Oregon Department of Transportation

State Radio Project

State Radio Project

Final Project Report

December 2017

Credits

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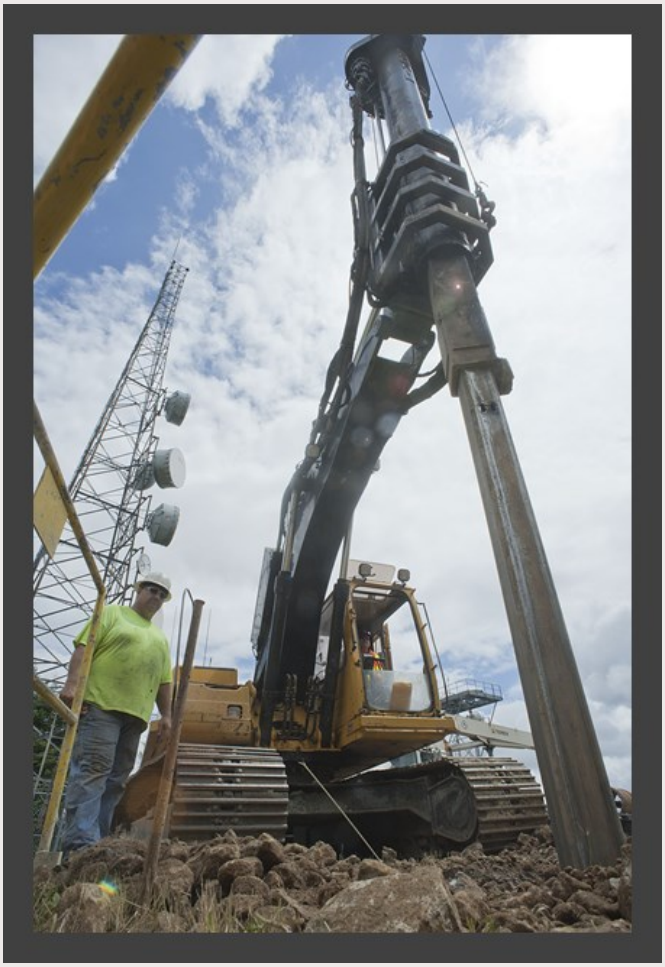

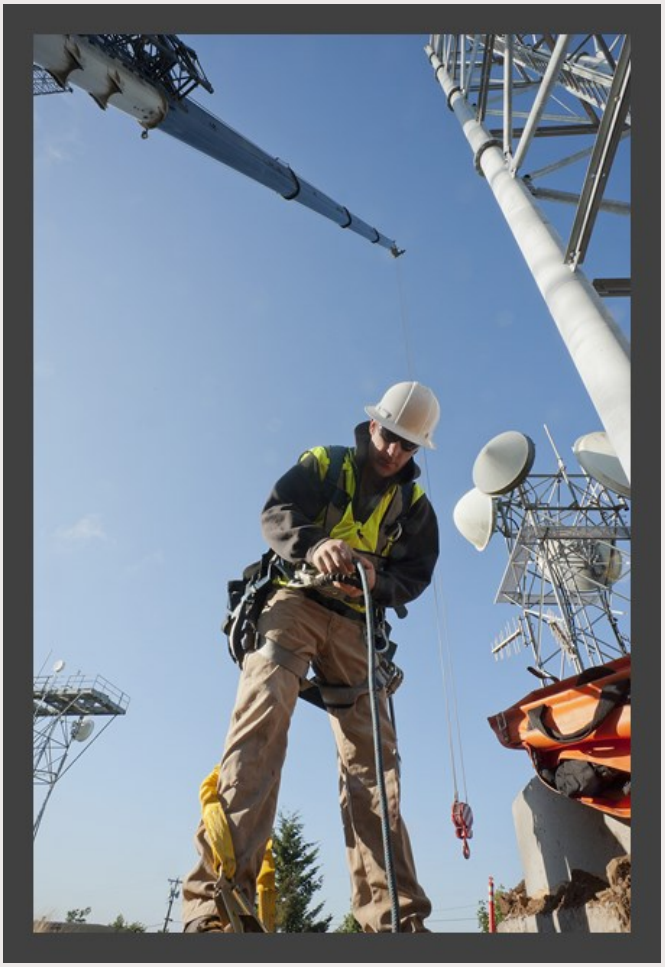

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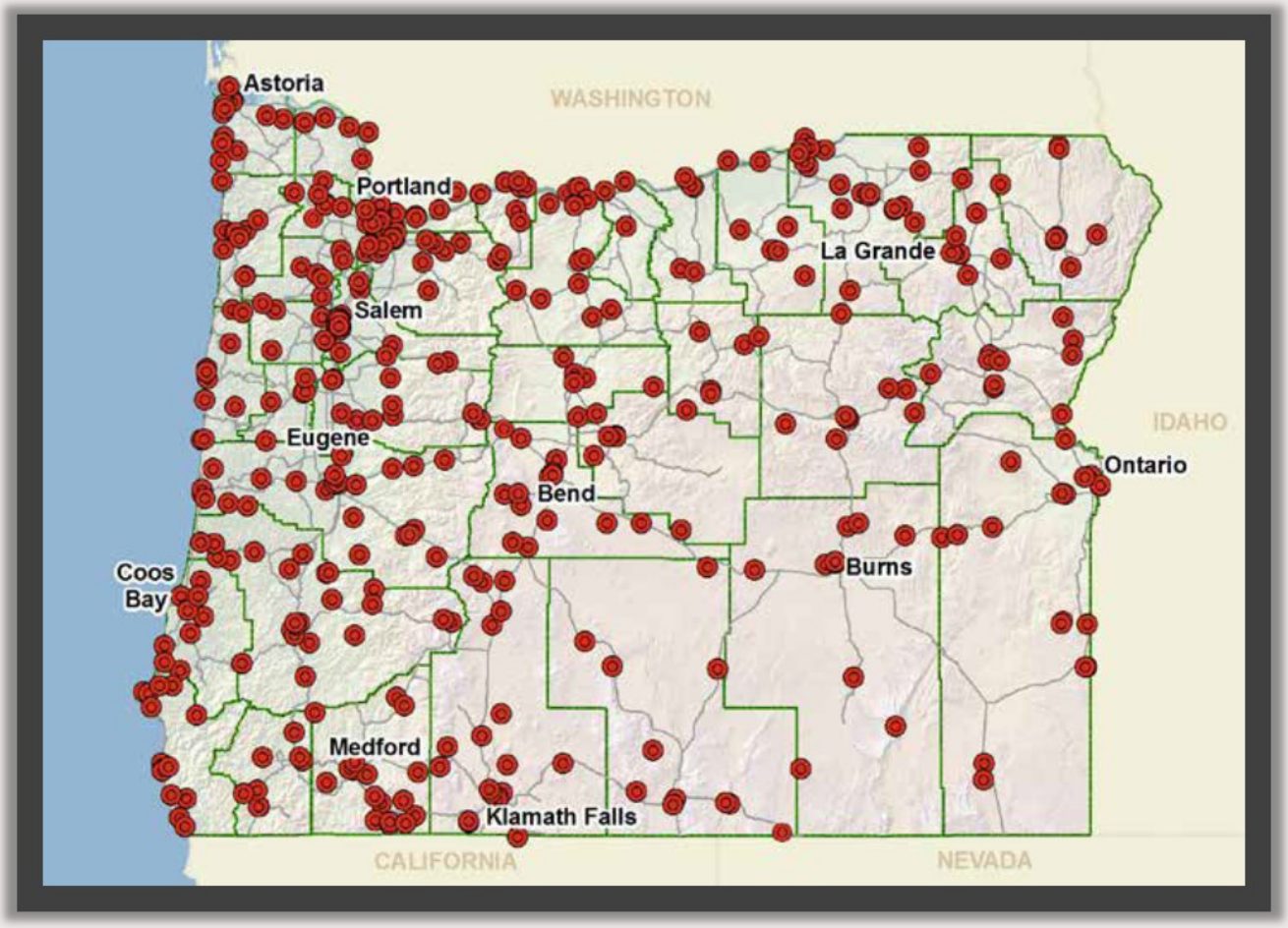
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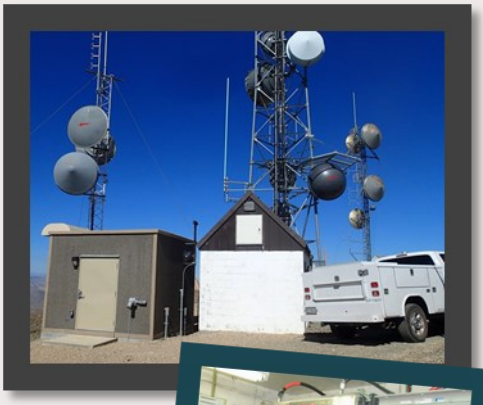
State Radio Project Reaches Successful Conclusion with an Enhanced and Modernized System

The Oregon Department of Transportation's State Radio Project, which replaced and modernized aging public safety communications systems statewide, marked its official completion June 30, 2017. After seven years of planning, developing and building the complex, technology-rich system, ongoing operations and maintenance responsibilities will reside with the ODOT's Wireless Communications Section.



The radio project integrates modern technology into the enhanced communications system that first responders depend on to do their job. It allows for shared efficiencies with other state agencies including the Oregon State Police as well as other first responder agencies.

The major components of the new system include new narrowband mobile and portable radios, a digital microwave system, consoles and logging recorders at statewide dispatch centers, a new trunked radio system and a new network management system.

After the legislature transferred the project, formerly known as the Oregon Wireless Interoperability Network, or OWIN, from OSP in 2010, ODOT re-engineered the project to focus on repairs and modernization. It was scaled back from a $600 million project and assigned a new schedule, staff and a final budget of $229 million to better fit Oregon's fiscal constraints and public safety emergency service needs.

Underscoring the need for an upgrade to Oregon's 30-year-old system, a series of storms in late 2006 knocked out radio communication systems around the state. The aftermath of the storms brought to light some important issues.

"We listed recommendations for a new system to be more reliable, especially during inclement weather," said Rob Reish, Wireless Section manager. "We used this list as our guide for the new radio system."

ODOT's first priorities were meeting the obligations of the partnerships established by OWIN and meeting the federally mandated narrowband deadline. To meet the partnership obligations, team members rescoped and refined the obligations in conjunction with their partners and delivered on time everything that had a critical deadline.

"One of the highlights of the project is that we were able to fulfill all partnership obligations," said Gail Harbert, site acquisition manager on the project. "We gained trust by doing what we said we were going to do and we left on a positive note."

After completing work such as site design, intergovernmental agreements and site leasing, the team tackled civil site work construction in 2014 and 2015, with the majority of the 157 sites completed by the end of 2015.

Most site work included erecting larger towers for the new larger digital microwave systems and building new or upgrading existing shelters to house new equipment such as generators, batteries, HVAC systems and trunking equipment. Many sites needed electrical upgrades and some sites received solar arrays to power systems where electricity wasn't available.

To monitor all these disparate systems, the project acquired a new Wireless Integrated Management System to manage the network. This system monitors the various equipment on mountaintop sites, enabling Wireless technicians to "see" equipment status remotely.

After microwave and trunking equipment were installed, the project team and radio users noticed an increase in coverage.

"At the beginning of the project we knew that there were coverage gaps around the state," said Dick Upton, State Radio Project manager. "Our goal was to reduce those gaps, but we didn't know how well the new technology would expand radio coverage. We also added repeaters and new sites which really closed the gaps in coverage. The radio system that we delivered is far better than the system it replaced."

The final component of the new radio system was a new console system. The project team and dispatch operators from ODOT and OSP designed a console system to meet the specific needs of dispatch operators. All six Emergency Operation Centers statewide have upgraded to the new console system — including new logging recorders — and are fully operational.

> *"Our success is due to the strong partnerships the project team formed, especially with the Wireless Communications Section."*
>
> – Dick Upton, State Radio Project manager

As the project neared completion, efforts turned to the closeout process. It was a meticulous procedure that involved closing contracts and rectifying records and filing everything in a consistent format to ensure accessibility after the project end date.

"We owe the success of this project to the people who worked on it," said Upton. "Our success is due to the strong partnerships the project team formed, especially with the Wireless Communications Section. From ODOT's project delivery standpoint, we supplied the structure, but Wireless provided the know-how, the understanding of the technology and the leadership around those issues and was an integral part of the State Radio Project." ■

State Radio Project

By the numbers

$229 million

To repair or replace deteriorating state radio network

213

Sites with microwave, conventional or trunked repeaters

42

Partnership obligations fulfilled

Interoperable communications between trunked system and

6 counties

via ISSI connections

Fulfilled

FCC obligation to transition to narrowband operations

$550 THOUSAND

Returned to the state highway fund

$10.4 million

To fulfill partnership obligations

Physical improvements made to

161 sites

5,500+

Radios deployed

1

Consolidated State Radio System for ODOT and OSP

Narrowbanding

Project Goal – Completed

Comply with the approved FCC waiver deadline to transition state radios from wideband to narrowband transmission by Nov. 1, 2013, and position for future narrowbanding requirements.

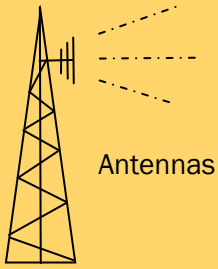
$33.4 million
Expended to complete narrowbanding work

Office remotes and base stations installed at
119 SITES

5,500+
Mobile and portable radios deployed


Narrowbanding improvements made to **269 sites**

Fulfilled
FCC obligation to transition to narrowband operations


116
Antennas installed

50 additional
Repeaters and antennas to increase coverage

142
Mountaintop repeaters replaced

Narrowbanding is the federal mandate to use less space on the radio spectrum by migrating from wideband transmission to narrowband. The Federal Communications Commission required all states to switch to narrowband operations by January 2013.

The narrowbanding component of the radio project involved two primary work efforts. The first required the transition of ODOT and OSP radio operations to narrowband mode to comply with the FCC mandate. The second effort included implementing equipment upgrades, beyond those required for narrowband operations, to mountaintop tower sites and office locations throughout the state.

When the project began installing mobile radios in 2012, the team encountered significant issues with the radios. As a result, project staff prepared a waiver request for the FCC to consider extending Oregon's deadline. The waiver was granted, giving the project until November 2013 to transition to narrowband operations.. Harris Corp., the manufacturer of the radios, fixed all the issues and after extensive testing, the project restarted radio deployments. The project completed the migration to full narrowband operations a few months ahead of the new deadline. ■

Office Remotes and Base Stations: Repurposing Radios as Remote Receivers Means Considerable Savings

Substantial cost savings were realized for the radio project by repurposing single-band mobile radios from OSP and ODOT vehicles as office remote receivers statewide.

More than 200 Kenwood mobile radios were removed from radio users' vehicles as the new Harris mobiles were installed.

In a parallel initiative, 119 offices around the state were scheduled to receive new Harris remote receivers as part of the "office remote" setup. It occurred to Chuck Kummer, senior wireless system specialist with the Wireless Section, that reuse of the Kenwood radios was not only possible, but desirable. Since the existing units were capable of narrowband operations, they had the necessary features to do the job.

"It just made sense: We don't need to buy expensive new radios — we can use the equipment that's already paid for," he said.

What the radio project calls an office remote is a base receiving station that brings in the signal from mountaintop repeaters in the area. In effect, the office remote is the means by which that office is added to the communications loop. In many cases the office remote is simply a mobile radio with a power supply and several remote units attached that resemble a desktop phone.

There are locations where the reconfigured Kenwoods won't work and it will be necessary to purchase new radios. But when they do fit, the radio project can save approximately $7,700 per unit.

With the approximately 75 Kenwoods targeted for reuse in various offices around the state, the reduction in project costs is estimated to be a little over $550,000. Since more than 200 of the Kenwood models have been reclaimed, the project had plenty to use as office remotes; surplus units were offered to other agencies and public safety organizations.

The repurposed radios have all of the required functionality of the originally selected model, being digital and P25 compliant. All that is needed is for technicians to rewire the units, converting them into remote receivers. In fact, some Kenwood units have already been in use in some offices as remote receivers for years.

"They're fairly new radios with adequate capabilities," said Joe Messman, Wireless Section field operations manager. "They have sufficient functionality to operate in the offices, and they still have plenty of functional life ahead."

Both OSP and ODOT were receptive to repurposing the units, mainly due to the cost savings. In most offices, the radio equipment is installed out of sight in a back room or closet, so users rarely see the receiver. It may not be shiny and new, but they meet the need and conserve public funds. ■

ODOT, OSP Radios Developed Multiple Personalities

The Wireless Section maintains "radio personality" files for ODOT and OSP users. These personality files tell the radio who is talking, how to perform and which talk channels it can use. These personality profiles range from those designed for general agency users such as ODOT Maintenance workers or OSP troopers to specialized files for SWAT team members and incident responders.

The Kenwood radios being replaced could not hold all of the channels needed for use in Oregon. Instead, the radios were programmed regionally, with each region getting a different file. The new Harris radios are capable of holding all the needed channels and more, so the Wireless Section is in the process of writing distinct personalities for each of the 40 unique groups identified. The process involved significant design and input time, but the Wireless Section had each ready to install when the new radios were deployed. ■

Narrowbanding

Mountaintop Repeaters: Initiative Plus Team Effort Equals Significant Savings

When faced with an expensive interface panel that was also a space hog in the radio project's repeater racks, Thomas Kilfoil, with the Wireless Section, was pretty sure he could make it cheaper, and he was certain he could make it smaller and simpler to install.

The DC (direct current) interface panel is a generic black metal box whose wiring configuration enables an interface between a radio and its external power supply.

The panel ODOT had been buying is based on old technology, with fuses instead of breakers. Each panel needed about an hour or more of modification to be compatible with the radio project's new Harris radios.

Kilfoil came up with a single box that could interface with two radios instead of just one and was sized to fit the racks. With the connector box built and some additional work in-house, the prototype fit the bill.

The Wireless Section placed its order for 100 boxes and finished up the wiring in-house with the support of its interns and specialist Kevin Maine, who trained the interns and performed quality control of their work.

As a result of the team effort, the costs went from roughly $1,200 for two panels to $253 for one custom box. Multiplied by 100 installations, the savings are considerable.

"Our sites are so cramped; this project is a space-saver as much as a money-saver," Kilfoil said. "The space requirements for the interface units are cut in half." ■

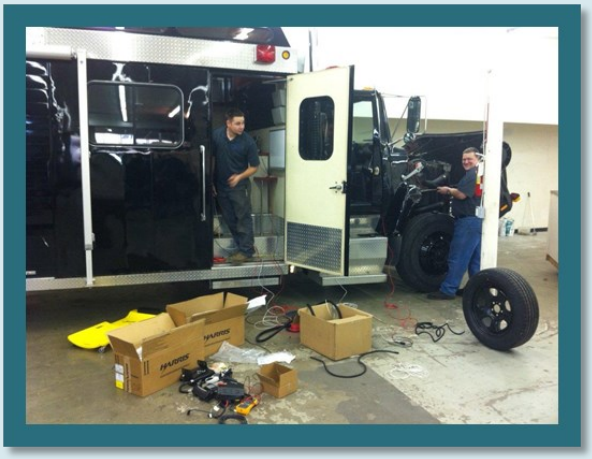
Radio Deployments and Training Roll to a Smooth Completion

The deployments, installation and training constituted a monumental initiative, not to mention the identification of the agencies' and radio users' needs and the assessment, planning, equipment selection, acquisition and testing that had to take place before the first radio was even deployed. The successful outcome of each step was critical to the radio users – their lives depended on it.

From a planning standpoint, just understanding the overall scope of the effort was daunting. The project first had to identify all the personnel who needed handheld portable radios and assess which vehicles needed mobile radios from among the staff and fleets of multiple participating agencies.

That list included OSP, ODOT's Maintenance and Motor Carrier divisions, the Oregon departments of Corrections and Forestry, the Office of Emergency Management and the Oregon Office of the State Fire Marshal. To complicate matters, the installation of mobile radios had to incorporate and accommodate new fleet vehicles as well, a moving target.

The scheduling and coordination support provided by ODOT and OSP staff made the deployment possible.

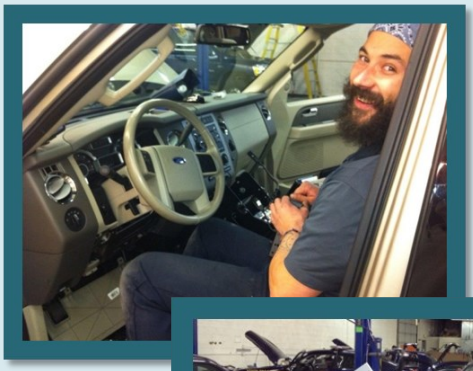


That's not to say the deployments didn't have some speed bumps. Early in the installation of mobiles for ODOT Maintenance, project staff discovered a malfunction with the new radios that was occurring at an unacceptable rate. The glitch had the potential of making the radio unreliable – which meant safety was compromised, a no-go when lives are at stake.

Collaborative and timely decision making by the deployment team and project staff, coupled with the follow-through from the radio vendor, Harris Corp., helped to develop a workable solution and resume installations.

A subsequent moisture issue with the radio antennas on the vehicles arose. Water was collecting in the base of the antenna, which caused the mobile radio not to function correctly. Once again, the deployment team worked through the issue and landed on a solution without delaying the installations.

The work of Harris staff and technicians from the Wireless Section helped make this endeavor a success. ■



OSP, Radio Project Align and Prepare through 'Readiness' Initiative

Through the Readiness Initiative, OSP and radio project staff worked together to identify and prepare the different parts of the business organization the project would affect: business integration, finance, communications, radio deployment, training, operations, agreements and contracts. OSP established sponsors in each area and instituted formal project management. Sponsors were tasked with defining needs, priorities, barriers and resources for their discreet areas.

The Readiness team then looked at the project staff and identified corresponding functions: the people with whom the OSP sponsors needed to communicate for a successful rollout. Connecting people in corresponding functions was an enormous asset and aid to communication and easing integration.

"OSP's radios are their lifelines," said Joe Messman, Wireless Section field operations manager. "That was a big eye-opener and a message I've been able to bring back to the radio project team. Early on, it seemed like this was just another project for ODOT to deliver. It helps to provide a wider perspective to folks who are used to playing a specific role in a construction project. Project staff now realize that they are helping to protect and save lives."

Both agencies refined processes, and together discovered areas of deficiency, be it in expertise, skill sets, personnel assigned or just things they had not thought of. Similar efforts were initiated internally at ODOT Maintenance to ensure crews were equally prepared for the change that the radio project ushered in.

"Overall, the Readiness Initiative has been very successful in assuring that we're able to encompass all of our business needs and make sure that we have a strong plan for the integration," Major Craig Durbin, OSP's representative to the radio project, said. "It has really opened up communication." ■

Narrowbanding

Surplus Radios Support Public Safety Efforts Statewide

In 2013 the radio project completed its upgrade of the state's public safety radios to a digital platform to comply with the FCC narrowband mandate. When the statewide deployment of the new Harris radios wrapped up, the project was left with more than 3,000 analog mobile and portable radios – which proved to be much appreciated by other state and local public safety agencies.

After determining which equipment to keep for spares, staff inventoried and reconditioned the remaining radios for distribution. To manage such a large surplus, ODOT followed a two-tiered process, first offering the radios to the Oregon Department of Administrative Services to advertise and sell to cities, counties and local agencies across the state at deeply discounted prices, returning those funds to the state coffers.

Once DAS sold as many of the radios as it could, it transferred what remained back to ODOT. But because ODOT's rules don't allow the agency to sell equipment directly, project staff reached out to other agencies to see if there was interest in acquiring the still high-quality radios for free.

This equipment offering provided much-needed resources to support the missions of public safety agencies statewide and allowed the radio project to pay it forward.

Sublimity Rural Fire Protection District

"The Kenwood radios allowed us to expand our narrowband capability, and the price allowed us to buy twice as many radios compared to new equipment," said Brandon Hamilton of Sublimity Rural Fire Protection District. "They filled a hole, equipment-wise, so it's appreciated."

"The narrowband radios will allow us to easily reprogram frequencies in case we're called on to travel outside our area to help other agencies," he said.

Oregon Department of Forestry

"Most small rural fire districts have small budgets and can't afford to replace equipment on a regular basis, let alone purchase additional equipment," said Ryan Gantt, ODF communication system analyst. He sent an email to the districts asking if there was any interest and, just about every rural fire district in Oregon responded to his inquiry.

"Many parts of the rural landscape don't get cell coverage, so radios become an important lifeline," said Eulus Newton, ODF equipment pool manager said.

ODF received more than 400 surplus radios and will distribute them to rural fire districts statewide.

Chemeketa Community College

Charles Sekafetz, instructor with Chemeketa's Electronics and Networking Technologies program, requested surplus radios to use in the classroom.

"Knowing how a radio works is important, but so is setting up talk channels, priority codes, trunking systems and repeaters. These types of skills will be needed in the future," said Sekafetz. "With the donation of the 50 radios from ODOT, we can actually simulate setting up talk groups, and talk groups within talk groups."

Marion County Jeep Patrol

“These are $160 compared to twice the price for equipment that we considered purchasing,” said David Hanus of the Marion County Jeep Patrol. “Now all of our 20 volunteers have narrowband radios in their vehicles. That means we can easily put more volunteers in the field during an emergency.”

Wasco County School District

Wasco County School District has taken active steps to prepare for an emergency event. They formed a volunteer task force and created partnerships with local emergency responders, including the state police.

OSP Lt. Patrick Shortt reached out when the task force expressed interest in deploying handheld radios to each school. Receiving 15 radios, WCSD now has a direct link between its schools and the local 911 dispatch center.

“The nice thing about the radios that the radio project gave us is that they are VHF capable, which means more reliable coverage that spans a greater distance,” Shortt said, adding that many of the district’s schools are in rural areas.

McKenzie Rural Fire Protection District

Bret Thompson of the McKenzie Rural Fire Protection District bought four mobile radios to use mainly as base stations for his 25-vehicle fleet, reserving one in case a replacement is needed.

“We’ve standardized our system so that all our vehicles and base stations now have the Kenwood TK-790 installed,” Thompson said. “That makes it easier for our volunteers to use same radio no matter which rig they operate.”

Thompson also said the low cost was the number 1 reason he bought the surplus radios, in addition to knowing that with the radio project they would be serviced and maintained in great operating condition.

“The cost difference was huge for used radios compared to new. We saved enough to buy four instead of two,” Thompson said.

Josephine County

“We did our research,” said Robert Keith of Josephine County Public Works. “The Kenwood units are a higher-end radio that meets our requirements for use in rocky, hilly terrain. They meet federal narrowband requirements and saved us over $18,000 compared to brand new radios. We basically bought them for half the price of other equipment we were considering.”

“The surplus radios are basically plug-and-play with no learning curve for our operators,” Keith said. “As soon as the radios turn on, they are self-explanatory and very easy to use compared to the old equipment they replace.” ■

Infrastructure: Civil Site Work

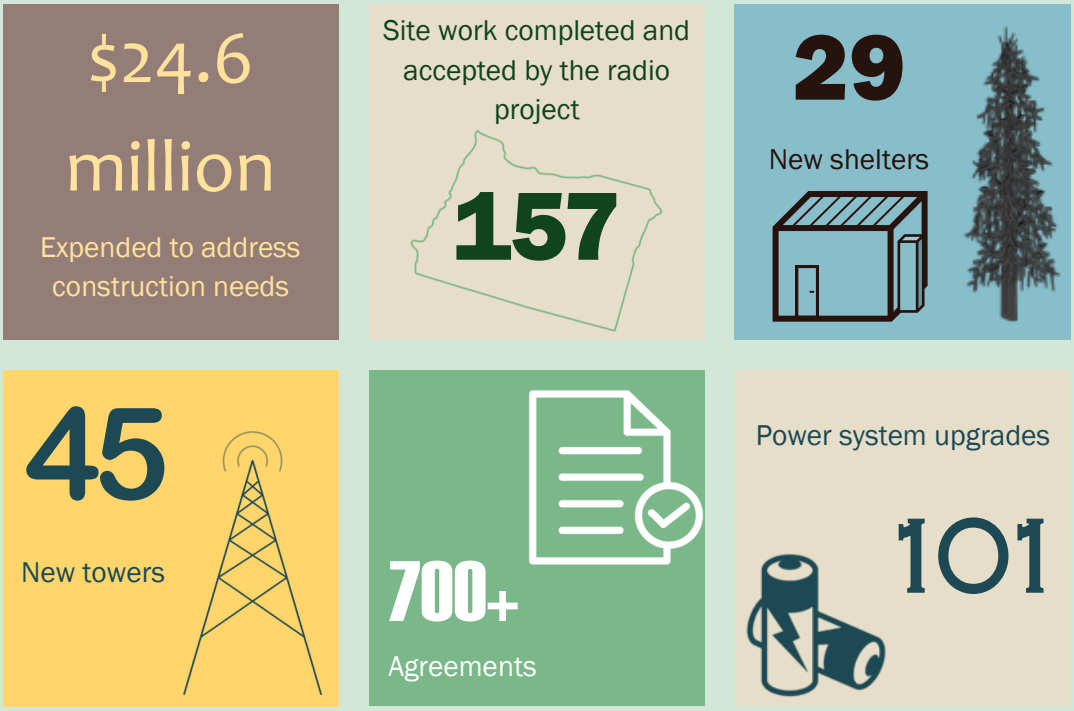
Project Goal — Completed

Repair or replace critical components of Oregon's deteriorating state radio network and extend the useful life of the existing ODOT and OSP wireless communications systems.

The infrastructure component of the radio project included civil site work and advanced technology installations.

Civil site work involved activities that prepared a new site for the installation of radio equipment, such as clearing a new site for a tower foundation, pouring concrete tower foundations, installing radio towers and electrical conduit, and building shelters to house equipment such as generators, batteries and HVAC systems. Other work involved installing propane tanks, security fencing, ice bridges and solar arrays.

The upgraded technology required improvements to towers, shelters, power supplies and other facilities at most sites. New leases, permits and agreements were obtained, as needed. ■



Accomplishments	Total
No site work necessary under the radio project after July 1, 2011	56
Site acceptance completed between July 1, 2011—Dec. 31, 2013	38
Site acceptance completed in 2014	57
Site acceptance completed in 2015	45
Site acceptance completed in 2016	17

Leveraging Resources: Reusing Existing Infrastructure Maximizes Utility and Savings

Part of the radio project strategy was to reuse all that is salvageable on the existing emergency communications system to help meet current needs.

At the Agency Plains site in Jefferson County, for example, the existing building was too small to hold the new equipment. Rather than demolish it and install one large building, the project installed a similarly sized building adjacent to the existing one. The new building holds the new radios, and the older one shelters the necessary generator and batteries, saving costs and resources.

Similarly, at Wilson River in Tillamook County, in a partnership between the county, state and PacifiCorp, the project reused an existing OSP building for the generator shelter and added another building to house the new radio equipment.

The radio project is looking at radio towers as well. While many of the towers are structurally sound, some don't have the height to accommodate the antennas.

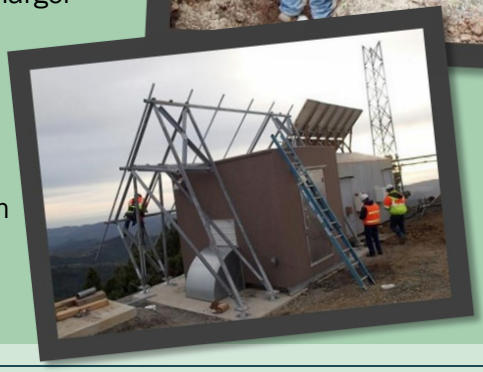
With an analog system, a single antenna can send a long signal in the direction it's pointed. With digital antennas, the maximum path is 35 miles, and atmospheric conditions can otherwise distort the signal. Two antennas, spaced 30 feet apart, are needed to ensure that the signal is maintained along the path. Because of spacing requirements, our 40-foot towers don't have adequate height for the duplicate installation; a 70-foot tower is required. But the shorter tower might be a good fit for a spur site that has a shorter signal path requirement. ■

Construction, Construction and More Construction

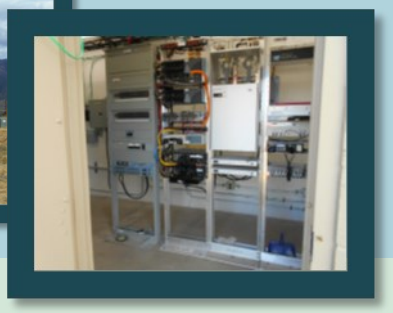
Once a radio project site received necessary clearances, including acquiring property and access rights and developing lease agreements, construction began. Some sites required a complete site build including things like clearing the land, digging trenches for conduit and electrical wiring, building a shelter to house generators, HVAC, batteries and trunking equipment, installing propane tanks and erecting radio towers to hold microwave antennas.

In 2014, the radio project implemented a strategy of grouping civil site work similar in scope and geographical location into bid bundles to be more efficient and to attract additional contractors who normally bid on larger projects.

In 2015 the project's focus shifted to technology implementation. The Wireless Section took the lead on installing trunking systems on sites where civil site construction is complete. The project was able to reuse existing equipment that was better suited for other sites. For example, buildings that were too small in one application were moved to another location to be utilized again. Existing towers were also reused, modified or upgraded, in several cases saving the need to buy all new towers. ■



Infrastructure: Civil Site Work



John Day Airport, Grant County

Work at the John Day Airport site in Grant County included a new generator, new propane tank, shelter improvements, installation of bollards, and electrical and grounding upgrades.

Swan Lake Point, Klamath County

At Swan Lake Point, a 105-foot guyed tower was removed and replaced with a new 140-foot self-supporting tower on a new concrete foundation. Crews also constructed a new 75-foot permanent access road and installed a new ice bridge, along with HVAC enhancements and numerous electrical, grounding and equipment upgrades.

Beaver Mountain, Baker County

Work at Beaver Mountain in Baker County included removal of an existing 30-foot tower and installation of a new 120-foot tower. A new concrete generator building was installed at the site, and the existing shelter was converted to a battery and equipment shelter. Additional propane storage was incorporated to provide power for the backup generator.

Pharmacy Hill, Malheur County

Work at the Pharmacy Hill site included a repurposed 40-foot tower, a new ice bridge, a new shelter entry port and antenna installation.

Dodson Butte, Douglas County

Dodson Butte received shelter improvements and a new HVAC unit, generator, 120-foot tower and ice bridge. New propane tanks and electrical grounding system improvements round out the scope of work for this site.

Table Mountain, Jackson County

At Table Mountain BLM in Jackson County, crews decommissioned the existing 40-foot tower and installed a new 120-foot tower, removed the existing BLM shelter, and installed a new equipment and generator shelter. The site also received two new 1,000-gallon propane tanks, bollards, fencing, utility connections and an exterior grounding system.

Doherty Slide, Lake County

Work at Doherty Slide in Lake County included a new fence and repurposed shelter installation with a solar array mounted on the roof, a new 80-foot tower, a new ice bridge, and electrical and grounding work.

Infrastructure: Advanced Technology

As part of upgrading, modernizing and enhancing the State Radio System, the radio project acquired and installed advanced technology components, including a new digital microwave system, microwave hops, digital repeaters and antennas, a new dispatch console system and logging recorders, a trunked system with repeaters and switches and a new network management system.

Microwave Modernization

The microwave component of the radio project involved replacing old and outdated ODOT and OSP analog microwave with digital microwave, and making necessary network updates to transition voice and data messages to the new digital microwave system.

Microwave installation includes the acquisition, installation, implementation and optimization of the new digital microwave radios, antenna dishes, wave guides, routers and ancillary equipment to support both conventional and trucked radio systems.

Trunked Radio System Implementation

A trunked radio system is used to maximize available capacity in a two-way radio system. Because not everyone in a group talks at once and radio transmissions are usually short. A trunked computer can assign talk frequencies in a manner that allows multiple groups of users to share a small set of frequencies without hearing each other's conversations. This effectively compresses the voice signals and enhances the capacity of the system.

The trunked system will allow local radio communications between public safety personnel; microwave will distribute those signals over a larger area, enabling distance and interagency communications. This section of work involves procurement and installation of trunked radio repeaters, switches, dispatch consoles, and VHF integration. ■

Trunked radio system master switches

Expended to implement the trunked radio system

$27.5 million

Microwave hops commissioned

$27.3 million

Expended to deploy and commission the digital microwave network

67

Dispatch consoles installed at **5** sites

Microwave equipment installed at

22

Limited service consolettes funded

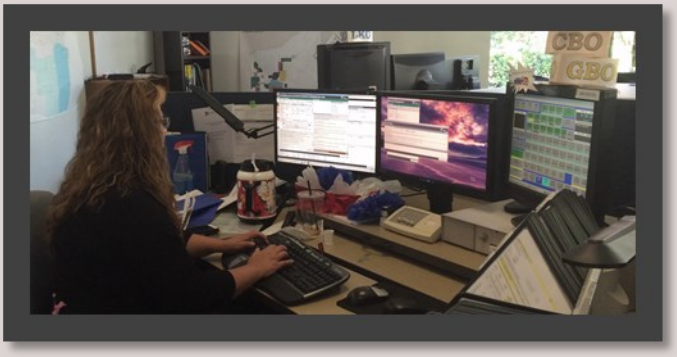
Wireless infrastructure management system elements funded

150

39

Trunked radio repeaters installed

Integrated Consoles Streamline Information for Dispatchers



Once the radio project updated emergency radios for ODOT and OSP to narrowband operations, emergency communications between the two agencies were made easier statewide. The project then turned its attention to the OSP and ODOT dispatchers whose job it is to coordinate communications among agencies during fast-moving emergencies to quickly send the right responders to the right place at the right time.

With the installation of 67 state-of-the-art integrated consoles for OSP dispatchers in Salem and Medford, and ODOT dispatchers in Bend, Medford, Salem and Portland, the challenging job should be a little easier thanks to new features and enhanced capacity.

After an extensive planning effort and completion of factory acceptance testing, the radio project received the new consoles in June 2015. Wireless Section technicians joined with the console vendor, Pantel, to set up a staging area in Salem to further test several applications. After installation and additional testing periods, ODOT and OSP dispatch centers were made fully operational on the new Pantel system in 2016.

New Features Offer Efficiencies and Enhancements to Current Processes

The new consoles are much larger and have touch-screen capability. They also give operators the capability to customize their screens with a certain font size or background color, and those settings are linked to their user profile. Regardless of location, an operator's settings are saved and available when they log in.

The new system includes many welcome additions. The force active feature protects the safety of police officers by preventing the dropping of channels. A dispatcher cannot sign off when a shift ends until another dispatcher actively takes over the channel he or she was monitoring. This ensures that there is never a radio channel that goes unmonitored. Another new feature allows two programs to be visible on one screen. In the old system, dispatchers had to exit their radio screens and sign into another program to access live recall.

A nice addition that works in conjunction with the new consoles is the "beehive" light. Before, dispatchers couldn't always tell if another dispatcher was on the phone, especially because they wear headsets at all times. With the beehive light connected to the console, one color lights up when dispatchers are on the phone, another color lights up if they are on the radio, and if they are not on a call, the light remains unlit. Others can now easily see what is happening in the room.

The dispatch consoles integrate and seamlessly operate with the new narrowband and legacy radio systems and existing telephones. The new design allows dispatchers to see and coordinate emergency operations information on a single, on-screen system when dispatching responders saving valuable time when it matters most. ■

Microwave Enhancements Improve Reliability

Replacement of the aging analog system was a critical component of the radio project. Installation of 143 microwave hops, connecting 137 sites, make up the digital microwave network of the State Radio System. These enhancements allowed for implementation of the trunked radio system. ■

Infrastructure: Advanced Technology

Transitioning to Trunked Radio Operations

After years of planning, the radio project team initiated the systematic cutover of radio users in the trunked coverage area of the state from the VHF analog radio system to the new digital trunked radio communications system in 2016.

The project team, including vendors, spent years planning the digital upgrade to the trunked radio system and many months refining the integration of three disparate systems — the existing VHF radio system, the new Pantel console system and the new Harris Corp. trunked system — allowing users seamless operations between all three.

Testing the System

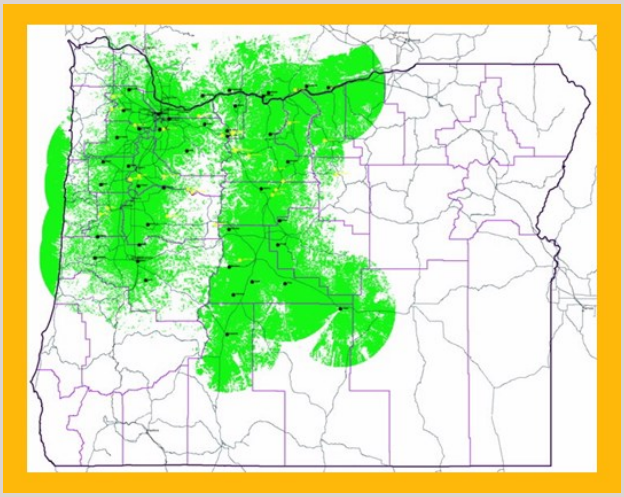
In summer 2016, the project team initiated the cutover in McMinnville, adding a small controlled group of live ODOT Maintenance crews and OSP troopers to perform the required confidence test of the new system.

After two weeks of live operations on the trunked radio system, the project team suspended operations to resolve garbled voice transmissions that surfaced during the live confidence test.

After pinpointing and resolving the cause of the garbled voice transmissions, the cutover to the digital trunked radio system in McMinnville was reinstated and the confidence test period resumed. The cutover went smoothly, and the ODOT and OSP test participants were using the new system.

Bridging Systems: Trunked Radio and VHF

By fall the radio project was working to transition ODOT and OSP radio communications systems in the Santiam Pass area along Oregon 22 and U.S. 20 from separate VHF channels to individual simulcast radio systems.



The simulcast system allows radio users to use one channel or talk group in areas of the state that are near both VHF and trunked coverage areas, with the objective of seamless communications between the two systems.

Weeks of preparations leading up to the transition involved installing, calibrating and fine-tuning equipment on three radio sites. ODOT and OSP users shared radio systems for several hours while each agency's system migrated to the new simulcast system. Wireless Section technicians were

on location at each affected site and at the dispatch centers and were in constant communication through a conference bridge.

Conducting the Drive Test

When the simulcast system was up, technicians drove the corridor to test the radio transmission at every milepost using "Harvard sentences" — phonetically balanced sentences that contain the full range of sounds used in everyday speech. The drive test was successful: The simulcast system provided improved voice quality in an area known for spotty coverage and voice transmission.

Challenges and Successes

Transitioning OSP's system proved to be a bit more complex than the ODOT cutover. Equipment swaps were needed at three radio sites instead of two. The team used an extra day of testing to confidently transition OSP to the new simulcast system.

"Taking an extra day to thoroughly test the new system paid off," said Lisa Strader, ODOT State Radio Project assistant manager. "We received positive feedback from troopers who frequently travel in the Santiam Pass, especially regarding the clarity of the radio transmissions and the expanded coverage area."

Jerry Martin, OSP Applications Team/CAD-Dispatch support manager, agreed that the OSP cutover was successful.

"The simulcast system greatly improves our ability to communicate in the Santiam Pass area," said Martin. "Troopers from The Dalles, Salem and Bend can now work on the same channel in the Santiam Pass, allowing them to talk to each other much easier than they used to."

Making it all Work

In addition to the simulcast cutovers, the project team made some final adjustments to the consoles and logging recorders, based on user feedback. The team worked with console vendor Pantel to make those adjustments and clear the final punch list items. Both the conventional and P25 confidence tests were completed in 2016.

The project conditionally accepted the entire trunked radio system after the successful cutover in McMinnville. The Wireless Section will complete the final equipment tuning, and will finish cutover to operations for this system. ■

Trunking Controllers: Equipment-sharing Agreement Generates Savings and Safety Benefits

The radio project coordinated an agreement to share the use of an Oregon Department of Corrections trunking controller set for the benefit of DOC and ODOT, as well as ODF and OSP.

The four agencies are now poised to take this state resource and expand its use. The savings is not only in radio project funds, but also in future operations and maintenance costs over the life of the future radio system. The integration could also allow DOC to monitor and track inmates in transit, improving the security of its communications.

The function of trunking controllers is to manage the signals to various radio sites. The DOC controllers need to be modernized and upgraded, so the radio project will provide the rework in exchange for using the controllers as part of the new State Radio System. ■

"This agreement is an excellent example of agencies coming together to increase efficiencies and improve public safety communications statewide."

– Tami Dohrman, DOC assistant director of general services (now retired)

Interoperability

Project Goal – Completed

Provide limited, local interoperability for public safety agencies and lay the foundation for expanded and improved interoperability in the future.

$2.1 million
Expended to implement and enhance tactical interoperability in coordination with the SIEC

Local public safety projects funded
5

2
Public safety agency radio conferences funded

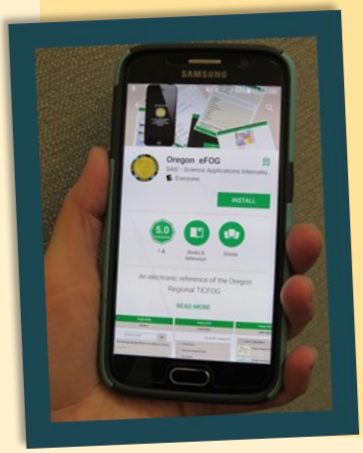
Strategic Technology Reserve Trailers deployed
12

Born out of the tragedy of Sept. 11, 2001, lawmakers called for the creation of an interoperable communications infrastructure that would allow all state, local, federal and tribal public safety agencies to share information instantly. Public safety agencies wanted a radio system for emergency responders from multiple agencies to be able to talk to each other on one channel.

Because of the revised limited budget for interoperability, the radio project worked with partner agencies through the State Interoperability Executive Council and the State Radio User Group to foster interoperability between state and local systems and maximize the use of those funds. ■

The Oregon TICFOG Goes Digital

The Tactical Interoperable Field Operations Guide for Oregon is the go-to guide for Oregon's public safety community to obtain contacts and resources available in a given area of the state. Historically the guide has been published in hard copy to allow first responders to use in the field when internet access is scarce. In 2012, the radio project set out to produce a digital version of the manual available for download to smart phones from the internet. This Electronic Field Operations Guide, or eFOG, enables first responders to have immediate electronic access to communications resources through their smart phone, enabling capabilities not possible in hard copy. ■



Funding Contributed to Local Public Safety Agencies to Enhance Interoperability Capabilities

The radio project had a limited budget for interoperability equipment and worked with and through the SIEC and the State Radio User Group to implement or improve connection points between state and local systems.

By way of a formal grant application process, five local agency projects were approved by the SIEC to receive a funding allocation from the radio project's interoperability reserve budget.

The approved projects were varied, but included elements such as connectivity of local radio systems to the State Radio System; installation of interoperability repeaters to provide external access to existing systems; and installation of stand-alone repeaters to provide interoperable communications in areas where trunked radio systems do not exist. ■

Strategic Technology Reserve Trailers are Ready to Move

Secured through a Public Safety Interoperable Communications Grant by the radio project, the Strategic Technology Reserve cache radio trailers are designed to establish local-to-county, county-to-state and state-to-federal communications when conventional systems are disabled.

In May 2012, the Wireless Section completed the final touches on the STR trailers in preparation for deployment and related training. Twelve STR trailers are located statewide and are available for use by public safety agencies in planned events or for emergency response. ■

Staff from the State Radio Project and Wireless Section Lend a Hand to Communications Training Exercises

Over the course of three uncharacteristically sunny November days in 2011, 27 emergency communications staff from Oregon and Washington were able to practice on unfamiliar equipment, shoulder to shoulder with strangers. It was all part of a training exercise that simulates real-world situations to enhance responders' abilities to adapt to the unpredictable and challenging conditions that arise in emergencies. This was just one of seven Communications Unit training events sponsored by the SIEC and supported by the radio project.

The Communications Unit Leader and Communications Unit Technician training and exercises provide a learning environment for participants to exercise emergency response plans, policies and procedures for a significant disaster response, use equipment at hand and deal with staff from other agencies.

Benefitting Communities Statewide

These events were the result of the public safety partnerships between and among federal, state and local jurisdictions to align their responses to threats and hazards. The training sessions establish a learning environment for participants to develop, test, work with and through tasks and equipment often needed during disaster response. The training sessions also provide participants valuable networking opportunities, allowing participants to learn from each other as well as exercise.

From July 2011 to June 2015, the radio project provided support for seven events that increased the knowledge of 139 local incident responders from more than 75 Oregon and southwest Washington public safety agencies and organizations.

The COML training, COMT training, and Communications Exercise events were produced and delivered by the U.S. Department of Homeland Security's Office of Emergency Communications Interoperable Communications Technical Assistance Program, with the input, advice and assistance of the planning teams comprised of staff from local emergency response agencies. ■

Partnerships

The Oregon Wireless Interoperability Network developed partnerships between the state and local jurisdictions with the intent to reduce costs to both parties, while capitalizing on opportunities for shared operations, maintenance and equipment. These agreements created interdependencies among participants for a functional system. In 2011, the radio project identified partnership groups as including sites that required work by the state to meet the needs associated with those agreements.

Radio project team members re-scoped and refined partnership obligations in conjunction with representatives from those partnering agencies to deliver on critical federal funding deadlines.

Although not called out as an official project goal, the radio project placed high importance on meeting all obligations to local agencies that have expended money contingent on state participation. This section of work and associated budget allotment allowed for the state to complete its share of projects already started by local partners.

The radio project fulfilled all grant-related obligations in July 2012 and completed all partnership obligations in October 2016. ■

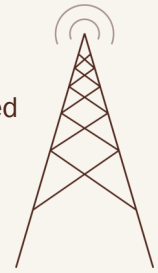
$10.44 million

Expended to fulfill partnership obligations

Construction completed at

Partnership microwave hops commissioned

26



Site work obligations fulfilled

42

Agreements Executed

Obligations fulfilled with 7 partner groups

Date	Accomplishments
Fall 2011	Developed scope, cost estimate and negotiated timelines with Oregon Office of Emergency Management (federal grant manager) and partners for all partnership sites
July 2012	Met obligations on all partnership sites with grants
January 2013	Met obligations on north valley partnership sites
May 2013	Met obligations on Lincoln County partnership sites
April 2014	Met obligations on southwest Oregon partnership sites
September 2014	Met obligations on the Columbia River Inter-Tribal Fisheries Commission and Chemical Stockpile Emergency Preparedness Program partnership sites
October 2014	Met obligations for the northwest coast network partnership sites
April 2015	Met obligations to the U.S. Department of Justice at Dodson Butte site
October 2016	Met obligations to the Klamath County Interoperable Communications Group
October 2016	Fulfilled all partnership obligations within the original budget

A Long Time Coming: North Coast Microwave is Up and Running

Overcoming more complications and dilemmas than most other partnerships, the North Coast partnership had reason to celebrate in summer 2012: The microwave circuits for radio communications have been completed. Using Public Safety Interoperable Communications and Department of Homeland Securities grant funding, the new microwave radio coverage connects public safety personnel throughout Tillamook and Clatsop counties, the cities of Seaside and Astoria, and Tillamook County Emergency Communication District (Tillamook 911).

PSIC and DHS grants funded, in large part, the communities' ability to participate in the project and upgrade their radio equipment. Previous agreements, some only verbal, made under the OWIN program had not been fulfilled.

Some of the grants required specific actions by the state, such as establishing connectivity between Tillamook and Clatsop counties by building a site at Neahkahnie Mountain. When plans for that site were eliminated, the project and partners had to find other ways to accomplish the requirements. Although for many the process was long and at times frustrating, completion happened in a timely fashion once work on the ground began.

While undergoing a major downsizing, the project was able to mend and formalize partnerships; acquire the use of sites; install infrastructure and less expensive, more functional equipment than originally planned; and complete microwave circuitry in the northwest part of the state.

The project and partners handled the challenges of developing and delivering this complex communications circuit by working together – credit is due all around for accomplishing the mission through collaboration. ■

Radio Project Celebrates Fulfillment of Southwest Seven Partnership

The radio project reached a milestone in 2014 when the state met its obligations to a long-standing partnership with seven Oregon counties.

Benton, Coos, Curry, Douglas, Josephine, Lane and Linn counties formed the Southwest Seven government entity in 2006, partnering with the OWIN program to seek funding for a radio communications system that would provide interoperability capabilities, and benefit all seven counties as well as the state.

After developing a plan for building out a radio communications system, the Southwest Seven applied for and received a federal funding earmark. Under the partnership, the state would build specific sites within the seven counties, and the Southwest Seven would install equipment purchased with the grant money.

OWIN did not get fully funded under the original proposal and the Legislature stepped in, recognizing that the OWIN plan created a dependency for local governments.

After the OWIN program was re-scoped as the State Radio Project, ODOT worked with the Southwest Seven partners to establish agreements and create a cooperative working relationship and a win-win situation.

As both partners demonstrated transparency, the trust level gradually increased. ODOT went through each site with the Southwest Seven and relayed what the discussions had been in the past, what the road blocks were and how they could be overcome.

Once needs were identified, the state determined how it could enter into agreements that were mutually beneficial. The result was both unique and successful. The partnership was accomplished in only two agreements involving 12 sites. ■

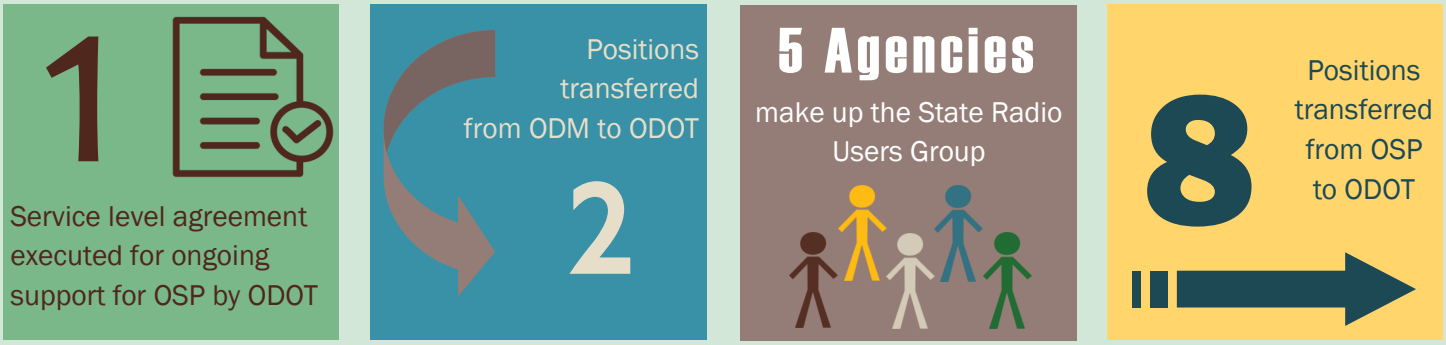
Consolidation

Project Goal — Completed

Consolidate the ODOT and OSP wireless communications systems into a single unit and allow for shared efficiencies and integration between the four existing state systems.

The transfer of OSP and ODM staff, infrastructure, radio assets and other equipment was approved by the legislature in 2013. As part of a policy option package made effective July 1, 2013, the operating budget for the State Radio System also transferred to ODOT. The consolidation of staff and assets benefits the overall system; it provides continuity in operations, yields efficiencies and is more cost effective.

Early in the planning phase, the need for a long-term state Land Mobile Radio governance model became clear. Through the radio project, the State Radio User Group was formed as the governing body over the state's multi-agency LMR communications systems. The five partnering agencies — DOC, ODF, ODOT, OSP, and OEM — collaborated to develop framework allowing the agencies to consolidate and share LMR operations and assets. ■



Landmark Agreement Ensures Agencies' Shared Future

An interagency agreement signed January 2013 marks the first time since the earliest beginnings in 2002 of what would become the radio project that all of the participating agencies have formally committed to a shared future together in all aspects of public safety LMR.

Historically, each agency has operated independently, coordinating operations to meet the needs of internal teams. Through the leadership and good-faith participation of each agency, the SRUG executives worked diligently to break down barriers to understanding and collaboration, and find common ground to understand the differing agencies' cultures and unique needs.

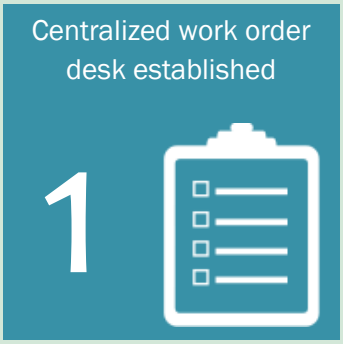
The new agreement defines and establishes agency governance and obligates the participants to cooperate in the ongoing sustainability, maintenance and use of the multistate LMR communication systems.

Through the collaborative efforts of its members, the SRUG has determined roles and responsibilities, established a cost model and how to share the load proportionately, scheduling; timing; managing stakeholders; legislation and federal mandates; new technologies; and is engaged in planning for a sustainable radio system into the future.

Also finalized in January 2013 was the Cost Model Agreement, which outlined the way costs would be allocated during the construction of the radio project. Agreements are now in place to share equipment, resources and training, which will help all the participating agencies save money and time. ■

State Radio System: Beyond the Project

Completion of the radio project means that the infrastructure and systems established through the project must transition to operations — more specifically, to the Wireless Section. Having been integrated in the delivery of the radio project, the Wireless Section prepared for the change by improving some internal processes to enhance its ability to provide the top notch service its customers have come to expect.



Wireless Section Introduces Centralized Work Order Desk

Developing efficiencies, streamlining processes and providing top-notch customer service are all goals successful businesses strive for, and the Wireless Section is no exception. What began as a special project in September 2013 soon became an official and permanent change in business practice: the new and improved Wireless Work Order Desk.

Historically, customers contacted their local technician when they needed service. With the old system, this system worked well. But as service began to expand, it became clear that a technician may not be the best first contact for every situation, such as filling an equipment order.

The time came for a more centralized and streamlined process to provide the best, most efficient service. The work order desk is staffed by specialists who allocate the right resource to fulfill the request. This centralized, full-service hub caters to a variety of customers and requests.

The new process provides a central phone number and email address for requests from around the state, primarily from ODOT and OSP. People are directed to call the central number or use the central email to make certain all issues are logged into the database. While customers can still contact their local technician, a trouble ticket is developed to notify the work order desk and record the work.

The system gathers a number of metrics that can be tracked and used for management needs, such as staffing and material orders, as well as reporting progress against service level agreements with its customers, like OSP.

The work order desk is the central point of contact for ordering parts and supplies and shipping them directly to technicians in the field. If a customer is nearby, they're welcome to stop by the work order desk to pick up a replacement part on something that isn't working.

The new and improved work order desk is an efficient and helpful resource that demonstrates the Wireless Section's commitment to its radio users. ■

Efficiency and Reliability Reaches New Levels with Integrated Network Operations Center

A streamlined digital radio network that includes monitoring all equipment functions at all state radio sites in Oregon has been gradually built and implemented by the Wireless Section. The Network Operations Center is enabling staff to be more proactive in meeting the needs of its customers and provides the ability to catch and resolve problems and outages more efficiently than ever before.

The wireless infrastructure management system, or WIMS, is the alarm management software that is used by the NOC. The WIMS monitors equipment alarms sent to the Net Guardian Remote Terminal Units installed at sites statewide.

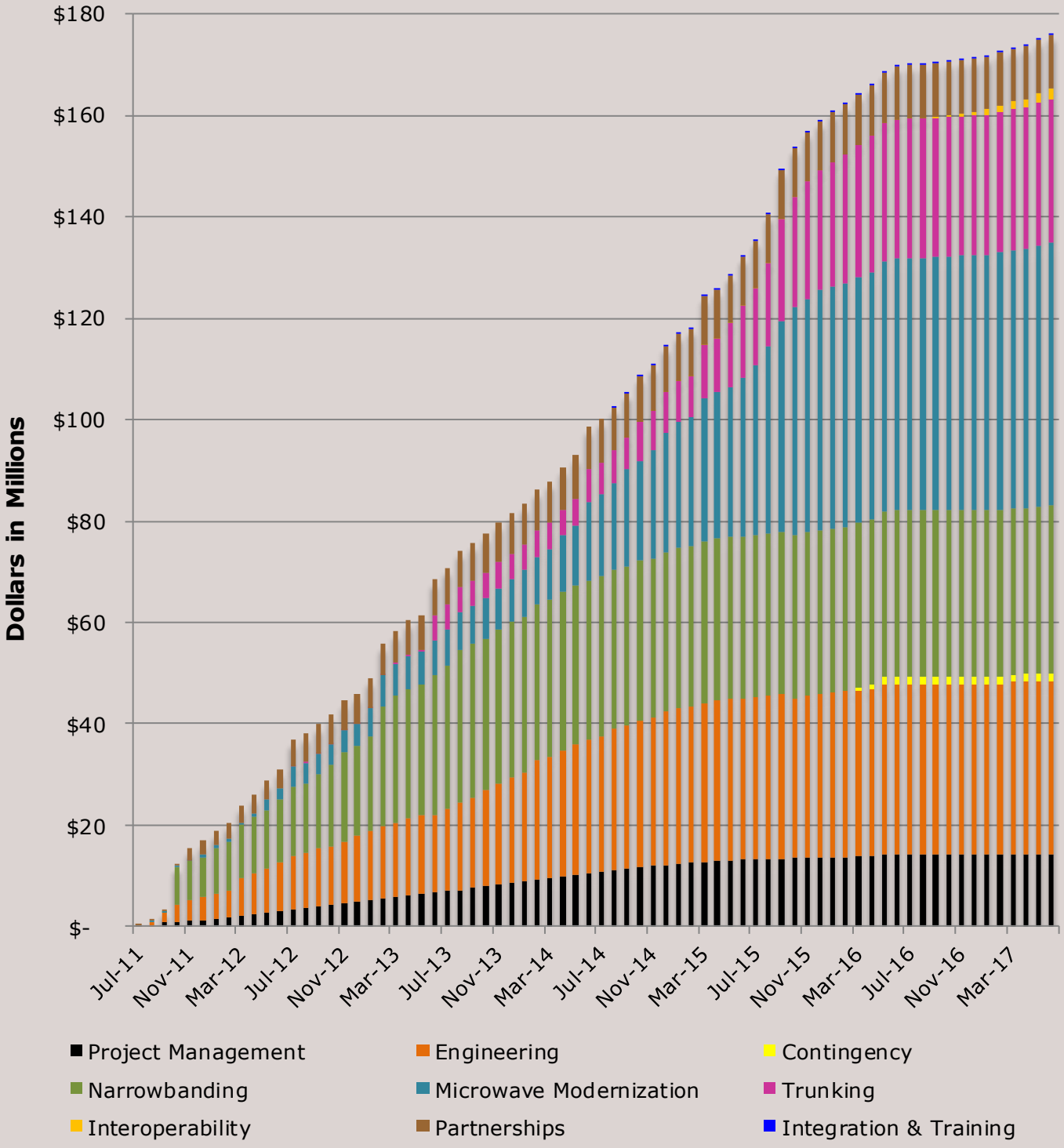
Historically, site equipment alarm information was managed by several systems. For example, one system monitors the battery charging systems, another monitors analog microwave alarm, yet another monitors the digital microwave equipment and so on. Today a technician must log in to each monitoring system without the advantage of a total system view, which allows multiple information sources to be compared and contrasted with each other in the same interface. With WIMS operational, all the monitoring system views are consolidated from many to one, providing a holistic view of the entire radio system network.

The NOC gives the Wireless Section the ability to remotely monitor radio network equipment operation, power system status, trunked radio system, room temperature, door status, smoke and gas detectors, propane tank levels and any other operational monitoring that the new and existing equipment is capable of and enabled to do. ■

Budget Recap

Finalized through closeout efforts and budget reconciliation, the radio project determined its expenditures totaled $174.5 million of the $175.1 available for use. The remaining $549,913 was returned to the state highway fund. The project's overall budget allotment of $229.9 million included $54.4 million spent by the OWIN program prior to 2011. ■

Project Cash Flow



Final Project Cost Summary

	Original Budget 09/07/11	Re-baselined Budget 09/30/13	Prior Budget Changes as of 05/31/17	Current Month Budget Changes as of 06/30/17	Current Budget as of 06/30/17	Funds Spent through 06/30/17	Balance
Totals by Phase							
Narrowbanding							
Repeaters	6,100,000	4,415,302	556,291	(11,943)	4,959,650	4,959,650	-
Office Remotes	2,000,000	2,116,600	(810,521)	(105,227)	1,200,851	1,200,851	-
Radio Deployment	33,200,000	25,742,427	820,362	452,526	27,015,315	27,015,315	-
Cutover/Testing	-	300,000	(69,295.00)	-	230,705	230,705	-
Narrowbanding Subtotal	**41,300,000**	**32,574,329**	**496,836**	**335,356**	**33,406,521**	**33,406,521**	**-**
Microwave Modernization							
Purchase & Installation	29,300,000	17,568,049	2,842,554	(4,796)	20,405,807	20,405,807	-
Network	-	5,498,992	160,452	1,725	5,661,169	5,661,169	-
Site Improvements	45,550,000	25,150,000	(910,301)	359,433	24,599,132	24,599,132	-
Network Management System	-	1,386,984	(129,484)	(70,579)	1,186,921	1,186,921	-
Training & Equipment Acquisition	-	500,000	(500,000)	-	-	-	-
Microwave Modernization Subtotal	**74,850,000**	**50,104,025**	**1,463,222**	**285,782**	**51,853,029**	**51,853,029**	**-**
Trunking							
Receivers	5,250,000	14,803,450	1,082,630	(70,358)	15,815,722	15,815,722	-
Switches	-	2,403,062	(288,813)	(1)	2,114,248	2,114,248	-
Consoles	1,400,000	3,941,546	1,519,437	(82,952)	5,378,031	5,378,031	-
Testing & Training	-	4,193,867	(1,121,792)	(960,013)	2,112,062	2,112,062	-
VHF Integrations	-	1,500,000	309,064	(13,690)	1,795,374	1,795,374	-
Trunking Subtotal	**6,650,000**	**26,841,925**	**1,500,526**	**(1,127,014)**	**27,215,437**	**27,215,437**	**-**
Interoperability							
Procurement & Installation	2,300,000	2,300,000	-	(187,648)	2,112,352	2,112,352	-
Interoperability Subtotal	**2,300,000**	**2,300,000**	**-**	**(187,648)**	**2,112,352**	**2,112,352**	**-**
Partnerships							
Construction	10,400,000	10,469,802	(30,353)	(0)	10,439,448	10,439,448	-
Partnerships Subtotal	**10,400,000**	**10,469,802**	**(30,353)**	**(0)**	**10,439,448**	**10,439,448**	**-**
Engineering							
Narrowbanding	1,300,000	1,532,772	284,714	-	1,817,486	1,817,486	-
Microwave Modernization	17,750,000	18,468,867	1,692,867	(1,280)	20,160,454	20,160,454	-
Trunking	1,850,000	9,299,376	1,113,582	90,996	10,503,953	10,503,953	-
Interoperability	-	3,064,792	(1,690,685)	-	1,374,107	1,374,107	-
Partnerships		410,155	(50,321)	-	359,835	359,835	-
Engineering Subtotal	**20,900,000**	**32,775,962**	**1,350,157**	**89,716**	**34,215,835**	**34,215,835**	**-**
Integration Training							
Integration Training	-	500,000	(350,000)	(14,709)	135,292	135,292	-
Integration Training Subtotal	**-**	**500,000**	**(350,000)**	**(14,709)**	**135,292**	**135,292**	**-**

State Radio Project Totals							
Narrowbanding	42,600,000	34,107,101	781,550	335,356	35,224,007	35,224,007	-
Microwave Modernization	92,600,000	68,572,892	3,156,088	284,503	72,013,483	72,013,483	-
Trunking	8,500,000	36,141,301	2,614,108	(1,036,018)	37,719,390	37,719,390	-
Interoperability	2,300,000	5,364,792	(1,690,685)	(187,648)	3,486,460	3,486,460	-
Partnerships	10,400,000	10,879,957	(80,674)	(0)	10,799,283	10,799,283	-
Integration Training	-	500,000	(350,000)	(14,709)	135,292	135,292	-
Phase Subtotal	**156,400,000**	**155,566,043**	**4,430,388**	**(618,516)**	**159,377,915**	**159,377,915**	**-**
Project Management	-	15,069,054	(839,638)	1,957	14,231,373	14,231,373	-
Project Management (Limitation 010)	-	-	-	-	967,511	967,511	-
Project Contingency Reserve	-	3,852,259	(2,951,394)	616,559	549,913	-	549,913
Total State Radio Project	**156,400,000**	**174,487,356**	**639,356**	**-**	**175,126,712**	**174,576,799**	**549,913**
Old OWIN Program							
Spending	45,000,000	49,256,733	(639,356)	-	48,617,377	48,617,377	-
Treasury Loan	8,000,000	6,247,831	-	-	6,247,831	6,247,831	-
Total Old OWIN	**53,000,000**	**55,504,564**	**(639,356)**	**-**	**54,865,208**	**54,865,208**	**-**
Grand Total	**209,400,000**	**229,991,920**	**-**	**-**	**229,991,920**	**229,442,007**	**549,913**

Acknowledgements

The radio project management team expresses its appreciation to the men and women who provided their expertise, time, and dedication to making the project a success. The interdependencies involved in this project required coordination and collaboration among its many participants, each of whom provided significant contributions.

The radio project would not have been successful without the work of its dedicated **staff**, including those from the **Contracting Services and Communications units of ODOT's Major Projects Branch**. This cross-functional team made sure that work was completed, contracts were executed, bills were paid, assets were tracked and progress captured and shared.

The **Wireless Communications Section** staff provided countless hours. It was through their passion, dedication and technical expertise that much of the work was completed. Their high standards for excellence and unwavering commitment to their customers resulted in an enhanced, serviceable communications system that will support ODOT Maintenance personnel and OSP Troopers for years to come.

Appreciation is certainly due to our **consultants** and **contractors**—both prime and sub—for their expertise. The consultant teams were diverse and brought needed skill sets to the project such as development of the microwave design, technology implementation, site project management, and the support functions of scheduling, stakeholder and risk management. The prime and sub-contractors for the radio project provided the muscle to bring the State Radio System to a new level of excellence. Thank you all for your contributions.

The management team would like to extend its appreciation to Maj. Joel Lujan of the **Oregon State Police** for dedicating resources to ensure the radio project's success. Maj. Craig Durbin and Lt. Jim Rentz were integral to the deployment of the new mobile and portable radios to the agency, while Jerry Martin provided technical expertise needed to ensure the console redesign and implementation met OSP's needs.

Thank you to our **local partners** and **Oregon Emergency Management** for your willingness to place your trust in the project team to deliver on the state's commitments.

The partnership with **State Interoperability Executive Council**, under the leadership of Chief Rock Rakosi, provided direction to support to the radio project's interoperability initiatives and goal fulfillment. Your commitment to and activism for the public safety sector is second to none. Thank you for allowing us a seat at the table.

A special thank you is owed to our oversight groups including the **Joint Legislative Committee on Information Management and Technology**, the **Legislative Fiscal Office** and the **Oregon Department of Administrative Services Enterprise Shared Services Quality Assurance Section** for its guidance throughout the project.

Lastly, we would like to extend our utmost appreciation to our project sponsor, **Tom Lauer**. Without his steadfast leadership, the radio project surely would not have been as successful as it was. Tom's dedication and strategic vision allowed the project to re-scope its purpose and charge forward toward completion.

Thank you all for your commitment and your effort.

Kind regards,

State Radio Project Management Team

— Dick, Lisa, Rob, Joe, Paul and Gail

Consultants

AECOM

Black & Veatch, Corp.

DPS Telecom

Federal Engineering, Inc.

General Dynamics, Corp.

Harris Corp.

HDR Engineering, Inc.

JLA Public Involvement

Legacy Wireless Services, Inc.

OBEC Consulting Engineers

Pantel International

Public Knowledge, LLC.

Science Applications International Corp.

Prime Contractors

ABN Engineering

Adcomm Engineering Company

Advanced Wireless Solutions, Inc.

Alcatel-Lucent

American Power Systems, LLC.

Axis Crane

Azimuth Communications, Inc.

Cellsite Solutions, LLC.

Christenson Electric, Inc.

Complete Wireless Solutions

Consumers Power Inc.

Cummins Inc.

Day Wireless

Digital Solar Technologies

Elk Mountain Construction

Excel Construction, Inc.

F & W Fence Company

Grain Communications

Hamon Construction, Inc.

Heil Electric

HP Civil, Inc.

HPS Construction, Inc.

Hunter Communications

Iron Triangle, LLC.

Joe Floyd & Sons, Inc.

KDS Electric, LLC.

Legacy Telecommunications, Inc.

Michael Becker General Contractor, Inc.

Miller's Tree Service, Inc.

Northside Electric

NorthSky Communications

Oldcastle Precast

Oregon Connector Co.

Patriot Tower, Inc.

PCR, Inc.

Pilgrim Communications, Inc.

Portland General Electric

RFI Americas, Inc.

Sabre Industries

Santiam Electric, Inc.

Shepherd Industries

Silke Communications, Inc.

Summit Solutions Group, LLC.

Tempest Telecom Solutions

Tornado Soft Excavation, LLC.

Tower Time Wireless

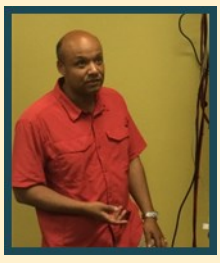
Valmont Structures

VB Construction

Wolden Struct Engineering

Xtreme Communications

Acknowledgements: Staff in Action




Wireless Communications Section
WORK ORDER DESK

Sites by County

Baker County

Baker City Maintenance
Baker City Patrol Office
Baker Scale
Beaver Mountain MW
Beaver Ridge OSP
Elkhorn Mountain MW
Halfway Hill
Lime Hill MW
Lone Pine MW
Richland Maintenance
Summit Point
Whitney Sand Shed

Benton County

Corvallis Maintenance MW
Mary's Peak MW
OSU Patrol Office
Vineyard Hill
Wren Peak

Clackamas County

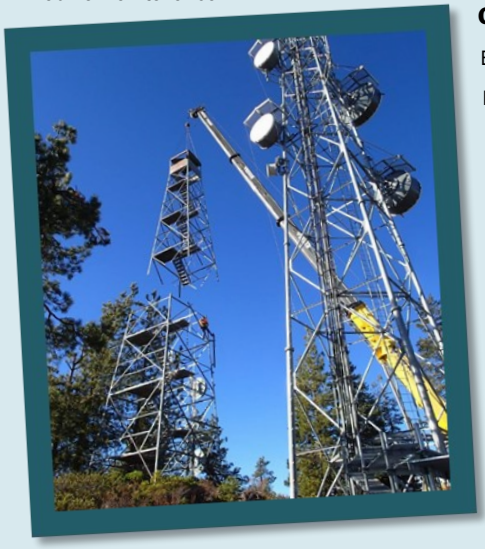
Brightwood
Coffee Creek, DOC – Wilsonville
Estacada Maintenance
Goat Mountain
Government Camp Maintenance
Government Camp Patrol Office
Lawnfield District Maintenance MW
Linhart Butte
Milwaukie Maintenance MW
Mount Hood (Timberline)
Mount Scott MW (District 2B)
PCC Patrol Office
Petes Mountain
Portland Patrol Office
Sand Shed (District 2C)
Sandy maintenance
Suncrest MW
Timberline C800

Clatsop County

Astoria Area Manager PM
Astoria District Office 1
Astoria MW
Astoria Patrol Office
Camp Rilea
District 1 Bridge Crew
Double Peak
Humbug Maintenance
Nicolai Mountain MW OSP
Seaside 911
Tillamook Head
Warrenton MW
Warrenton Maintenance
Wickiup Mountain MW

Columbia County

Clatskanie Maintenance
Clatskanie Mountain
Rainier MW
St. Helens patrol Office



Coos County

Baldy Butte (Coos Bay)
Bandon BPA
Bennett Butte MW
Blue Ridge North
Coos Bay Maintenance MW
Coos Bay Patrol Office
Coquille Maintenance MW
Davis Slough Maintenance (Coos Bay)
Four Mile
Noah Butte
Signal Tree (Ram Cell)
Signal Tree MW

Crook County

Barnes Butte
Grizzly Mountain MW (Crook)
Powell Butte
Powell Butte Vista
Prineville Maintenance
Prineville Patrol Office

Curry County

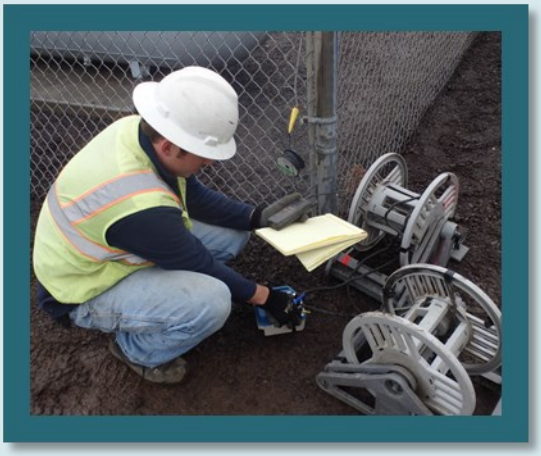
Black Mound
Bosley Butte
Cape Blanco
Cape Blanco (Curry)
Carpenterville
Curry County Courthouse
Edson Butte
Gold Beach Maintenance (Hunters Creek)
Gold Beach Patrol Office
Harbor Hill
Iron Mountain
Port Orford Maintenance

Deschutes County

Awbrey Butte
Bend District Office 10
Bend maintenance MW
Bend patrol Office
Brothers Maintenance
Deschutes County 911
Five Mile
La Pine Maintenance
Long Butte
Long Butte ODOT
Mount Bachelor
OSP East Headquarters
Pine Mountain MW
Region 4 TOC (Bend)
Sisters Maintenance
Sugar Pine
Wampus Butte
Wanoga Butte
Wanoga Sand Shed

Douglas County

Boswell Springs Maintenance
Canyonville Maintenance
Chilcoot Mountain
Cinnamon Butte
Cougar Pass



Dean Mountain
Debris Hwy 38 Dean Mountain Road
Debris Hwy 38 Scottsburg
Dodson Butte MW
Elkton Ridge
Harness Mountain (LCSO)
Harness Mountain MW
Lemolo Sand Shed
Mount Nebo
Red Butte
Reedsport Maintenance
Roman Nose
Rose Hill
Roseburg Maintenance (Shady) MW
Roseburg Patrol Office
Roseburg Region 3 Office
Scott Mountain (Douglas)
Steamboat Maintenance
Yellow Butte

Gilliam County

Arlington Maintenance
Arlington Patrol Office

Condon

Condon Maintenance

Grant County

Aldrich Mountain

Austin Maintenance

Dixie Butte

Fall Mountain MW

John Day MW Airport

John Day Maintenance/Canyon City

John Day Patrol Office

John Day Scale

Tamarack Mountain

Harney County

Beatys Butte

Best Lane

Burns Butte MW

Burns Maintenance

Burns Patrol Office

Devine Ridge MW

Doherty Slide

Dry Mountain

Jack Mountain

King Mountain

Steens Mountain

Stinkingwater Pass Sand Shed

Wagontire Mountain

Hood River County

Cascade Locks Maintenance

Cascade Locks POE

Debris I-84 MW Cascade Locks

Hood River (CRITFC)

Hood River 911

Middle Mountain (ODOT)

Middle Mountain (US Cellular)

Parkdale Maintenance

Jackson County

Ashland Maintenance

Ashland POE

Central Point Maintenance

Halls Point

Lincoln Maintenance Sand Shed

Mount Ashland

Mount Isabelle

OSP SW Headquarters

Prospect Maintenance

Region 3 TOC (Central Point)

Robinson Butte

Roxy Ann Mountain MW

SCC/Central Point Dispatch/SW HQ

Siskiyou Summit Fill

Siskiyou Summit Sand Shed

Soda Mountain MW

Starveout Mountain MW

Table Mountain (Jackson)

Table Mountain BLM (Jackson)

While City Maintenance District MW

Jefferson County

Agency Plains

Deer Ridge, DOC – Madras

Gray Butte

Madras Maintenance

Madras Patrol Office

Stephenson

Josephine County

Debris US-199 Road Closure

Eight Dollar

Fiddler Mountain

Grants Pass Maintenance

Grants Pass Patrol Office

Old Stage Road

Onion Mountain

Sexton Mountain MW

Klamath County

Applegate Butte

Chemult Maintenance

Chiloquin Maintenance

Gilchrist Patrol Office

Hamaker Mountain (KCSO)

Hamaker Mountain ODOT

Hogback Mountain

Klamath Falls MW

Klamath Falls Maintenance

Klamath Falls Patrol Office

Klamath Falls POE

Lake of the Woods Maintenance

Medicine Mountain MW

Odell Butte

Odell Lake Maintenance

Pelican Butte

Swan Lake Point

Walker Mountain MW (Klamath)

Lake County

Adel Maintenance

Adel Remote (Fish Rim)

Alkalai Lake Maintenance MW

Black Cap

Glass Butte BPA

Glass Butte MW

Grizzly Peak MW (Lake)

Lakeview Maintenance MW

Lakeview Patrol Office

Picture Rock MW

Round Pass

Silver Lake Maintenance

Lane County

Bear Mountain

Blanton Heights

Buck Mountain MW

Dead Mountain

Florence Maintenance

Florence Patrol Office

Glenada Ridge

Glenwood Maintenance

Sites by County

Goodwin Peak
Herman Peak
McKenzie Bridge Maintenance
Mount Hagan
Oakridge Maintenance
Oakridge Patrol Office
Prairie Peak MW
Quarry Hill
Springfield District Office MW
Springfield Patrol Office
Table Rock (Lane)
Veneta Maintenance
Vida
Walker Point (Lane)
Wallace Butte
Wolf Mountain (ATT)
Wolf Mountain

Lincoln County

Cape Perpetua
Cape Perpetua (Lincoln)
Euchre Mountain
Lincoln County
Newport Patrol Office
Ona Beach Maintenance
Rose Lodge Maintenance
Saddlebag
Table Mountain (Lincoln)
Yaquina Head MW

Linn County

Albany Maintenance
Albany Patrol Office
Cascadia
Green Peter
Green Peter ODOT
Hoodoo Butte ATC
Hoodoo Butte MW
McCully Mountain
Santiam Junction Maintenance
Scott Mountain Lookout (Linn)
Snow Peak
Sweet Home Maintenance
Washburn Butte

Malheur County

Basque Maintenance
Black Butte (Juntura)
Blue Mountain
Cottonwood Mountain MW
Coyne Ridge
Farewell Bend POE
Jordan Valley Maintenance
Jordan Valley Patrol Office
Juntura Maintenance
Mahogany Mountain
ODOT District 14 Office
Ontario District Office 14
Ontario Maintenance MW
Ontario Patrol Office
Pharmacy Hill
Snake River, DOC – Ontario
Succor Creek Summit Fill
Vale Butte MW
Vale Maintenance
Vale, District 14 Bridge Crew

Marion County

Anderson Readiness Center
Capitol Mall Patrol Office
Detroit Maintenance
Halls Ridge
ODOT T-Building MW
Oregon Department of Forestry
Oregon Emergency Management
Oregon Motor Carrier HQ
Oregon State Fire Marshal
Prospect, Lower (Hill) MW
Prospect, Main MW
Region 2 TOC (Salem)
Salem, Battery Room
Salem, District 3 HQ
Salem, District Office 3
Salem, Facilities
Salem, Maintenance
Salem, Materials Lab
Salem, OSP Office MW
Salem, Patrol Office
Salem, PM & Sign Shop
Salem, Radio Building D
Salem, Region 2 Electrical Building T
Salem, Region 2 Striping
Salem, Region EOC/HQ, Building B
Salem, Repair Shop, Building M
Salem, State Radio Project
Salem, Transport Services Building K
Salem, Wireless Building C
State Fairgrounds
State Penitentiary, DOC – Salem
Wipper MW
Woodburn Maintenance
Woodburn POE

Morrow County

Black Mountain (OSP)
Black Mountain MW
Boardman
Gleason Peak
Heppner Maintenance
Heppner Patrol Office
Jordan Butte
Wilkinson Hill

Multnomah County

200 Market
Ashforth Building (CRITFC HQ)
Baldock Maintenance
Barlow Maintenance MW
Council Crest
Debris I-84 MW Troutdale
East Portland Maintenance
Fremont Bridge MW
Interstate Bridge / Jantzen Beach
Lookout Point

Multnomah MW System

North Portland, Parkrose Maintenance

Portland Bridge Office

Portland Region 1 Office

Region 1 TOC (Portland)

Sylvan District Office Maintenance MW

Troutdale District Office Troutdale Maintenance MW

Willatin Tank

Polk County

Bald Mountain (Polk)

Doane Creek

Eagle Crest

Grand Rhonde Maintenance

Sherman County

Moro Maintenance

Tillamook County

Cape Lookout (L190)

Cape Meares

Debris Field Hwy 6 Tillamook

Neahkahnie

Tillamook Clatsop Connection

Tillamook DMV Maintenance MW

Tillamook Patrol Office

Wilson River MW

Umatilla County

Bone Point

Cabbage Hill (CTUIR)

Cabbage Hill (US Cellular)

Cabbage Hill MW

Cold Springs Scale House

Coombs Canyon

Hermiston Maintenance

Hermiston Patrol Office

Lorenzen Road (Exit 198)

Meacham Maintenance

Milton Freewater Patrol Office

Mount Weston

Mount Weston (Broadcast Building)

Pendleton East

Pendleton Justice Center

Pendleton Maintenance MW

Pendleton Patrol Office

Two Rivers, DOC – Umatilla

Ukiah Maintenance

Umatilla POE

Umatilla Ridge

Whitmore Road

Union County

Elgin Maintenance

La Grande Maintenance MW

La Grande Patrol Office

La Grande Scales

Ladd Canyon

Mount Emily MW

Mount Fanny

Spout Springs Fill

Wallowa County

Devil's Ridge

Enterprise Maintenance

Enterprise Patrol Office

Flora Fill Station

Howard Butte

Mount Howard

Wallowa Visitor Center

Wasco County

Criterion Summit MW

Foremans Point

Hulse Ranch MW

Kaser

Maupin Maintenance

Shaniko

Shaniko Tanager

The Dalles East (US Cellular)

The Dalles Maintenance MW

The Dalles Patrol Office

Tygh Ridge

Warm Springs Maintenance

Wasco Butte MW

Washington County

Banks Patrol Office

Beaverton Area Manager PM

Buxton Mountain MW

Cedar Hills

Debris Field Hwy 6 Banks

Gales Peak

Manning Maintenance

North Plains Patrol Office

Round Top

South Saddle Mountain

Tualatin Patrol Office ■

Oregon Department of Transportation

State Radio Project