all who have requested and are posted on the Office of the Chief Information Officer's website.

The WSP believes it has been successful in meeting the narrowbanding mandate while improving public safety-grade radio coverage and interoperability. The agency has stayed within the project budget. It has requested extensions to the schedule from the FCC, which have been readily granted due to the good progress WSP has made.

It is WSP's perspective that the above facts and context are not represented clearly in the SAO audit report despite two years of discussions between our teams. We provide them for clarity to the readers of this report and in the spirit of full transparency.

Sincerely,

Chief John R. Batiste
Washington State Patrol

Chris Liu, Director
Department of Enterprise Services

David Schumacher, Director
Office of Financial Management

Enclosure

cc: David Postman, Chief of Staff, Office of the Governor
Kelly Wicker, Deputy Chief of Staff, Office of the Governor
Miguel Pérez-Gibson, Executive Director of Legislative Affairs, Office of the Governor
Matt Steuerwalt, Executive Director of Policy, Office of the Governor
Tracy Guerin, Deputy Director, Office of Financial Management
Wendy Korthuis-Smith, Director, Results Washington, Office of the Governor
Tammy Firkins, Performance Audit Liaison, Results Washington, Office of the Governor
Jeff Canaan, Deputy Director, Department of Enterprise Services
Bob Covington, Deputy Director, Department of Enterprise Services
Marc W. Lamoreaux, Assistant Chief, Washington State Patrol

OFFICIAL STATE AGENCY MANAGEMENT RESPONSE TO THE PERFORMANCE AUDIT ON WASHINGTON STATE PATROL'S RADIO NARROWBANDING PROJECT: LESSONS LEARNED

AUGUST 2, 2016

This coordinated management response to the State Auditor's Office (SAO) performance audit report received on June 29, 2016, is provided by the Washington State Patrol (WSP), Department of Enterprise Services (DES), and Office of Financial Management (OFM).

SAO PERFORMANCE AUDIT OBJECTIVES (SUMMARIZED):

The SAO objectives were designed to answer:

1. Was WSP planning effective to determine the equipment and infrastructure needed to cost-effectively meet the FCC mandate for procurement?
2. Has WSP been transparent about outcomes attributable to its planning and contracting?

SAO Issues:

1. Patrol would have benefited from a deeper understanding of its current system and available technology.

STATE RESPONSE: Two technology approaches were available to WSP to achieve the narrowbanding mandate: analog and digital Project 25 (P25). P25 is an established standard for public safety agencies throughout the country, as well as for the federal government. WSP's primary reason for moving to P25 operation was that engineering predictions by both WSP and vendors indicated it would provide coverage far superior to narrowband analog in most areas of the state. These predictions have been proven accurate through coverage measurements performed by WSP after narrowbanding in digital P25. The primary exception to this is in the northcentral area of the state, near Okanogan and Wenatchee. In these areas, narrowband analog is preferable to P25 due to the rugged terrain. The decision to narrowband in either P25 digital or analog was made based on sound engineering and measurements in each area of the state, with input from the primary stakeholders and WSP district command staff.

2. Patrol could have benefited from further analysis into whether merging with IWN provided the best benefit to the state and required Motorola for all equipment and radios.

STATE RESPONSE: WSP was encouraged by the U.S. Department of Justice (DOJ) to explore partnering with it on its Integrated Wireless Network (IWN) system due to the 13-year working relationship between the two agencies. WSP did so. In addition to helping WSP meet the narrowbanding mandate, this partnership presented an opportunity to enhance WSP's radio system, reduce costs, and improve interoperability between state and federal law enforcement.

Other vendors' mobile and portable radios could have been used with less effectiveness and interoperability. Given limited funding and WSP's interoperability requirements with other first-responder communication systems, this was not a viable option. SAO stated in its report that WSP received the same or greater discounts on the Motorola radio equipment as comparable contracts that were competitively bid in the state.

3. Stronger project and contract management may have minimized project delays, system performance issues and likely budget over-runs.

STATE RESPONSE: In retrospect, WSP acknowledges that it should have requested additional project management staffing in its original budget request. When the agency realized the complexity of the project exceeded its abilities to manage it with existing resources, professional project management services were acquired and used from that point forward. These services have resulted in more thorough, repeatable and methodical processes and contributed significantly to the project's success.

WSP believes there has been strong contract management through the combined efforts of the agency project manager and DES. To date, the project has remained within budget.

4. The Patrol has effectively communicated with its public safety partners throughout the project. While other stakeholders have expressed concerns about the amount of project information that has been available in the past, project transparency has recently improved.

STATE RESPONSE: WSP has been open and transparent throughout the narrowbanding project. Prior to receiving funding, WSP informed legislative staff and stakeholders that the agency planned to migrate to P25 operation as part of the narrowbanding effort. This comported with state law, followed guidance by the State Interoperability Executive Committee (SIEC), and aligned with agency technical expertise and the experiences of other communications systems. WSP has also briefed the SIEC at each of its meetings since the project's inception. The agency has met regularly with the Washington Association of Sheriffs and Police Chiefs, Washington State Patrol Troopers Association, the media, legislative staff and interested citizens to discuss project status and issues, including ten briefings in 2012 alone. WSP has answered all questions openly and in a timely manner, and continues to do so. Project status reports have been provided monthly to all who have requested them and posted on the Office of the Chief Information Officer's (OCIO) IT project dashboard.

SAO Recommendation 1 to WSP: Over the short-term, mid-term and long-term, assess whether it is advantageous to stay merged with the IWN system.

STATE RESPONSE: WSP concurs with the recommendation. WSP regularly assesses and engages in partnership opportunities in the interest of achieving efficient, interoperable and cost-effective radio operations. Specific to the IWN system, this approach is in accordance with the interagency agreement between WSP and DOJ for shared-system integration.

Action Steps and Time Frame

- WSP has begun preliminary engineering work, in conjunction with the vendor, to evaluate options for changing the connection between IWN and WSP's radio system. WSP is evaluating the use of a Project 25 Inter RF Subsystem Interface (P25 ISSI) as a means of linking to other radio systems. The use of such an interface with IWN may allow continued system integration while reducing potentially problematic dependencies associated with a single merged system, as identified in the audit report. *By December 2016*

- WSP will brief agency management and stakeholders on the benefits, concerns, costs and impacts of changing from a merged system to a system using the P25 ISSI connection. *By July 1, 2017*
- If the decision to separate the systems is made, WSP will pursue appropriate budget requests and state procurement procedures to accomplish the transition in a timely manner. *Due date will be determined if necessary.*

SAO Recommendation 2 to WSP: Work with the Governor's Office to establish the minimum acceptable statewide coverage.

STATE RESPONSE: WSP concurs with the recommendation. WSP will identify its minimum statewide radio system coverage standards in a coordinated manner with the Governor's Office.

Action Steps and Time Frame

- WSP will conduct an analysis to determine the minimum statewide public safety-grade radio coverage standard appropriate for WSP's use. This analysis will review published industry standards, comparable statewide system specifications, and stakeholder input to define coverage standards. *By June 30, 2017*

SAO Recommendation 3 to WSP: Work with the Legislature to approve funding for needed upfront engineering studies, then conduct the studies to determine how much it will cost to achieve that coverage.

STATE RESPONSE: WSP concurs with the recommendation.

Action Steps and Time Frame

- WSP has prepared a budget request for an engineering study, as referenced by the SAO in its audit. WSP will follow established IT investment policies and request approval to pursue this study from the OCIO and the SIEC. *By October 20, 2016*
- WSP will submit a budget request for the engineering study to OFM. *By September 16, 2016*
- If funded in 2017, WSP will work with DES to contract with a qualified professional engineering firm to perform the statewide engineering study, which will include the agreed-upon coverage requirements. Completion of the engineering study is expected to take approximately one year from the start of contract. *Due date will be determined if funded.*

SAO Recommendation 4 to WSP: Using the studies, work with OFM to establish an informed long-term plan and budget request for future project work.

a. Connect this long-term plan to the upcoming phase-two narrowbanding effort and the subsequent vendor contracts that will support that effort.

b. Make sure its request for funding for the second phase includes project management and procurement costs that were not included in the budget for the first phase.

STATE RESPONSE: WSP concurs with the recommendation and will work with OFM to define future project work.

Action Steps and Time Frame

- WSP will use the results of the engineering study, including the coverage requirement standard agreed to by the Governor's Office, to work with OFM in developing a strategic plan for future system development. Any planned system upgrades will comply with narrowbanding phase two requirements. This strategic plan will also include appropriate project management and procurement resources. *Due date will be determined if funded*

SAO Recommendation 5 to WSP: Using the studies and long-term plan, work with the Legislature to help it decide the amount of project funding.

STATE RESPONSE: WSP concurs with the recommendation.

Action Steps and Time Frame

- WSP will use the results of the engineering study or studies, including the coverage requirement standard agreed to by the Governor's Office, to prepare a request for information for release to the vendor community. *Due date will be determined if funded.*
- Upon receipt of vendor information and in accordance with its system strategic plan, WSP will develop an appropriate budget request aligned with the state's IT investment procedures and requirements. *Due date will be determined if funded.*

SAO Recommendation 6 to WSP: Prepare monthly online reports that disclose the status of its phase-one and future phase-two narrow-banding projects to make sure all stakeholders receive timely information.

STATE RESPONSE: WSP concurs with the recommendation and will ensure stakeholders are informed of project status.

Action Steps and Time Frame

- WSP publishes monthly phase one project reports on the OCIO's IT project dashboard. This will continue throughout completion of phase one narrowbanding. *Complete and ongoing*
- When any future large-scale system expansion, system upgrade, or narrowbanding phase two projects are approved and funded, the project management team will require posting of these monthly reports. *Ongoing*

SAO Recommendation 7 to WSP: *Once project funding is established for the FCC phase-two narrowbanding:* Establish needed project management tools and resources before signing any contracts for goods and services.

STATE RESPONSE: WSP concurs with the recommendation and will ensure project management resources are in place at the beginning of phase two narrowbanding.

Action Steps and Time Frame

- When project funding is established for the FCC's phase-two narrowbanding, all OCIO IT oversight policies and requirements will be met, including those on external quality assurance and project management. *Due date will be determined after funding established*

SAO Recommendation 8 to WSP: *Once project funding is established for the FCC phase-two narrowbanding:* Establish contract coverage requirements that match what the Governor's Office has agreed to, and are based on engineering studies and available funding.

STATE RESPONSE: WSP concurs with the recommendation.

Action Steps and Time Frame

- Coverage requirements, based on engineering study results and in accordance with the Governor's Office approval, will be the basis for phase two funding requests and resulting vendor contracts. *Due date will be determined after funding established*

SAO Recommendation 9 to DES: Work with the Patrol to:

a. Establish each agency's roles and responsibilities in a written agreement.
b. Assure the proper scoping of future contract amendments.
c. Identify criteria for determining when the contract is complete and each agency's part in making that determination.

STATE RESPONSE: DES is making an administrative amendment to the contract that clarifies each agency's roles and responsibilities. This will include criteria for determining when the contract is complete and defining each agency's part in making that determination. The customer, as the subject matter expert, is ultimately responsible for ensuring the project is properly scoped.

WSP concurs with the recommendation to DES. WSP will work with DES to clarify agency roles via written agreements to ensure proper scoping of future contract amendments and clearly define contract completion criteria.

Action Steps and Time Frame

- DES will execute an administrative amendment to the contract, clarifying roles and responsibilities. *By August 15, 2016*

Appendix A: Initiative 900

Initiative 900, approved by Washington voters in 2005 and enacted into state law in 2006, authorized the State Auditor's Office to conduct independent, comprehensive performance audits of state and local governments. Specifically, the law directs the Auditor's Office to "review and analyze the economy, efficiency, and effectiveness of the policies, management, fiscal affairs, and operations of state and local governments, agencies, programs, and accounts." Performance audits are to be conducted according to U.S. Government Accountability Office government auditing standards.

In addition, the law identifies nine elements that are to be considered within the scope of each performance audit. The State Auditor's Office evaluates the relevance of all nine elements to each audit. The table below indicates which elements are addressed in the audit. Specific issues are discussed in the Results and Recommendations section of this report.

I-900 element	Addressed in the audit
1. Identify cost savings	**Not applicable.** Instead of cost savings, the audit determines that the Patrol's radio system will likely require additional infrastructure and funding.
2. Identify services that can be reduced or eliminated	**Not applicable.** Instead of questioning the level of goods and services the Patrol has purchased to date, the audit identifies a need for additional engineering studies and radio infrastructure.
3. Identify programs or services that can be transferred to the private sector	**Not applicable.** Public safety and emergency radio systems are essential government functions.
4. Analyze gaps or overlaps in programs or services and provide recommendations to correct them	**Yes.** The audit determined that the Patrol was slow to establish critical project management tools, such as a project charter, a risk management plan and a detailed task schedule. These tools are now in place.
5. Assess feasibility of pooling information technology systems within the department	**Yes.** The audit determined the Patrol is actively taking steps to use other federal and local government radio systems.
6. Analyze departmental roles and functions, and provide recommendations to change or eliminate them	**Yes.** The audit determined that contracting roles between the Patrol and the Department of Enterprise Services are unclear. The audit also determined that a full-time project manager would have been helpful much earlier in the project. The Patrol has since addressed this.
7. Provide recommendations for statutory or regulatory changes that may be necessary for the department to properly carry out its functions	**Yes.** The audit recommends the Legislature provide the Patrol with additional funding for engineering studies and infrastructure to improve radio system coverage.
8. Analyze departmental performance, data performance measures, and self-assessment systems	**Yes.** The audit determined that the Patrol now has a project advisory firm and a professional project manager to assist it with contract management and project quality. These parties regularly assess the Patrol's project management against its project schedule and leading practices.
9. Identify relevant best practices	**Yes.** The audit identifies leading practices for converting from a wideband to a narrowband radio system and the contract conditions that help do this. The audit determined that the Patrol adhered to some but not all of these practices for its Phase 1 conversion. The audit recommends the Patrol use all leading practices when it initiates the system improvements that are needed to meet the Phase 2 narrowbanding requirements.

Appendix B: Methodology

Leading practices applicable to narrowbanding projects

The U.S. Department of Homeland Security and industry sources recommend that agencies use sound project management practices to successfully meet the FCC's narrowbanding mandate. Many of the practices we identified in our research are broadly applicable to all capital projects and are widely available from multiple sources. Others are more specific to the process of transforming a radio system from wideband to narrowband; they were published and promoted by the FCC and other public service organizations at various times after the mandate was announced.

In addition to identifying 10 common and applicable leading practices, we considered the primary benefits they provide users.

	Leading practice	Benefits
1	Assess current equipment's capacity for narrowbanding	Prevents unnecessary equipment purchases. Provides starting point for determining the equipment that will be needed for the new system.
2	Measure existing system coverage	Used in engineering studies. Provides starting point for determining the equipment that will be needed for the new system.
3	Conduct an engineering study to identify the quantity and type of equipment that is needed to achieve the desired performance of the new system	Enables owners to make an informed budget request and a well-planned project scope.
4	Communicate with neighbors and interoperability groups about sharing costs and infrastructure	Can add coverage and capacity while preventing duplicative infrastructure purchases.
5	Establish project cost estimates, funding requests and procurement plans	Affirms planned project scope, planned contract scope and use of vendors.
6	Develop an upfront wideband to narrowband conversion plan, including a reasonable project schedule that includes important tasks and a good time to narrowband, a project charter, and a risk management plan	Strategy, tasks and schedule are needed to narrowband on time.
7	Establish upfront an experienced project team with clearly assigned roles and responsibilities	Ensure contract reflects project needs, and ensure contractor delivers on expectations.
8	Obtain proposals from multiple vendors	Increases likelihood of picking vendors with the best combination of pricing and solution.
9	Establish key contract conditions (including scope, coverage requirements and project deadlines) that are clearly described in the initial contract and any amendments	Success of contract and project made more likely.
10	Monitor completion of project tasks and vendor deliverables against project schedules and key contract conditions, holding employees and vendors accountable	Success of project outcome made more likely.

Sources for the leading practices that were available before and after the Patrol's formal budget request (September 2010)

- ***A Guide to the Project Management Body of Knowledge,*** 2000 edition, published by the Project Management Institute Inc.
- ***FCC Narrowbanding Mandate – A Public Safety Guide for Compliance,*** published by the FCC in 2006
- **U.S. Department of the Interior Radio Communications Program Audit Report,** published by the U.S. Department of the Interior Office of Inspector General in 2007
- ***VHF/UHF Narrowbanding Information for Public Safety Licenses,*** published by the FCC Public Safety and Homeland Security Bureau in 2010
- **Like it or not, narrowbanding is just around the corner,** published by Public Safety Communications Magazine in June 2011
- ***A Practical Guide to Narrowbanding,*** published by Homeland Security in 2011
- ***Yellow Book,*** published by the U.S. Government Accountability Office in 2011
- ***Great Lessons Learned in Project Management,*** published by Management Concept Press in 2015, written by David Pratt, PMP
- Interviews with radio system professionals

How we conducted our assessments

To answer our audit objectives, we determined whether the Patrol followed the practices shown above. To make these determinations and to learn about the project's status and the system's actual and anticipated performance, we reviewed the Patrol's internal project status reports, its project status presentations to the SIEC, and records from a Department of Labor and Industries investigation into safety concerns about the Patrol's radio system. We also interviewed officials at these agencies, businesses and organizations:

• The State Patrol's Radio and Budget departments	• Third-party vendor that provides the Patrol with quality assurance services
• Department of Enterprise Services (DES)	• Third-party vendor that serves as the Patrol's project and contract manager
• Office of Financial Management (OFM)	• Motorola, the firm that received the Patrol's sole-source contract
• U.S. Department of Justice (DOJ)	• Vendors that would have bid for the project if Patrol had solicited competitive proposals
• U.S. Federal Bureau of Investigation (FBI)	• Pierce County Emergency Management
• Department of Fish and Wildlife (DFW)	• Thurston County 911 Radio Technical Services Manager
• Department of Natural Resources (DNR)	• Oregon Department of Transportation (ODOT) Procurement and Narrowbanding Project Managers
• Washington State Troopers Association	

We also reviewed these records:

• State Patrol's budget and procurement correspondence with OFM and DES	• The Patrol's partnership agreement with DOJ
• Patrol and vendor coverage forecasts	• Oregon's partnership agreement with DOJ
• Patrol's radio system correspondence with DFW, DNR and Washington legislators	• The Department of Labor & Industries workforce safety complaint filed by the State Patrol Troopers Association, and the final report on the resulting investigation
• Contract conditions and pricing for radio system procurements made by the ODOT, Pierce County, and Spokane County	• Patrol contract documentation with Motorola

Lastly, we also compared what we learned to the project updates the Patrol has given the state's legislative transportation committees.

Appendix C: Radio Terminology and Sources that Describe Wideband Analog vs. Narrowband Digital Coverage

Radio terminology

ISSI: An "inter-switching system interface" (ISSI) allows users on one radio system to communicate with users on a neighboring radio system through talk groups. These talk groups are made up of users from both systems. Users in these talk groups can communicate at the same time with users from their home system and the neighboring system. Conversely, if a radio user from one system attempts to communicate with users on a neighboring system when there is no ISSI connection between these two systems, although the user may still roam onto the neighboring system (which requires permissions from neighboring system), the user loses his or her ability to communicate with the home system. An ISSI interface avoids this loss.

Microwave infrastructure: This technology includes, but is not limited to, cable, antennas, routers, switches and data processing units, and is used for microwave transmission. Microwave transmission is the transmission of data by electromagnetic microwaves, which are widely used for point-to-point communications. To accomplish these transmissions, a transmitting antenna on one end is used to direct data in a straight line to a receiving antenna. Microwave transmissions cannot pass around hills or mountains as lower frequency radio waves can.

Signal interference: Also referred to as multipath reflection or multipath interference. See the following source below for a detailed description: *Training Guide: P25 Radio Systems,* published by Daniels Electronics LTD in September 2004, copyright 2004.

Resources that address the problems of transitioning from wideband analog radio systems to narrowband digital (without adding infrastructure)

Restoring system receiver performance after narrowbanding, written by Alfred T. Yerger II – published by Public Safety Communications on January 1, 2010
First paragraph – "Manufacturing and system design engineers tell us to expect a 5 to 6dB reduction in system coverage performance after converting our analog FM systems to narrowband digital technologies."
http://psc.apcointl.org/2010/01/01/narrowbanding-the-tech-side/

Lessons learned & best practices, published by Public Safety Communications on June 29, 2011
Section titled Reduced Coverage – "Alfred T. Yerger II, an RF engineering specialist for Bird Technologies Group, said to 'expect a 5 to 6dB reduction in system coverage performance after converting analog FM systems to narrowband digital technologies.' "
http://psc.apcointl.org/2011/06/29/narrowband-migration/

October 20, 2009 Presentation to the Interim Science, Technology, and Telecommunications Committee, 49th Legislature of the State of New Mexico
Page 28 – "Transition from a wideband analog to a narrowband digital system will result in a reduction in coverage."
http://www.nmlegis.gov/sessions/interimcommittees/sttc/2009/nov.%209-10/Legislative_STT_Narrowbanding_ppt__10-20-092.pdf

Tetra Technology – Advantages and Disadvantages, published by the TETRA Association in January 2006
Page 3, Chart 1 – shows that analog has greater signal distance than digital
http://www.tandcca.com/Library/Documents/Why_TETRA/Technology%20Benefits.pdf

Narrowband Conversion and Digital Modulation, A CSI Telecommunications, Inc. Whitepaper - by William F. Ruck – Published by CSI Communications, Inc. 2010

Page 7 – "When comparing analog modulation to digital modulation it is critical to recognize that while there is little difference in performance and audio quality where signal distance is good, there is a major difference in poor signal areas. Analog modulation degrades slowly with more and more background noise as the signal gets weaker. Even though it may be difficult to understand a weak signal, with some care a message can be passed. Digital modulation is perfect until there is not enough signal for the decoder to work properly. When this happens, the signal is muted and no communication is possible. There is not even an indication that someone is trying to communicate."

Page 8 – "Operationally, areas that are known to be 'fuzzy' with analog modulation will become completely 'deaf' with digital modulation … [T]o have equivalent practical coverage for a digital modulation system, it may be necessary to add additional [receiver sites and transmitter sites]."

Page 8, Figure III - shows that analog has greater signal distance than digital at the lower levels of sound quality. http://www.csitele.com/wp-content/uploads/2014/06/Narrowbanding.pdf

DMR versus TETRA system comparison – published by Radio Activity Solutions on July 9, 2009
Page 9, Figure 8 – shows that analog has greater signal distance than digital.
http://www.ronet.co.za/downloads/DMR_vs_TETRA_comparison.pdf

Training Guide: P25 Radio Systems, Published by Daniels Electronics LTD in September 2004, Copyright 2004

Page 40 - "Although it appears that the digital radio signal performs with greater coverage area than an analog radio signal, other factors must also be taken into consideration, such as multipath reflections. Multipath reflections of the RF carrier occurs when two or more signals of the same origin arrive at the receive antenna delayed in time because they traveled different path lengths or because of reflections and scattering in the propagation environment. This deterioration of the signal must be considered when planning coverage areas.

"… In the worst case, when the subscriber radio is stopped in a signal null, the signal is severely degraded and a single, strong specular reflection may completely cancel the transmitted signal. Where analog reception can become noisy, digital signals could be lost altogether. Increasing power is not a viable remedy because both the direct and reflected signal will increase proportionally, preserving the interference nulls."
http://www.dvsinc.com/papers/p25_training_guide.pdf

Figure 1 – Illustration from Training Guide: P25 Radio Systems

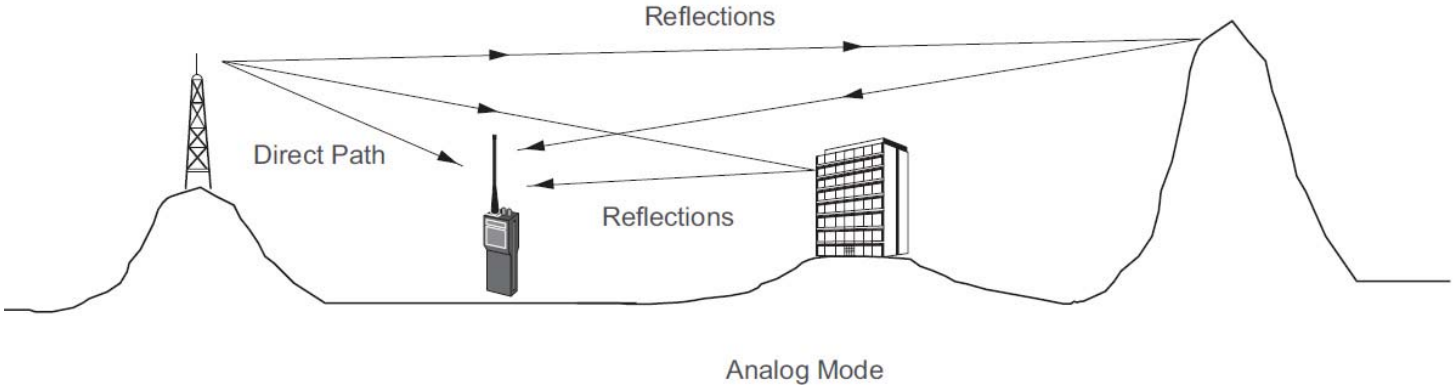


Figure 3-2: The Effects of Multipath.

Auditor interview with Joe Blaschka, ADCOMM Engineering – Public safety communications engineering consultant who works for the Patrol and provides it with advice on project quality

"In most places when you go narrowband you lose coverage. Digital can restore some of what you would have lost if you had moved from wideband analog to narrowband analog. In a perfect environment, half of the coverage lost through narrowbanding would be recovered by converting to digital. But multi-path interference causes more havoc on digital than it does with analog. Washington's terrain and geography would create [such] interference in the system. You might even go backwards and lose [more coverage than you would when narrowbanding in analog]."

View of Northeastern Washington: Flat terrain shown towards the bottom is less susceptible to multi-path reflections or multi-path interference than the mountainous and hilly terrain on top.

Figure 2 – Map of Northeastern Washington

Source: http://www.google.com/maps/dir/

Narrow It Down – Analog vs. Digital Radio Systems, written by Steven J. Makky Sr. – published by Public Safety Communications in March 2011

"In an analog system, radio signals tend to become noisy as the signal weakens as the limits of usability are reached. In a digital system, sound may distort or 'pixelate' rather than become noisy just before the signal processors can no longer detect data and turn it into audio."
http://legacy.apcointl.org/institute/emd_pdf/Analog%20vs%20Digital%203-11.pdf

P25 debate: The digital standard revisited, written by Bernie Olson – published by Urgent Communications on July 1, 2001

"Digital Project 25 radios have significantly greater range than analog radios for systems designed for DAQ 3.0 or above. At the fringe of coverage (below signal levels normally used for system design), digital begins to break down…At these weak signal levels analog would still be understandable (with great effort) while the digital radio would mute." http://urgentcomm.com/mag/radio_debate_digital_standard

The Difference between Analog and P25 Radio Systems, published by Elert and Associated Technology Consultants on April 10, 2013

"On a digital system, when you lose part of the signal, you are left with nothing. These systems therefore work well in populated areas where towers are available to handle the number of users. In rural areas, analog may still be a better choice, because when analog radios lose a signal, you may hear some static but still be able to pick up enough of the voice for the message to be relayed."
http://www.elert.com/the-difference-between-analog-and-p25-radio-systems/

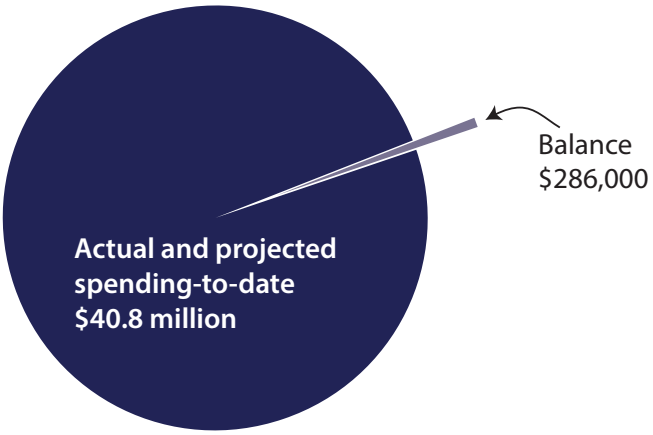
Appendix D: State Patrol Cost Comparisons

In comparing the State Patrol's narrowbanding project costs to those of other state and local governments that have also narrowbanded, we also considered the DOJ equipment purchases that have benefited the Patrol, as well as the overtime and travel costs of the Patrol's radio personnel during the project period.

As of March 2016, the Patrol reported the project costs shown in **Figure 3**.

Figure 3 – The balance in the Patrol's narrowbanding project budget as of March 2016

Total project budget: $41.1 million*



Note: The Patrol's reported $41.4 million project budget exceeds the $40.1 million in appropriated project funding as it includes additional 2013-15 appropriations.

However, these costs do not reflect the additional infrastructure that the Patrol will likely need in order to address the coverage challenges described in the report. They also exclude nearly $4.75 million spent on the Patrol's project staff, quality assurance advisor fees and professional project manager fees, which were charged to other funding sources.

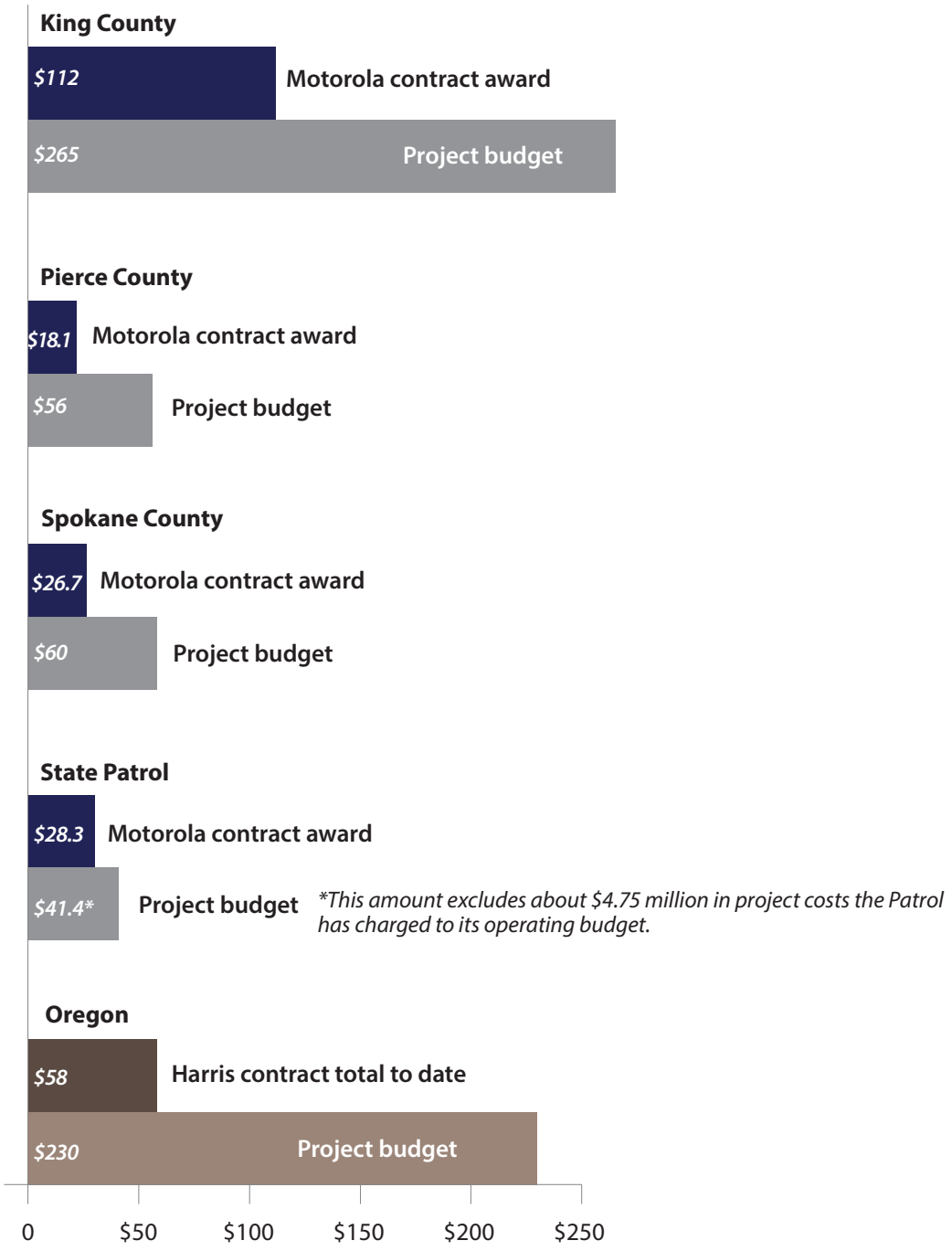
Between 2003 and 2005, DOJ paid for $40 million to $70 million in microwave and other infrastructure. The Patrol now owns this and it shares one-third of that microwave capability with WSDOT and one-third with the DOJ, providing the Patrol with an additional $13.3 million to $23.3 million in project benefits. The Patrol also receives secondary radio coverage through its merger with DOJ's IWN radio system, which enables it to use DOJ's share of the microwave.

Comparing the State Patrol's budget with other regional government radio projects

Each of these radio system projects required a different mix of new and upgraded equipment to narrowband. Moreover, contract coverage guarantees for each also exceeded the Patrol's contract guarantees. However, **Figure 4** does provide a sense of scale for the budgets such complex projects may require.

Figure 4 – Comparing the Patrol's budget with other radio projects

Dollars in millions



Appendix E: Additional Information about Budget Proposals for Engineering Studies

The State Interoperability Executive Committee (SIEC), of which the State Patrol was a member, submitted a $500,000 budget request for a statewide engineering study to the Governor in October 2008. The Governor's Office told the SIEC in 2009 that the study had not been funded. The Patrol did not request funding to pay for its own study before submitting its budget request to OFM in September 2010.

SHB 1175 and ESHB 2190 would have required a study or review. The first was considered eight months before the Motorola contract was signed in late 2011, and the second in early 2012, after the FCC's first extension to another public safety entity. The 2011 legislation died during negotiations, and Governor Gregoire vetoed the 2012 bill.

Drafts of the 2011 and 2012 bills contained language that would have required a pre-engineering study or technical review that, in part, looked at the Patrol's decision to use DOJ's IWN system, whether existing infrastructure was being sufficiently leveraged, and ways to mitigate coverage gaps.

A draft of the 2011 bill that ultimately funded the narrowband project proposed appropriating $600,000 to the Department of General Administration (now DES) to coordinate with the Patrol and a communications consultant to complete an engineering study. In addition, it directed the Patrol to request a waiver from the FCC to extend the deadline for narrowband conversion to allow additional time for any issues identified by the engineering study to be mitigated. The bill also placed more than $20 million in an "unallotted status" in 2012 after the Legislature had a chance to review the results of the study. However, by the time the bill was passed, the required engineering study and appropriation had both been removed.

Figure 5 – Text of SHB 1175, Requiring Preliminary Engineering Study

(3) The final report must:
(a) Review the existing documentation and publications available from the state interoperability executive committee;
(b) Analyze existing state agencies, cities, counties, and private entities network and infrastructure inventory and detail the required reprogramming and replacement status of the components;
(c) Document radio coverage requirements and current radio network operations;
(d) Review existing or planned state, local, and private entities communication systems for opportunities to partner with those entities to mitigate coverage issues;
(e) Redesign the system to address coverage and performance gaps, after meeting narrowbanding requirements;
(f) Leverage existing communication systems at the state and local levels along with private entities to take advantage of existing or planned infrastructure;
(g) Provide engineering opportunities within budget constraints to ensure that the most recent technology and equipment is being used to

p.5 SHB 1175

Figure 5 – Text of SHB 1175, Requiring Preliminary Engineering Study, continued

best serve state, local, and private entities strategically for future communication platforms;

(h) Recommend communication plans and design to be considered for radio specifications, performance, and interoperability;

(i) Develop a migration plan and cost analysis, including schedules;

(j) Develop a request for proposals that will encourage multiple proposals;

(k) Identify the required elements that should be included in a request for proposal to ensure that the equipment chosen can be integrated with different manufacturers and different protocols for flexibility and cost efficiency for future equipment purchasing while considering performance and communication systems compatibility; and

(l) Develop a budget proposal with the elements described in this subsection that provides options and considers state, local, and private entities systems that are already in place, or planned to be in place, for partnering opportunities.

A draft of the 2012 bill was proposed shortly after DES signed the Motorola contract. It identified a technical review as critical for ensuring that the partnership with IWN would result in a successful narrowbanding project. In part, the review was intended to assess the pros and cons of merging with IWN and the Patrol's risk management strategy. Below is an excerpt from that bill.

Figure 6 – Text of ESHB 2190, Requiring a Technical Review (Proposed in Early 2012)

(9) The office of financial management through the chief information officer shall conduct a technical review of the Washington state patrol's conversion to narrowbanding and the decision to utilize the United States Department of Justice's integrated wireless network

ESHB 2190.PL

for the transition. The technical review must include an analysis of whether the conversion constitutes an appropriate opportunity for the state to leverage existing infrastructure, mitigates any communication gaps, provides for a risk mitigation strategy, provides opportunities to move to future emerging technologies, and is consistent with the elements of the chief information officer's state technology strategy. The chief information officer must provide a report of findings to the joint transportation committee by September 1, 2012. The recommendations must include any essential elements of the conversion that are necessary to ensure the existence of a comprehensive, interoperable, and reliable communication system within the United States Department of Justice's integrated wireless network with appropriate risk mitigation plans in place.

On May 23, 2012, Governor Gregoire vetoed that bill. The excerpt below shows the veto note, which says a review – if not explicitly an engineering study – had already been performed.

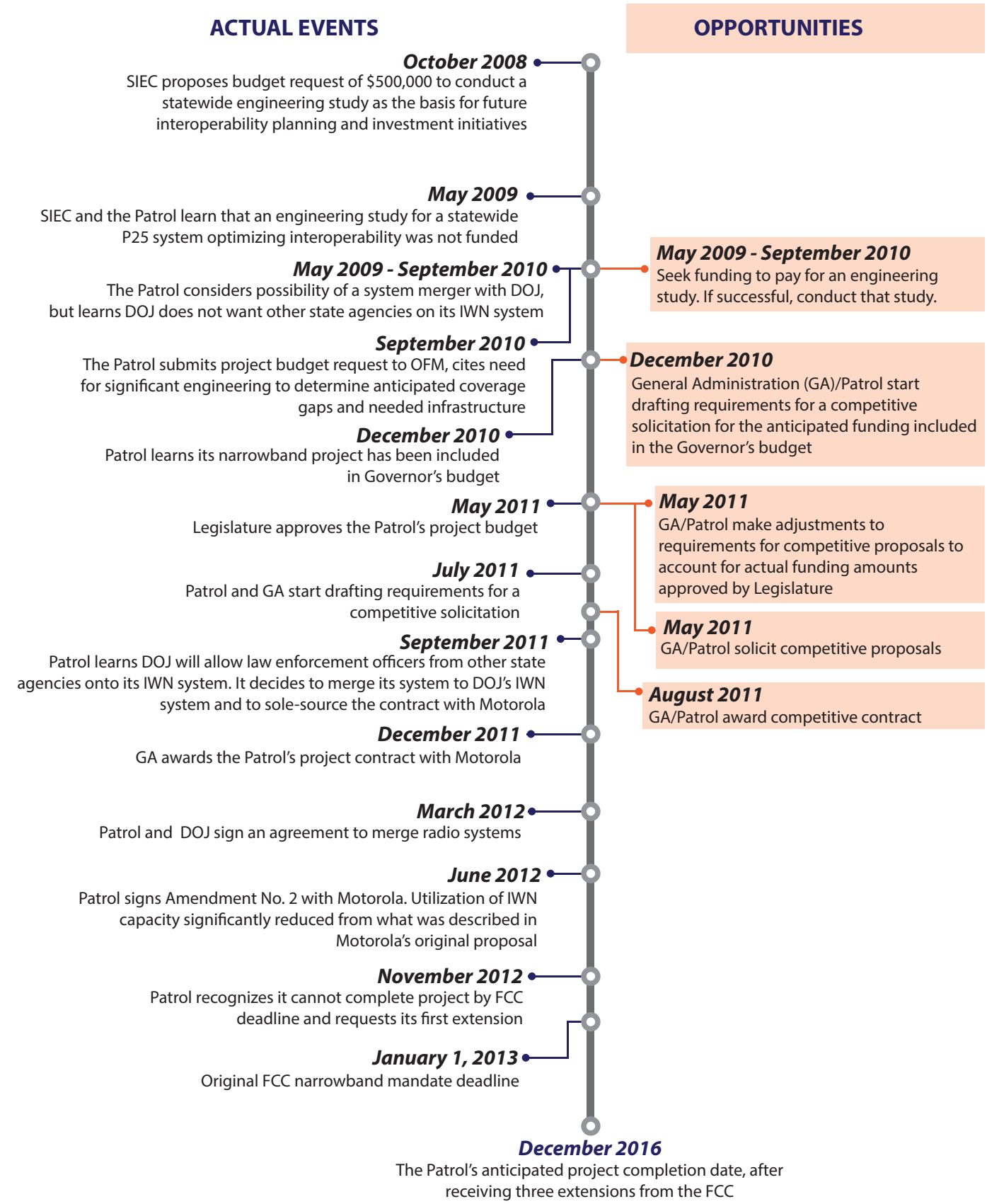
Figure 7 – Governor's May 23, 2012 reasons for vetoing the Engineering Study Proposed under ESHB 2190

These provisos require the Office of the Chief Information Officer (OCIO) and the Washington State Patrol to conduct a technical review of the State Patrol's conversion to narrowbanding. Funding was not provided in either proviso, and review of the narrowbanding project has already been done by external entities. For these reasons, I have vetoed Section 102(9) and Section 604.

Source: Governor's veto message on ESHB 2190 submitted to the Honorable Speaker and Members of the House of Representatives.

The Patrol told us it believes the review cited above was performed by OFM and the Joint Transportation Committee. OFM told us its review was financially and not technically focused. The review by the Transportation Committee consisted of State Patrol briefings.

Appendix F: A Timeline of Events and Opportunities in the State Patrol's Narrowbanding Project



Appendix G: Assessment of Merger-Related Savings

The Patrol made two decisions in its narrowband project that are closely entwined: merging its radio system with DOJ's IWN, and to make that merger as easy as possible, choosing Motorola as its sole supplier. In explaining its decisions, the Patrol told legislators and the media that the merger with IWN achieved $12 million in savings. To assess whether it is possible the Patrol will fully realize that amount of savings, we considered the utilization of IWN infrastructure by the Patrol and the current value of the contract with Motorola.

While the Patrol did receive some added coverage from the merger, its utilization of IWN is lower than expected

The Patrol believed that by merging with IWN it could leverage the existing IWN coverage footprint to avoid $12 million in infrastructure costs when compared to building a stand-alone system. However, the Patrol's use of the IWN system to date and its planned use following the project's completion, is far less than described in Motorola's original proposal.

The IWN system is a trunking network as opposed to the conventional technology that is utilized to provide most of the Patrol's system coverage. Outside the Puget Sound area where a trunk system was installed as planned, Motorola's original proposal assumed troopers would use IWN as their primary communication system and that upgrades to the Patrol's conventional system would only occur where IWN did not provide coverage. However, after the contract was signed, the Patrol realized that while troopers could communicate with one another and with federal law enforcement while on the IWN system, they could not communicate with local law enforcement officers who use their own radio systems. This is because when using IWN, the Patrol and its troopers cannot scan other agencies' radio communications, speak with them, or continue to provide them with dispatch services.

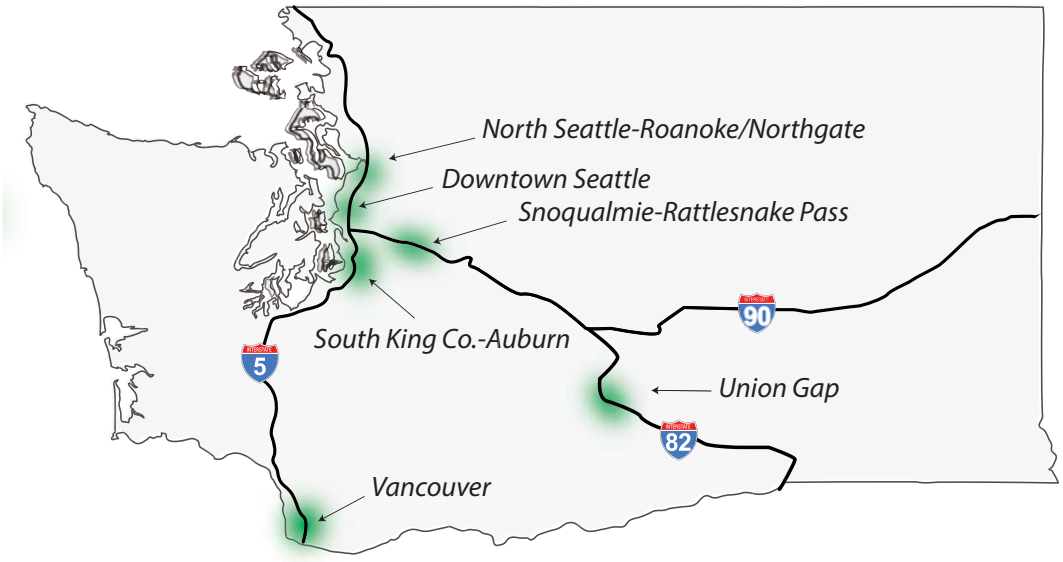
Coverage and capacity

Coverage refers to the area and distance from transmitters where users receive acceptable quality radio signals.

Capacity refers to the number of users who can be accommodated on the available system bandwidth.

To address these interoperability challenges, the Motorola contract was amended to include an upgrade to all of the Patrol's conventional sites instead of only the ones that were located where IWN did not provide coverage. While this system redesign improved interoperability with local law enforcement, it significantly reduced the Patrol's reliance on IWN. We found that with the exception of a few specific locations along I-5 and I-90, the Patrol uses its conventional system as the primary system instead of IWN as originally planned. The limited locations where IWN provides primary coverage are shown in the map below.

Figure 8 – Locations where the Patrol uses IWN as its primary coverage



Map source information:
Interviews with Patrol vendors and staff, and review of project manager's monthly reports. We have included Vancouver and Union Gap on this map because Patrol officials told us that troopers use IWN as their primary coverage source at these locations.

However, it should be noted that in interviews with troopers conducted by Labor and Industries and the Patrol's quality assurance advisor both indicate troopers do not use IWN as a primary source at these two locations because of difficulty using the radio system or the inability to communicate effectively with local law enforcement.

A Patrol staff member told us the Patrol did not avoid any purchases of infrastructure as a result of the merger.

Even though the Patrol is utilizing the IWN system less than originally planned, the merger has increased its coverage footprint. However, the Patrol's quality assurance advisor reports that because IWN's capacity is so limited, this raises questions about the Patrol's continued use of IWN as a primary coverage source.

This change in utilization has resulted in contract overages. When in 2011 the Patrol described the $12 million in savings the merger achieved, its contract with Motorola totaled $26 million (before taxes). Largely due to Amendment No. 2, the contract has since increased by roughly $4 million.

The Patrol has characterized the discounts it received from Motorola as savings attributable to its merger with IWN. However, the Patrol could have obtained these discounts without merging with IWN. For this reason, the contract increases and the significantly lower-than-planned reliance on IWN suggest the Patrol will not fully realize the $12 million savings it originally anticipated from the merger.

Appendix H: Other Observations

The Patrol did not explore all avenues of funding

Even though the FCC's website had information on available federal grants to help pay for narrowbanding projects, the Patrol did not apply for any. We found other jurisdictions such as Pierce County used federal grants to help pay for their narrowbanding projects. The Patrol told us it did not seek federal grant funding for its own narrowband conversion project because it lacked dedicated grant staff.

Changing technology and a desire for competitive pricing support the Patrol's periodic reassessment of its partnership with DOJ and its use of proprietary features

If the Patrol had built a stand-alone system that was not merged to the DOJ's system, it would have still had to replace equipment that was end-of-life or was not narrowband capable. To merge with DOJ, the Patrol also built its own master-site, which it would have had to do had it built a stand-alone system. This site makes the Patrol less vulnerable to a loss of communications in the event the DOJ site is no longer supported or experiences an operational failure. Having this site also makes the Patrol more capable of separating from DOJ in the future if necessary.

In 2011, the Patrol could have merged its system onto the DOJ's system using a core-to-core approach, or it could have tied the two systems together using an ISSI tie-in. At the time, the core-to-core approach resulted in a merged system that achieved a far more seamless ability to roam from one system to the other. However, there is now a new ISSI tie-in the Patrol could use to connect to the DOJ system or any other trunk system and roam almost as seamlessly as the core-to-core approach it currently uses. Although separation would require equipment reprogramming costs and potentially a duplicative core to avoid system downtime, this new technology allows the Patrol to periodically reassess its merger with DOJ.

Other reasons for the decision to sole-source to Motorola include the proprietary radio features described earlier. These features are only available when a Motorola radio is used on a Motorola system. But P25-standard radios should work on any system regardless of whether that system is conventional or trunk. If both DOJ and the Patrol agreed to stop using proprietary Motorola features, the Patrol could purchase replacement radios from a broad pool of competing vendors. This would likely reduce its future costs. However, the Patrol also uses county systems that were installed by Motorola. One of these counties also uses proprietary features, which requires the Patrol's troopers who work in that county to use Motorola radios.

Washington may have overlooked an opportunity to obtain improved pricing for other state agencies that use the Patrol's radio system

When state purchasing departments make large purchases on behalf of one state agency, they can roll their purchasing needs into a larger contract to obtain better pricing if they can identify other agencies that need the same item. In Oregon's contract, radio prices for the Oregon State Patrol and the Oregon State Department of Transportation were comparable to those paid by the Washington State Patrol, after accounting for differences in features. However, Oregon's contract provided any subsequent agencies that purchased radios off that contract pricing that was at least 5 percent less.

In its contract with Motorola, the Patrol obtained an additional 9.7 percent discount on radios that was not obtained by the Department of Natural Resources (DNR) or the Department of Fish and Wildlife (DFW). Although smaller than the Patrol's purchase of 2,400 radios for $10.5 million, DNR and DFW purchased about 300 radios (25 and 272 respectively) in 2013 for a combined total of about $1.9 million. Had these two agencies received the same discount provided to the Patrol, they would have paid about $245,000 less. DES believes these agencies could have purchased their radios using the contract for the Patrol narrowbanding project because it had a provision that allowed agencies to do so as long as they were using the Patrol system as their primary communications system.

How we determined the Patrol's radio pricing so we could compare it to other state agencies

In their respective contracts with Motorola, both the Patrol and Pierce County received two layers of discounts that were applicable to their radios and the purchased infrastructure. Both contracts specify how the first discount is applied across the radios and infrastructure, but only Pierce County's contract specified how the second discount was to be applied. To arrive at the Patrol's net pricing for radios, we broke out the second discount using the same breakout shown in the Pierce County contract.

Appendix I: Subject Matter Expert Review of State Auditor's Office Report Findings

Our report was edited based on the subject matter expert's (SME) review of its conclusions and the Patrol's concerns.

Port of Seattle Radio Communications Administrator's Written Assessment of SAO's Report Findings

June 9, 2016

The purpose of this report is to provide SME response, as permitted by RCW 39.34, to the Washington State Auditor's Office (SAO) conclusions in a draft for an audit of the Washington State Patrol's (WSP) very high frequency (VHF) narrow-banding and 700 MHz trunked upgrade land mobile radio project (Project). Prior to the Project, the WSP's radio system was primarily conventional VHF. The main driver of the Project was to narrow-band WSP's conventional VHF infrastructure, as mandated by the Federal Communications Commission (FCC). The Project also included the build-out of a new 700 MHz trunked radio system in the central Puget Sound region, and merging the core switching equipment of WSP's new 700 MHz trunked system to the United States Department of Justice (DOJ) Integrated Wireless Network's (IWN) VHF trunked radio system.

Procedures Performed:

Multiple reviews of the SAO's conclusions as found in their draft report and subsequent edits.

Met with the SAO on a weekly basis to discuss the draft report, provide feedback and ask clarifying questions.

Review of Motorola Contract and Amendment 2 to the Contract.

Review of MOU between DOJ and WSP.

Interviews with WSP Command and Executive staff, which included their Electronic Services Division Commander, Chief Technology Officer, Chief Financial Officer and Assistant Chief.

Interview the Project's Quality Assurance (QA) Advisor and review of the QA's monthly status reports.

Interview WSP's Project Manager (PM) and review of the PM's bi-weekly project status reports.

Interview Motorola Solutions, Inc.'s (MSI) current PM and an MSI representative who was on the original engineering design team.

Review of WSP's technical review comments on the SAO draft report.

Review of SAO interview notes with members of the Legislature and staff, Commander of WSP's Electronic Services Division, WSP technicians, Project QA advisor, MSI and OFM.

Content:

This response speaks to the SAO conclusions on WSP's current utilization and reliance of IWN as compared to MSI's original design and scope for the Project. The content also addresses the perceived risks and benefits of merging trunked systems with IWN. The response also considers the likely coverage changes encountered during the migration of the VHF conventional overlay from wideband analog to narrow-band digital; noting District 6 will remain primarily analog, as opposed to digital. The Project was originally expected to be completed by the January 1, 2013, FCC mandated deadline; however, there were delays. Potential contributing factors are also considered in this response.

Context and Perspective:

In preparation of writing this response, the SME met with representatives of the SAO, WSP and third party individuals; such as the QA Advisor, WSP/MSI Project Management and an MSI engineering representative familiar with the original design. The SME wanted to understand their perspectives on the Project and its timeline in order to learn the goals and scope of the Project. Although a new 700 MHz trunked system was installed and merged with IWN, the primary goal of the Project was to be in compliance with the FCC mandate for migration of VHF public safety frequencies from wideband to narrow-band by January 1, 2013, and to address potential coverage concerns in order to maintain equivalent coverage.

Conclusions:

Contract Amendment 2

Amendment 2 (MSI Change Order 1) contained considerable change in scope that appears to have contributed to increased risk in Project control, schedule and cost. At a high level review, the original scope of the Project consisted of the new 700 MHz trunked system, in the central Puget Sound region, merged with the IWN trunked system, 28 new conventional sites, to fill the gaps that the new IWN-WSP trunked system couldn't cover, and 8 dispatch console sites. This was an MSI implemented design and why we see the covered area reliability requirements for the 700 trunked and VHF conventional system in the original contract. This original design was relatively low risk and likely could have been completed by the January 1, 2013 deadline. It would have supported WSP and their partner agencies', DNR and DFW, communications needs. During detailed design review (DDR), the week of February 27, 2012, WSP added the requirement for a Statewide VHF narrow-band conventional system and eliminated MSI's proposed 28 new VHF sites as shown in the original contract to fill in the gaps. This is when it was decided WSP would go with a one-to-one site upgrade on their existing VHF equipment. The reason for this change was due to multiple outside agencies, other than DNR and DFW, who were also reliant on, or dispatched thru, the existing WSP VHF system. The agencies did not necessarily have radio subscriber equipment capable of operating on the IWN-WSP P25 trunked system. By reducing the conventional VHF repeater sites down to the 28, they would have disrupted operability for, and interoperability with, said agencies, which would not have been advisable.

Since MSI was no longer contracted to provide new equipment for the conventional layer, WSP now took on the responsibility for these locations. It was now going to be WSP who would primarily be responsible to flash upgrade their existing equipment and reprogram to narrow-band. MSI would no longer have the responsibility for coverage area test plans for the VHF overlay, since the WSP took on this work.

After coverage complaints were made, MSI did assist WSP in testing coverage area predictions and found complaints were coming from outside the covered area prediction map when outside the 3.0-3.4 delivered audio quality (DAQ) prediction, which will be discussed again within this response. It was an important decision for WSP to make. They needed to keep the full VHF layer, so as not to disrupt operability for their partners and prevent loss of existing interoperability. Although it was an important change, it was a change that likely increased the schedule timeline, increased cost and decreased quality, due to the use of old equipment that is rapidly approaching its end-of-life.

Conventional VHF Narrow-Band Coverage

As presented to the Senate Transportation Committee, in January of 2011, WSP was aware of a typical loss of 15-30% coverage if they were to narrow-band in analog. Narrow-banding in analog could also require adding 25-35 new radio equipment tower sites to fill gaps, per WSP's presentation. In order to maintain cost effective equivalent coverage and better position the system for the second phase of narrow-banding, WSP recommended narrow-banding in digital.

There is little doubt coverage has changed. However, it's difficult to precisely convey the change since a baseline of pre-existing coverage didn't exist prior to beginning the Project. Coverage baseline data could have been gathered during a detailed engineering study prior to beginning the Project. There were attempts to fund or require a detailed engineering study. As stated in the SAO report, the State Interoperability Executive Committee requested funding for a statewide engineering study which could have assisted in planning of the Project. Funding was not approved. The $60M capital budget for the Project included a statement that the project would require "significant engineering to determine anticipated coverage gaps." However, it did not contain a budget line item for this engineering. Instead, it contained a line item for System Integration and Engineering Services. SIES is generally a line item you would find in an Offer for Sale from a vendor. These are the costs that cover such tasks as detailed design review with vender engineers, factory staging of equipment, field installation, programming and optimization, project management, factory and field test acceptance procedures. SIES can sometimes also include technical and administrative training. SIES is not equivalent to a detailed engineering study. It is the SME's conclusion, there were likely misunderstandings between some legislators and WSP on SIES and what it detailed. Also, the WSP's presentation to the Senate Transportation Committee reflects a line item in the budget request for "Systems Integration and Engineering." This was likely a cost received from a vendor to support SIES. The $60M budget request was partially funded. The WSP executed the Project per the approved budget. Although, the legislatively approved budget did say it was funding engineering services, it did not contain language that required a significant engineering study.

Even though an engineering study was not performed, it is likely the WSP did maintain equivalent coverage, at some of their existing sites, by migrating to narrow-band digital, rather than narrow-band analog. This equivalent coverage would be based on a public safety standard of delivered audio quality (DAQ) of a 3.0 (Speech understandable with slight effort. Requires occasional repetition due to noise or distortion) - 3.4 (Speech understandable without repetition. Some noise or distortion present). SAO report, page 9, "Exhibit 3 – Comparison between analog and digital modulation," shows an example of potentially equivalent, if not greater coverage, with digital.

The loss of coverage was likely realized outside the public safety grade coverage. It is the outer fringe of this DAQ 3.0 – 3.4 service area that was most likely affected after narrow-banding in digital at some sites. The public safety quality coverage of an existing site very well could have improved in comparison to the pre-existing wideband analog. However, it is the pre-existing poor to marginal coverage areas with DAQ sound quality under 3.0 (for example, DAQ 2.0, where speech is understandable with considerable effort. Requires frequent repetition due to noise or distortion), where complete coverage losses were experienced. If there were pre-existing poor or marginal areas, WSP likely noticed coverage losses in these areas after narrow-banding.

When comparing wideband analog to narrow-band digital, it is important to recognize that, while there is little difference in performance and audio quality in good signal areas and, in fact, narrow-band digital can perform slightly better, there is a major difference between wideband analog and narrow-band digital in poor or marginal signal areas. Analog modulation degrades slowly with more and more background noise as the signal gets weaker. Even though it may be difficult to understand a weak signal, some words may be understood and the listener can often "fill in" the missing parts of the message. Digital modulation is perfect until there is not enough signal for the decoder to work properly. This is when the signal is suddenly muted and no communication is possible.

Without a baseline, it's not possible to pinpoint exact locations, but it is likely WSP did maintain and improve its public safety quality coverage; however, areas outside the fringe of DAQ 3.0 -3.4 service area, coverage losses likely were experienced.

Although, narrow-band digital can maintain and slightly improve existing coverage, as described above, in mountainous or hilly terrain, digital modulation can be quite sensitive to multi-path reflection interference causing loss of digital signals within the required service coverage area. It is important to note, WSP performs an in-house, localized, engineering study, of each district, prior to migrating to narrow-band.

Pre-existing radio signal strength levels are measured every 1/8 of a mile on major roads and highways. The data collected is shared with District command and priorities are set for correction of coverage loss in areas of pre-existing poor to marginal coverage being relied upon by WSP Troopers.

An example of expected coverage loss due to multi-path interference would be District 6, which, at the time of this writing, is not complete. District 6 will primarily remain analog narrow-band due to anticipated coverage loss caused by multi-path interference, as described above and within the SAO's report. This will require adding radio equipment sites. District 8 migration also required the addition of multiple sites.

With limited funding, it's also important to note the many successes WSP has had in partnering with outside agencies to gain and share site infrastructure in order to continue to build a statewide, interoperable radio system-of-systems, thus saving costs towards the Project and mitigate coverage gaps due to the narrow-banding migration in both urban and rural areas of the State:

Clallam County – Olympic Public Safety Communications Alliance Network (OPSCAN)

Microwave system management – OPSCAN purchased digital microwave infrastructure using grant funding and provided it to the WSP. In exchange, WSP provided project management and bandwidth capacity which reduces the county's need to build and maintain their own system. This leverages WSP's experience to improve service and saves both agencies money.

Skagit and Island Counties - Northwest Regional Interoperability Committee (NWRICS)

Microwave system management – NWRICS purchased digital microwave infrastructure using grant funding and provided it to WSP. In exchange, WSP provides bandwidth and manages both the Skagit and Island County systems and their bandwidth on the WSP system. This leverages WSP's experience to improve service and saves all agencies money.

Spokane County - Spokane Regional Emergency Communications System (SRECS)

Radio Site and system sharing – Allows the WSP to use the Spokane Regional Emergency Communication System infrastructure to improve radio coverage and interoperability between the WSP and local law enforcement. The WSP and SRECS also share microwave connectivity and radio sites, decreasing costs for both agencies and reducing redundant investments.

Pierce County

SR410 Project – Benefits the people in Pierce County and the WSP by improving radio coverage on SR410 from Greenwater to the top of Chinook Pass. This project aids operable and interoperable communications.

Radio Site and System sharing – The WSP carries Pierce County Sheriff's radio traffic on the WSP microwave improving coverage for Sheriff's deputies. In turn, Pierce County allows the WSP site and system access and use of the Pierce County radio system for primary radio communications. This will improve radio coverage county-wide for the WSP and improve interoperability between state and local law enforcement.

Law Enforcement Radio Network (LERN) – This will merge the three WSP LERN stations with two new Pierce County LERN stations which will give all law enforcement agencies county-wide coverage and improved interoperability.

City of Tacoma

Radio Site sharing – This allows Tacoma to use the WSP Parkland tower and equipment room to provide needed coverage for their users. Tacoma allows the WSP to use the city's Indian Hill radio site to provide 700 MHz trunked coverage for District 1 and 2 troopers. This is an exchange of services with no ongoing costs to either agency.

Clark County - Clark Regional Emergency Services Agency (CRESA)

System sharing – The WSP provides backup communications center capability and CRESA provides the WSP with microwave backhaul for Rainier Hill. Increased system sharing will occur in the future as CRESA deploys its new radio system.

Snohomish County - Snohomish Emergency Radio System (SERS)

Site sharing – SERS allowed the WSP to install a base station at its Gold Hill site to provide needed coverage in the Darrington / Oso area. In turn, the WSP allowed SERS to install equipment at our King Lake site which benefits their operations in the area.

Washington State Department of Transportation (WSDOT)

The WSP and WSDOT have jointly developed radio sites for many years and share approximately 75 sites and facilities around the state. These partnerships have allowed both agencies to expand their radio and microwave systems in cost-effective ways. The WSDOT uses approximately one-third of the WSP microwave capacity for their communication systems.

Integrated Wireless Network (IWN)

Initially, the Department of Justice (DOJ) purchased digital microwave infrastructure and provided it to the WSP. In exchange, the WSP provides microwave bandwidth and manages the system for them. This leverages the WSP's experience to improve service and saves both agencies money. In 2009 the WSP purchased new dispatch consoles in Marysville using grant funding to prepare for the 2010 Winter Olympics and DOJ hosted those consoles on their master site. In 2011 the WSP put two trunked sites on the DOJ system to improve coverage for both agencies, and in 2012 the WSP joined the IWN system. This partnership provides improved radio coverage for state and federal law enforcement agencies across Washington.

WSP 700 MHz Trunked System Merger with IWN VHF Trunked System

As noted directly above within the "Conventional VHF Narrow-Band Coverage" section of this SME response, it is noted in 2012, the WSP joined the IWN system. As part of the Project, WSP decided to merge their new 700 MHz trunked system with IWN. Originally, DOJ didn't want WSP partners, specifically, Department of Natural Resources (DNR) and Department of Fish and Wildlife (DFW), to have access to the DOJ's IWN System. However, and as noted in the SAO report, IWN reversed their decision during September of 2011. It was early September when WSP authorized solicitation for their Project, as they could not join IWN if their partners, who were reliant on their current system, were not welcome. It was the end of September, the same month, when DOJ reversed their decision and WSP chose to join IWN. This was a cause for concern to the SME due to the uncertainty of future funding from the Federal Government for the IWN system.

U.S. Department of Justice, Office of the Inspector General, Audit Division, Audit Report 07-25, March 2007: "… We found that the IWN project, which may cost $5 billion, is at high risk of failing to secure an integrated wireless network for use by DOJ, DHS, and Treasury. The causes for the high risk of failure include: (1) uncertain funding for the project; (2) disparate departmental funding mechanisms that allow the departments to pursue separate wireless communications solutions apart from IWN; (3) the fractured nature of the IWN partnership; and (4) the lack of an effective governing structure for the project. Unless these issues are addressed, a joint wireless communication system may not be developed and the resulting separate agency communications systems may not be adequate in the event of another terrorist attack or natural disaster that requires a coordinated emergency response. …"

U.S. Department of Justice, Office of the Inspector General, Audit Division, Audit Report 12-10, January 2012: "… The Office of the Inspector General (OIG) performed this audit to assess the status of the implementation of the IWN program. In our previous audit, issued in March 2007, we found that the IWN program was at high risk of failing to secure an integrated wireless network for use by the Department, Treasury, and DHS. …

Weaknesses and threats by joining the IWN system:

Funding for IWN was limited in 2011 and in 2012, funding for any additional investments to expand the system, ended.

The portions of IWN that were built out, such as within our region, continued to be used and, at the time of the merger and beyond, were being maintained. The reason for concern is the lack of uncertainty with on-going funding to support future IWN upgrades or build-out of the System. By joining IWN, it's no longer just the IWN system. It is the IWN-WSP system. They share the same System ID and are, even though configured in a multi-zone environment, essentially as one (the System). For example, if WSP wants to upgrade their 700 MHz portion of the System, the IWN portions must also be upgraded. If IWN is unable to upgrade their equipment, for varying reasons, WSP will be responsible for upgrading the IWN and WSP infrastructure. If WSP chooses to maintain and operate their new 700 MHz trunked system within public safety standards, they will want to have a System Lifecycle Plan in place that upgrades their common-off-the-shelf equipment (which consists of many components of the P25 core switching site, remote site equipment and dispatch site and console equipment) within time intervals that mitigates risk of failure. These upgrades can include hardware and software or sometimes just software. If a system goes too long without being maintained or upgraded thru a system lifecycle plan, multiple upgrades, or "jumps" in hardware/software versions may be required to get "caught up." With their current vendor, MSI, after becoming 5 versions behind the latest System release, the System can no longer be properly supported; such as security updates or application and operating system patches, for example.

IWN capacity limitations restricting future growth of talkgroup resources and an increase of subscriber units being placed in a busy queue for voice channel grants is another concern. However, WSP talkgroup counts are low. This should help mitigate some concerns with regard to capacity as demonstrated during recent events, such as the POTUS and Chinese Delegation visits to our region.

Another concern is access to the IWN sites. Security requirements on the Federal side can cause delays to site access and system configuration updates.

There is also concern for uncertainty of IWN pullout from the merger. Likewise, the MOU between IWN and WSP states the preferred method to connect is thru an inter-RF subsystem-interface (ISSI); stating, "… the link shall be transitioned to the ISSI protocol within six months of the commercial availability of ISSI that meets the requirements for data functionality …" That functionality likely exists now with MSI's ISSI-8000 which supports seamless voice and enhanced data roaming between two MSI cores. A transition, such as this, is not trivial with regards to cost, effort and risk. The Patrol must pay the full cost for this transition.

Strengths and opportunities of joining the IWN system:

Due to maintaining the full VHF conventional overlay, as described earlier in this response, the IWN portion of the System is used as secondary communications in many portions of the State. Regardless, there are strengths to the merger with IWN, at this time, and the sites also hold potential growth for the future for the WSP and possibly other State agencies.

The System provides seamless automatic roaming coverage, between IWN VHF and WSP 700 MHz trunked infrastructure, in the central Puget Sound region.

The System provides for over-the-air rekeying of encryption keys into hand-held and vehicle-mounted radio subscriber units.

No loss of data information, such as GPS and emergency and individual identification of subscriber units.

Fixed network equipment sharing; sites, repeaters, backhaul.

Although WSP has taken on financial responsibility risk by joining IWN, it's quite possible WSP has gained access to upwards of $80M in IWN fixed network equipment. This does not include the financial gain to the microwave equipment acquired by IWN and issued to WSP, which would be an additional cost savings of over $50M. The SAO report does show a value on the microwave equipment. However, it's difficult to apply a value to the fixed network radio site equipment, since, in some instances, they may have already been site sharing prior to the merger. There may be IWN sites not heavily used by WSP; however, these sites could provide foundation for future growth of WSP and other State agency communications needs.

There could be a potential opportunity for WSP to acquire site and/or site equipment from IWN if the Federal partner is unable to continue ongoing maintenance and operations responsibilities per their MOU. Due to a recent vendor protest, IWN cannot make any purchases with MSI; this would include a Service Agreement, Software Upgrades or System Upgrade Services. These are vital services often included in System Lifecycle Management planning of a Public Safety land mobile radio system. The Patrol must pay the full cost of these services.

Summary and Recommendation:

There were challenges at the start of the Project that may have been avoided if the Project contained funding for project management and internal engineering, and system administration staff costs. I agree with the SAO report that it's important to continue to assess the merger with IWN due to the levels of uncertainty described above in both funding and sustainability. The SAO report recommends working with the Governor's Office to determine minimal acceptable statewide coverage. I would also recommend the WSP determine what is the acceptable risk they can accept with regard to on-going maintenance and operations of the System and develop a Lifecycle Plan for the System. In summary, for those areas examined, I agree with the findings and recommendations contained in the State Auditor's report.