OREGON WIRELESS INTEROPERABILITY NETWORK (OWIN) PROJECT

Implementation Plan
(Deliverable 13-A)

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Executive Summary

This *Implementation Plan* describes an approach to deploy the Oregon Wireless Integrated Network (OWIN). The purpose of this *Implementation Plan* is to identify the major activities required to construct OWIN in a logical and systematic manner.

OWIN will be composed of several subsystems. A backhaul system composed primarily of microwave is required to connect every site together into a complete network. The primary radio system will be the Project 25 (P25) trunked radio subsystem. Federal Engineering (***FE***) bases this plan on earlier work that has divided the OWIN P25 trunked system into three distinct geographic areas, and two different frequency bands. Each area will use one primary frequency band. Some sites have trunked Very High Frequency (VHF) channels, other sites have trunked 700 MHz channels, and a few sites will have both VHF and 700 MHz channels.

Most of the mobile units operating in the trunked radio system will be equipped with a mobile radio and a portable radio. The mobile radio may connect to a vehicular repeater.

Since the P25 system is a digital network it carries a continuous data stream. This allows it to transport low speed data for some mobile computer applications. In the areas that will have 700 MHz for their radio system, higher speed applications will be available on a separate 700 MHz high speed data system that will be installed at all of the 700 MHz sites.

There will also be a shared conventional radio subsystem serving the needs of the OWIN agencies including the Oregon Department of Forestry (ODF). This system will use two P25 conventional VHF repeaters at each OWIN radio site. Additionally, there will be a repeater on each site that is presently an ODF radio site to replicate the current ODF system coverage specifically for the use of ODF and their cooperators.

To provide interoperability among all public safety radio users in Oregon, an interoperability subsystem will have a mix of repeaters and simplex channels located at selected sites.

Because of their centralized type of dispatch, the Oregon State Police (OSP) and Oregon Department of Transportation (ODOT) will have new dispatch consoles installed in their dispatch centers. The Oregon Department of Forestry (ODF) and the Oregon Department of Corrections (DOC) will be equipped with appropriate dispatch equipment at each of their facilities.

The creation of such a complex system as OWIN will take, at a minimum, three biennia to complete. Although the State suggested a three-phase approach to implementation, ***FE*** recommends a slightly different approach. We believe that preparatory work should take place prior to the first phase of radio site implementation. For that reason, ***FE*** expanded the concept of the State's three phases, creating an additional phase (Phase 0), which includes a series of activities that would be completed prior to what the State defined in Phase 1. Phase 0 would install new dispatch center consoles, the trunking and P25 controllers, the interoperability matrix and the microwave system connecting these components prior to the fist phase of OWIN. A more detailed explanation of this process is included in this report.

The complexities of the OWIN radio project, promise to challenge the best Project Team that Oregon can offer. The ability to adjust appropriately and effectively remains crucial. It is for that reason that ***FE*** recommends that OWIN maintain a separate and independent Project Manager to work in concert with OWIN Staff and the eventual vendor who will build OWIN. Additionally, due to the investment, size, complexity, and nature of this project, ***FE*** also recommends the use of a structured system development lifecycle approach, coupled with a comprehensive project management/quality assurance methodology, to assist the Project Manager, OWIN and the legislature support and monitor the activities of this project.

The above tasks and their approximate costs are summarized in the following table:

Phase	Area	Summary of Work	Cost	Time
0	Preparatory work - Northeastern Oregon	Dispatch centers, system controllers, interoperability matrix, loop microwave to connect the Phase 1 sites, Phase 1 subscriber units, Phase 1 site upgrades	$147,000,000	1 Yr
1	Preparatory work - Southern Oregon Implementation work - Northeastern Oregon	Radio installation in Phase 1 sites, Upgrade of Phase 2 sites, microwave to spur Phase 1 sites, loop microwave to Phase 2 sites, Phase 2 subscribers	$161,000,000	1 Yr
2	Preparatory work - Northwestern Oregon Implementation work - Southern Oregon	Radio installation in Phase 2 sites, Upgrade of Phase 3 sites, microwave to spur Phase 2 sites, loop microwave to Phase 3 sites, Phase 3 subscribers	$166,000,000	2 Yrs
3	Implementation work - Northwestern Oregon Project completion and quality assurance - Statewide Oregon	Radio installation in Phase 3 sites, microwave to spur Phase 3 sites, system testing	$191,000,000	2 Yrs

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1.0 Introduction

The Oregon Wireless Interoperability Network (OWIN) project has progressed through the following steps:

- Selecting Federal Engineering, Inc. (***FE***) as the State's consultant
- Performing a needs assessment
- Studying the State's radio sites
- Studying the radio coverage from theses sites
- Performing a frequency assessment
- Developing a channel plan
- Selecting the frequency bands and technology to use

FE completed work to develop a conceptual microwave system and radio design for OWIN. These conceptual designs provide the basis for determining a budgetary estimate and provide insights into the implementation process.

This report is the *Implementation Plan* for the OWIN project. The statement of work (SOW) describing the implementation planning work calls for a high level plan to build out the system and to migrate users onto the new system. The State defined an implementation process of three phases as follows:

Phase 1 - east of the Cascade Mountains
Phase 2 - southwestern Oregon
Phase 3 - northwestern Oregon

The SOW requires that the plan for each phase will include the estimated costs and schedule for build-out of the three major components: supporting infrastructure (buildings, towers, etc.), microwave system, and radio system. Major milestones will include, as required:

- Frequency coordination and licensing
- Site acquisition and permitting
- Communications and coordination with impacted system users
- Opening contract discussions/negotiations with vendor(s)
- Completing contract discussions/negotiations with vendor(s)
- Site preparation
- Construction of site infrastructure
- Equipment procurement
- Factory testing
- Inventory database generation and control
- System staging

- Start of installation and programming
- Site inspection and testing
- Completion of installation and programming
- Testing and preliminary acceptance
- Subscriber loading
- Testing and full system acceptance
- Documentation and “as built” drawing review
- Operation, maintenance, and subscriber training

The SOW also requires that the implementation plan include a high-level discussion of the migration strategies for each of the state’s radio owning agencies to the new architecture for each implementation phase.

This *Implementation Plan* will review the OWIN conceptual designs. It will then examine the phased approach recommended for OWIN. Then we will develop a phase-by-phase implementation plan, followed by a summary of the costs for each phase.

2.0 OWIN conceptual design

OWIN is composed of multiple subsystems, forming a system-of-systems design. In some cases, we describe and discuss these subsystems as if they were completely independent. Yet in other cases, the functionality of one subsystem is so closely related to another that their points of separation can become blurred.

2.1 Site infrastructure subsystem

The towers, equipment shelters, power systems including emergency generators form the fundamental subsystem that will support, house and power the electronic subsystems. The site infrastructure must be in place and ready for service before the microwave and mobile radio equipment is installed, turned-up and tested.

2.2 Microwave subsystem

The backbone of OWIN is the microwave subsystem. This subsystem will connect every site together to form a complete network. While it is possible to deploy other types of digital networks to connect sites together, ***FE*** recommended the use of digital microwave because experience has shown that it is typically more functional, reliable and economically viable for remote applications.

2.3 Primary radio subsystem

The primary radio system will be the P25 trunked radio subsystem. This subsystem meets the requirements of the Project 25 (P25) standard, making it compatible with equipment from multiple vendors. This portion of the system will be trunked, meaning that it uses a pool of channels for all users, and when a conversation starts, the system automatically assigns a channel for it. This is in contrast to today's system where dedicated channels are used for individual agencies and where secondary channels are usually not available to handle a second conversation.

2.4 VHF and 700 MHz P25 hybrid subsystems

The proposed plan divides the OWIN P25 trunked system into two areas using a different frequency band in each area. As presented in previous reports, Very High Frequency (VHF) (150-174 MHz) has greater range and provides the greatest coverage, but there are not enough VHF channels available to use throughout the State. The 700 MHz band, recently released for the public safety licensees, has sufficient frequencies, but provides less coverage and requires many more sites. ***FE*** designed a hybrid system of both VHF and 700 MHz bands to make best use of 257 radio sites. Some sites have trunked VHF channels, other sites have trunked 700 MHz channels, and a few have channels in both bands. Some of the trunked VHF channels use simulcast to improve coverage and reduce the frequency requirements. There are sixteen VHF simulcast groups varying in size from two to six radio sites. Within each group, all the sites use the same channels. Each site or simulcast group will use between four and eight channels.

Most of the vehicles operating in the trunked radio system will be equipped with one of several configurations of a mobile radio and a portable radio. In the typical configuration, the mobile will be on the primary band (VHF or 700) for the units normal operating area. The portable will be on the other band and will rest in a charger unit allowing it to function as a mobile radio. The mobile will connect to a vehicular repeater. The vehicular repeater will operate on the same band as the portable radio and when the portable radio is taken out of the car, the vehicular repeater will relay its transmission through the mobile radio into the trunked system.

2.5 Low speed and high speed data subsystems

Since the P25 system is a digital network, it carries a continuous data stream, and can carry low speed data for mobile computer applications. This low speed data can be used for form-based, information look-up and filing, but is not fast enough to carry web and image based applications. The P25 data requires minimal equipment connected to the mobile radio and will provide data coverage wherever the P25 voice network works.

For higher speed applications, a separate 700 MHz high speed data system will be installed in the sites supporting the 700 MHz portion of the P25 trunked system. This network will carry applications that are more demanding and this network also requires an additional radio and computer components in each equipped vehicle.

2.6 VHF conventional subsystem

OWIN also contains a VHF conventional subsystem. This subsystem has two components.

The first component is a radio subsystem designed to serve the Oregon Department of Forestry (ODF). This component will have a repeater on each OWIN site that is, or is close to, an existing ODF radio site. This approach will achieve coverage equal to ODF's present system in their service areas. It will also retain compatibility with the federal agencies and other agencies with whom ODF interoperates.

The second component is two, statewide, conventional repeater channels located at each OWIN site to provide ODF and other OWIN state users with a means for local tactical or statewide coordination efforts.

2.7 Interoperability subsystem

To provide interoperability among all radio users in Oregon, an interoperability subsystem will have repeaters at selected radio site. This system will implement several national interoperability channels, including VHF channels, UHF channels, and 800 MHz channels. These channels will operate in both the analog and the digital modes to enable any agency using any type of system to use theses channels. Nationwide calling channels will be operated only in the analog mode. These channels, as well as channels and talkgroups from other subsystems, will connect to an interoperability matrix switch that will permit any channel to connect to any other channel. Remote computer terminals at various dispatch centers will provide control of the switch.

2.8 Dispatch subsystems

The Oregon State Police, Oregon Department of Forestry, and Oregon Department of Transportation will have new dispatch consoles installed in their dispatch centers.

Additionally, where appropriate, installation of additional radios will enable OSP dispatch centers to communicate with the Department of Corrections.

3.0 Alternative implementation approaches

The installation of a massive system such as OWIN will take multiple biennia to complete. To attempt to rush this process would require many people all working in parallel on every aspect of the system. This would result in little consistency in installation technique and many different levels of expertise all trying to do the same type of work and testing. A phased approach for implementation permits an orderly systematic process with a realistic number of installers and testers.

The statement of work (SOW) describing the implementation planning work calls for three phases as follows:

- Phase 1 -- east of the Cascade Mountains
- Phase 2 -- southwestern Oregon
- Phase 3 -- northwestern Oregon

There are many alternative phasing approaches possible for this implementation. Each approach entails a different way of dividing the sites and infrastructure into manageable pieces of work. What must be considered at a minimum to determine an acceptable approach is; the locations of the sites, the routing of the microwave, the installation of and connection to the dispatch centers and any central control equipment, and the installation of new mobile equipment.

3.1 Recommended approach

Although the State did suggest the above approach, it allowed ***FE*** to develop an alternative approach, providing that we can demonstrate additional efficiencies. ***FE*** believes that the State's approach is feasible. However, we recommend modifying that approach in two ways. First, we believe that there are activities that must take place prior to the installation of mobile radio equipment in Phase 1 sites. To accommodate activities we recommend the adoption of a preparatory "Phase 0 (Zero)". This "Phase 0" or "Pre-Phase 1" work will greatly improve the workflow and immediate value of the implementation phases that follow. Secondly, we believe that the division of the implementation areas slightly differently than originally suggested by the State to better align the infrastructure build out process. The approach recommended is as follows:

Phase 0 – Preparatory Infrastructure
Phase 1 -- Northeastern Oregon
Phase 2 -- Southern Oregon
Phase 3 -- Northwestern Oregon

The OWIN radio sites included in phases 1 thru 3 are shown on the following map, Exhibit 3.1, Map of implementation phases.

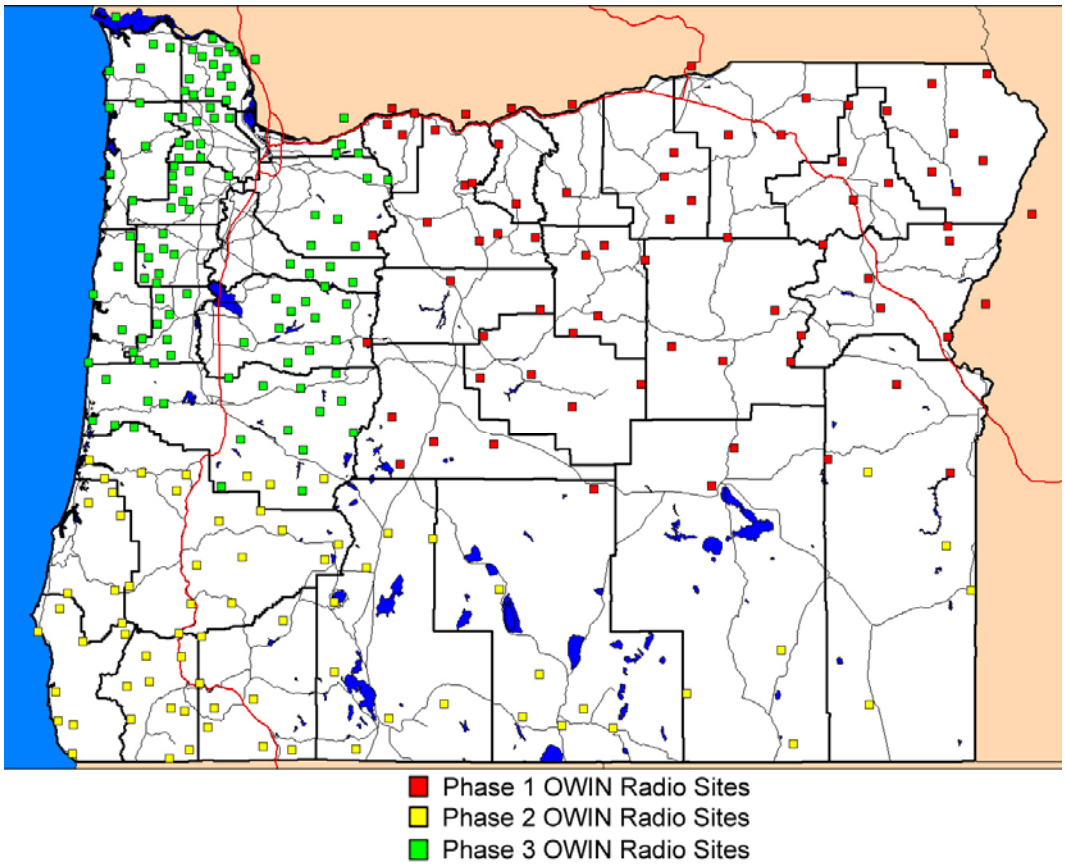

Exhibit 3.1 -- Map of implementation phases

The recommended phase approach deploys 257 mobile radio sites in three phases. However, we recognize that before installing the first mobile radio site, other work activities must be completed. The most obvious is the preparation of the radio sites. Many of the radio sites require new towers, new generators, or improvements to the site infrastructure. It is important to complete these improvements prior to the installation of the radio system equipment.

The radio system is highly dependent upon the control given by centralized controllers. These controllers are located at two locations. Installation of these controllers must occur before any portion of the trunked mobile radio system can be put into use. Similarly, the existing consoles cannot operate the new radio systems. Before turning on the new system, new equipment consoles must be available. The new consoles can operate with the existing radio systems, allowing them to be implemented in Phase 0 and used to smooth the transition in future phases.

As all of the radio subsystems will connect into the interoperability subsystem controlled by a centralized matrix switch, it too must also be ready prior to activating the new radio sites.

The subsystems listed above connect to each other and to the mobile radio base stations by the microwave system. Before the radio system can be put to use, the microwave links connecting the centralized controllers and interoperability matrix switch must extend to each of the radio sites. Loop and backbone microwave deployment will occur in the phase prior to deployment of the radio system equipment is a particular area. Spur microwave route construction will occur during the deployment phase.

Phase 0 will see the infrastructure completed to allow activation of Phase 1 mobile radio sites as they are installed. The dispatch consoles, the interoperability matrix, the central controllers, and the loop microwave network as needed to connect Phase 1 sites will be installed, tested, and placed in operation. Spur route radio sites will be upgraded as necessary. Additionally, ***FE*** recommends purchasing and installing the new mobile and portable radios for the operations fleet that make use of the radio systems in the Phase 1 region. These radios will be programmed to operate on the existing radio system and the new system aiding in a smooth transition.

Phase 1 would see the installation of the radio sites in the northeastern section of the State and the completion of site infrastructure served by Phase 1 spur microwave routes. Also during Phase 1, the loop microwave sites needed for Phase 2 will be constructed or upgraded and the microwave network will be extended to those sites. Similar to the activities during Phase 0, subscriber mobile and portable radios will be installed for the units operating on the Phase 2 portion of the system.

Phase 2 would see the installation of the mobile radio sites in the southern portion of the State and the completion of site infrastructure served by Phase 2 spur microwave routes. During Phase 2, the sites needed for the Phase 3 loop microwave will be constructed or upgraded and the microwave network will be extended to those sites. Subscriber mobile and portable radios will be installed in the units serving the Phase 3 area, completing the subscriber equipment installation.

Phase 3 will implement the mobile radio sites in the northwestern section of the State and the completion of site infrastructure served by Phase 3

spur microwave routes. Complete system testing will follow the implementation work.

The specific sites recommended for each phase are shown in Appendix A - *Radio Site Implementation Phases*. This appendix also shows the quantity of channels, repeaters, base stations, and other equipment the sites in each phase. These quantities are summarized in Exhibit 3.1 - Summary of site data per phase.

Equipment	Phase 0	Phase 1	Phase 2	Phase 3
Sites for radio install		73	72	112
Sites to be constructed, reconstructed, or upgraded	54	83	73	95
Microwave hops	56	91	74	95
Dispatch Centers	6			
Central Controllers	2			
Interoperability Switch	2			
Subscriber mobiles	3165	1583	1583	
Subscriber portables	3305	1653	1652	
Simulcast Zones		8	6	2
VHF Simulcast Trunked Repeaters		113	100	46
VHF Trunked Repeaters		222	99	81
700 MHz Trunked Repeaters		32	172	666
Total Trunked Channels		363	375	793
700 MHz Hi Speed Data Radio		6	33	95
VHF ODF Base Stations		14	25	16
VHF P25 Conventional Stations		148	142	224
VHF Interoperability Stations		90	74	60
UHF Interoperability Repeaters		69	55	57
800 MHz Interoperability Repeaters		73	54	52

Exhibit 3.1 - Summary of site data per phase

Throughout each of these phases, OWIN would coordinate with other communications system projects that are in planning or in deployment. This includes the Federal Integrated Wireless Network (IWN) program, the communications systems of the many Oregon counties and municipalities, as well as the communications systems of the adjoining states. This coordination may cause adjustments to the plans and schedules of each phase, but will assure a higher level of functionality when completed.

3.2 Rationale and assumptions for the approach selected

FE explored several implementation scenarios. As stated above there are many ways to divide the work into manageable pieces. Some of the scenarios we investigated include:

- Changes in the order of the defined phases
- Different divisions of regions
- Technology based phases, i.e. 700 MHz followed by VHF regions

FE believes that the recommended implementation phasing approach to be more feasible than the State's suggested approach due to the planned configuration of the microwave network. When the State suggested its phases, the backbone network configuration was not developed, and many of the infrastructure necessary upgrades were unknown. The recommended phasing incorporates logical engineering assumptions that were impossible to know until the frequency planning, the radio conceptual design, and microwave conceptual design were completed. We describe these assumptions and considerations in the following paragraphs.

The State's Phase 1 included the eastern half of Oregon. The State assumed that the eastern sites would include the fewest number of channels and the lowest subscriber count. This assists in the easing of early transition issues. ***FE***'s recommended Phase 1 will implement even fewer sites. The reduced number of channels, sites, and users will allow the accomplishment of testing and debugging more easily than in areas with more sites. Further, this section of the State has less complex microwave routes and fewer new sites, allowing implementation and testing to begin more quickly. The State also reasoned that the eastern part of the State is in the most need for an upgraded radio system. ***FE*** agrees, and selected the northeastern section as the first area for infrastructure improvement and the installation of OWIN. The required routing of the microwave loop also validated this recommendation.

Similarly, the State's Phase 2 was also a less populated area of the State. This southwestern section of the State also has lower quantities of sites and subscribers, making installation and testing easier than the northwestern section. ***FE*** recommends the entire southern portion of the State be included in Phase 2. This corresponds closely with another of the proposed microwave loops and keeps the number of sites to implement similar to Phase 1.

The Phase 3 area is very similar for both the State's and ***FE***'s implementation approach. This area will be the most complex to implement, with many new sites, double the number of channels than the other two phases, with most being 700 MHz channels. It is in the most densely populated area of the State. However, by the time, OWIN is ready to implement Phase 3, the other phases will have provided the vendor the experience to handle these more complex issues in a more efficient manner.

Although Phase 3 is the most complex work in this project, it will include significantly less microwave and backbone site improvement tasks, since that work would have been completed in previous phases. There are still a significant number of spur route sites to be completed in this phase. This phase also includes spur microwave routes to serve terminal locations currently service by the existing microwave system that will need to connect to the new microwave system. Service to those existing non-core terminal locations must be established to allow the removal of the old microwave system. The ***FE*** plan allows for a workload balance over four phases that will ensure Phase 3 success.

FE is recommending a Phase 0, prior to Phase 1 that provides for the logical deployment of the loop microwave sites and routes for Phase 1 prior to the deployment of the Phase 1 mobile radio equipment. This concept of having the loop or backbone microwave leading the mobile radio site equipment by one phase permits the completion of the mobile radio system with out delays that could occur with the lack of support systems. These support systems include the switching systems, dispatch capabilities, and the backhaul connectivity needed to support the mobile radio deployment in an area. Construction of mobile radio sites served only by spur microwave routes may occur during the same phase as the mobile radio system deployment in that area because they are not part of the critical backbone communications network. ***FE*** recommends that these spur routes should be constructed early during each phases to prevent delay of the radio system implementation.

FE's recommended approach will provide a logical progression furing the implementation, with prerequisite work performed in the phase before the radio implementation, all the while keeping work loads balanced amongst the phases.

It should be noted that during the proposal stage of the procurement process, the vendors will develop their own implementation schedule and phasing plan. The State will have the ability to approve the plan of the selected vendor, or negotiate an alternative plan.

4.0 The implementation plan

The four phases, Phase 0 through Phase 3, defined in Section 3 comprise the extensive amount of work required to implement OWIN statewide. These phases will begin after the selection of a vendor or vendors. The steps necessary to reach implementation are as follows:

- The State prepares one or more Requests for Proposals (RFP's)
- The State issues the RFP's for bids
- The State conducts pre-proposal meetings answering bidders' questions
- The State issues addendums to the RFP's as needed
- The bidders prepare and submit their proposal(s), including a conceptual design and a high-level implementation plan
- The State evaluates the proposals
- The State may narrow the quantity of bidders
- The bidders make presentations and clarify their proposals
- The State selects one or more bidders as the finalists
- The finalists makes their best and final offer or enter negotiations with the State
- The State awards one or more contracts for the system

Upon execution of a contract, the successful bidder performs the necessary engineering to transform their conceptual design into a detailed design and an implementation plan. This plan will be a step-by-step plan, with time periods defined, to carry out all phases of the implementation.

The following is ***FE***'s recommended implementation plan. Presented here is a generalized, high-level plan that will provide the State and bidders an outline of the tasks that we believe will carry this project to completion.

4.1 Phase Zero—engineering and preparation for radio system

The following activities will be required during Phase Zero to implement the OWIN radio system:

Phase Zero - Engineering and preparation for radio system		
Item #	**Task Name**	**Responsibility**
1	System engineering (detailed design)	Vendor
2	Prepare detailed project implementation plan, including milestones, critical paths, and measurable check points	Vendor

Phase Zero - Engineering and preparation for radio system		
Item #	**Task Name**	**Responsibility**
3	Prepare table of both State and vendor assumptions	Vendor
4	Identify required resources (State personnel, State facilities, access to sites, outside personnel/equipment to meet time frame	Vendor
5	Establish escalation policy & procedures	Vendor
6	Develop and maintain risk register and risk mitigation procedures	Vendor
7	Prepare acceptance test procedures	Vendor
8	Prepare training curriculum	Vendor
9	Prepare site test & approval procedures	Vendor
10	Review of above plans	State
11	Negotiate above plans	State & vendor
12	Approve of above plans	State
13	Perform frequency analysis and planning	Vendor
14	Prepare frequency plan	Vendor
15	Approve Frequency plan	State
16	Acquire sites (all phases)	State & vendor
17	Acquire site permit/agreements	State & vendor
18	Order equipment	State & vendor
19	Establish inventory control procedures	State
20	Status meetings regularly	State & vendor
21	Prepare Frequency Coordination and FCC licensing – microwave and mobile radio	Vendor
22	Approve & submit licensing	State
23	Prepare FCC microwave licensing	Vendor
24	Approve & submit microwave licensing	State
25	Acquire & Prepare Phase 1 sites	State & vendor
26	Upgrade or construct Phase 1 loop sites	Vendor
27	Site inspection & completion tests	Vendor
28	Site tests and inspection approval	State
29	Install microwave links for Phase 0 & 1 and loop infrastructure	Vendor
30	Status meetings regularly	State & vendor
31	Coordinate with impacted users	State
32	Receive Phase 1 mobile radios	Vendor
33	Train Phase 1 subscriber users	State & vendor
34	Install Phase 1 mobiles	Vendor
35	Stage Phase 0 system at factory	Vendor
36	Perform factory testing	Vendor
37	Perform customer testing at factory	State & vendor
38	Receive Phase 0 & 1 Infrastructure	Vendor
39	Stage Phase 0 locally	Vendor

Phase Zero - Engineering and preparation for radio system		
Item #	**Task Name**	**Responsibility**
40	Train dispatchers	State & vendor
41	Install Console common equip	Vendor
42	Install Interoperability matrix switch	Vendor
43	Install Dispatch Consoles	Vendor
44	Install Interoperability control computers	Vendor
45	Install P25 central controllers	Vendor
46	Connect Phase 0 loop microwave to dispatch & control equipment	Vendor
47	Completed portion system testing -functional specifications	State & vendor
48	Completed portion system testing -equipment specifications	State & vendor
49	Completed portion system testing -coverage specifications	State & vendor
50	Failure operation and recovery testing	State & vendor
51	60-day burn-in performance	State & vendor
52	Approval of tests	State

At the conclusion of Phase 0, the dispatch centers will be operational using new consoles and controlling the existing radio channels. The interoperability matrix switch will be installed and may be usable for the existing channels (depends on vendor equipment and interfacing considerations). The constructed microwave system will connect the dispatch centers to the central control equipment and the interoperability switch. The loop microwave network will extend through the Phase 1 region and will have connected roughly 40% of the sites deployed during Phase 1. The microwave must stay ahead of the radio system implementation during all phases. In addition, the conclusion of Phase 0 should see the majority of Phase 1 sites acquired, permitted and where possible built, upgraded, and ready for mobile radio installation. System users within the Phase 1 area will have had training as to how to use the new subscriber radios in the old system, and all Phase 1 users will have the new subscriber units.

Other than new mobile and portable radio equipment, and new dispatch console equipment, all of the system users will continue to operate on their existing radio systems as they are today.

FE anticipates that Phase 0 will take approximately one year. The specific schedule cannot be determined due to the seasonal nature of much of the construction work, and the inability to predict the contract start date.

4.2 Phase 1 —Northeastern Oregon region

The following activities will be required during Phase 1 to implement the OWIN radio system:

Phase 1 - Northeastern Oregon		
Item #	**Task Name**	**Responsibility**
1	Prepare Phase 2 sites	State & vendor
2	Upgrade Phase 2 sites	Vendor
3	Site inspection & completion tests	Vendor
4	Site tests and inspection approval	State
5	Install loop microwave links for Phase 2 and infrastructure. Complete spur microwave sites for Phase 1.	Vendor
6	Status meetings regularly	Vendor
7	Coordinate with impacted users	State
8	Receive Phase 2 mobile radios	Vendor
9	Train Phase 2 subscriber users	State & vendor
10	Install Phase 2 mobiles	State & vendor
11	Stage Phase 1 system at factory	Vendor
12	Perform factory testing	Vendor
13	Connect/patch channels needed for continual operation during installs	State & vendor
14	Receive Phase 1 Infrastructure	Vendor
15	Stage Phase 1 locally	Vendor
16	Install Phase 1 radio site equipment	Vendor
17	Test end-to-end radio-to-console for all radios installed	State & vendor
18	Test end-to-end radio-to-interoperability matrix	State & vendor
19	Train users for Phase 1 operation	State & vendor
20	Move mobile and portable radio users to new Phase 1 channels	State
21	Prepare Phase 1 as-built documentation	Vendor
22	Completed portion system testing -functional specs	State & vendor
23	Completed portion system testing -equipment specs	State & vendor
24	Completed portion system testing -coverage specs	State & vendor
25	Failure operation and recovery testing	State & vendor
26	60-day burn-in performance	State & vendor
27	Approval of tests	State

At the conclusion of Phase 1, the dispatch centers' new consoles and the interoperability matrix switch will connect to Phase 1 mobile radio site equipment via the new microwave. The loop microwave network will extend through the Phase 2 region and will have connected many of the sites scheduled for implementation during Phase 2. The microwave must stay ahead of the radio system implementation during all phases. In

addition, by the conclusion of Phase 1, the majority of Phase 2 sites acquisitions have already taken place, where possible sites will be built, upgraded, and ready for Phase 2 mobile radio installation. Phase 1 area users will have been trained a second time, this time as to how to use the new radio system and how to roam into areas not yet completed. System users within the Phase 2 area will have had training as to how to use the new subscriber radios in the old system, and all Phase 2 users will have the new subscriber units installed.

Radio operating districts and facilities within the Phase 1 area will transition to OWIN. Some operations may require the use of both the current system and OWIN for some period. DOC facilities will continue to use their existing systems for their unique on-site communications needs.

FE anticipates that Phase 1 will last approximately one year. Depending on the specific schedule developed, Phase 1 may start during the latter stages of Phase 0 activities.

4.3 Phase 2 —Southern Oregon region

The following activities will be required during Phase 2 to implement the OWIN radio system:

Phase 2 - Southern Oregon		
Item #	**Task Name**	**Responsibility**
1	Prepare Phase 3 sites	State & vendor
2	Upgrade Phase 3 sites	Vendor
3	Site inspection & completion tests	Vendor
4	Site tests and inspection approval	State
5	Install loop microwave links for Phase 3 and infrastructure. Complete Phase 2 spur microwave sites.	Vendor
6	Status meetings regularly	Vendor
7	Coordinate with impacted users	State
8	Receive Phase 3 mobile radios	Vendor
9	Train Phase 3 subscriber users	State & vendor
10	Install Phase 3 mobiles	State & vendor
11	Stage Phase 2 system at factory	Vendor
12	Perform factory testing	Vendor
13	Connect/patch channels needed for continual operation during installs	State & vendor
14	Receive Phase 2 Infrastructure	Vendor
15	Stage Phase 2 locally	Vendor
16	Install Phase 2 radio site equipment	Vendor

Phase 2 - Southern Oregon		
Item #	**Task Name**	**Responsibility**
17	Test end-to-end radio-to-console for all radios installed	State & vendor
18	Test end-to-end radio-to-interoperability matrix	State & vendor
19	Train users for Phase 2 operation	State & vendor
20	Move mobile and portable radio users to new Phase 2 channels	State
21	Prepare Phase 2 as-built documentation	Vendor
22	Completed portion system testing -functional specs	State & vendor
23	Completed portion system testing -equipment specs	State & vendor
24	Completed portion system testing -coverage specs	State & vendor
25	Failure operation and recovery testing	State & vendor
26	60-day burn-in performance	State & vendor
27	Approval of tests	State

At the conclusion of Phase 2, the new consoles and the interoperability matrix will connect to Phase 2 mobile radio site equipment via the new microwave. The loop microwave network will extend through the Phase 3 region and will have connected many of the sites scheduled for implementation during Phase 3. In addition, at the conclusion of Phase 2, the majority of Phase 3 sites will be acquired and where possible built, upgraded, and ready for mobile radio installation. Phase 2 area users will have been trained a second time. The training this time includes how to use the new radio system and how to roam into areas not yet completed. System users within the Phase 3 area will have had training as to how to use the new subscriber radios in the old system, an introduction into the new system, and how to roam in other areas. All Phase 2 users will have the new subscriber units installed.

As with the previous phase, radio operating districts and facilities within the Phase 2 area will transition to OWIN. Some operations may still require the use of both the current system and OWIN, however as OWIN becomes more robust the number should decrease. DOC facilities in the Phase 2 area will continue to use their existing on-site communication systems.

FE anticipates that Phase 2 will take approximately two years to complete. Depending on the specific schedule developed, some Phase 2 tasks could start during the latter stages of Phase 1.

4.4 Phase 3 —Northwestern Oregon region

The following activities will be required during Phase 3 to implement the OWIN radio system:

Phase 3 – Northwestern Oregon		
Item #	**Task Name**	**Responsibility**
1	Coordinate with impacted users	State
2	Status meetings regularly	State & vendor
3	Stage Phase 3 system at factory	Vendor
4	Perform factory testing	Vendor
5	Complete Phase 3 spur microwave sites	Vendor
6	Connect/patch channels needed for continual operation during installs	State & vendor
7	Receive Phase 3 Infrastructure	Vendor
8	Stage Phase 3 locally	Vendor
9	Install Phase 3 radio site equipment	Vendor
10	Test end-to-end radio-to-console for all radios installed	State & vendor
11	Test end-to-end radio-to-interoperability matrix	State & vendor
12	Train users for Phase 3 operation	State & vendor
13	Move mobile and portable radio users to new Phase 3 channels	State
14	Prepare Phase 3 as-built documentation	Vendor
15	Status meetings regularly	State & vendor
16	Perform complete acceptance test	State & vendor
17	Finalize as-built documents	Vendor
18	Sign-off on acceptance testing	State
19	Completed portion system testing -functional specs	State & vendor
20	Completed portion system testing -equipment specs	State & vendor
21	Completed portion system testing -coverage specs	State & vendor
22	Failure operation and recovery testing	State & vendor
23	60-day burn-in performance	State & vendor
24	Approval of tests	State

At the conclusion of Phase 3, the new consoles and the interoperability matrix will connect to all of the State's radio site equipment via the new microwave. The completed microwave network would connect all of the mobile radio sites and other OWIN locations. The entire system will have undergone testing and proven to meet specifications or a punch list of unresolved issues and a methodology to address each issue will be prepared. Users will be migrated to the remaining portions of the system as it is completed. Phase 3 area users will have been trained their second time, to include how to use the new radio system and how to roam into other areas. All users statewide will have the new subscriber units.

The remaining radio operating districts and facilities will transition to OWIN. All operations would now rely on OWIN with the exception of DOC facility on-site communications. The remaining non-OWIN systems can be decommissioned.

During Phase 3 OWIN will decommission any older active microwave equipment and supporting facilities. Once decommissioned the electronic assets can be disposed of, salvaged, or sold. Retired buildings and towers could be scrapped, leased, or sold to other telecommunications companies or users to recover some value.

FE anticipates that Phase 3 take approximately two years. As with previous phases, some of Phase 3 tasks could start during the latter stages of Phase 2.

4.5 Phase effect on agencies

The OWIN participating agencies will find the phased implementation as proposed herein to be dependent upon their area of operation rather than on a per agency basis. All agencies with dispatch centers will have new equipment during Phase 0. Each agency will have changes to its radio operations during each phase for each region of the State. The users will receive mobile and portable radios in the previous phase operating on both the old and new system. When each phase is completed, users with operations or facilities in that area will migrate to the new system, but they must still understand how to use the radios in the other phase areas to allow them to roam out of their area. Continuing training will be important to keep the users up-to-date on how to operate their new radios under all situations. The agencies will find radio operations more flexible and more automatic as each phase is completed.

5.0 Summary of the phases and costs

The complexities of the OWIN radio project, promise to challenge the best Project Team that Oregon can offer. The ability to adjust appropriately and effectively remains crucial to maintaining the phased schedule and cost estimate. It is for that reason that ***FE*** recommends that OWIN maintain a separate and independent Project Manager to work in concert with OWIN Staff and the eventual vendor who will build OWIN. Additionally, due to the investment, size,

complexity, and nature of this project, ***FE*** also recommends the use of a structured systems development lifecycle methodology to help ensure the success of the implementation of OWIN. Further, the complexity of this project will require a comprehensive program management approach and resource commitment that will provide the overall project management and quality assurance oversight to assist the Project Manager, OWIN staff, and the legislature support to monitor the activities of this project. The components of the implementation plan provide a flexible approach that helps anticipate and adjust to unforeseen occurrences or variables. Regularly monitoring the progress of implementation and expenditures, procurement methods, risk mitigation plan, and performance measures will help predict needed adjustments caused by evolving or unforeseen variables. For the OWIN project the practical effects of such adjustments could include revisions in network design, refinements in how funding is managed and enhancements to organizational responsibilities and project policies over time.

The following table provides a high-level view of the OWIN timeline and estimated costs.

Phase	Area	Summary of Work	Cost	Time
0	Preparatory work - Northeastern Oregon	Dispatch centers, system controllers, interoperability matrix, loop microwave to connect the above with Phase 1 sites, Phase 1 subscriber units, Phase 1 site upgrades	$147,000,000	1 Yr
1	Preparatory work - Southern Oregon Implementation work - Northeastern Oregon	Radio installation in Phase 1 sites, Upgrade of Phase 2 sites, microwave to spur Phase 1 sites, loop microwave to Phase 2 sites, Phase 2 subscribers	$161,000,000	1 Yr
2	Preparatory work - Northwestern Oregon Implementation work - Southern Oregon	Radio installation in Phase 2 sites, Upgrade of Phase 3 sites, microwave to spur Phase 2 sites, loop microwave to Phase 3 sites, Phase 3 subscribers	$166,000,000	2 Yrs
3	Implementation work - Northwestern Oregon Project completion and quality assurance - Statewide Oregon	Radio installation in Phase 3 sites, microwave to spur Phase 3 sites, system testing	$191,000,000	2 Yrs

6.0 Conclusions

This *Implementation Plan* is close to the State's suggested approach for a three-phase implementation plan for OWIN. ***FE*** modified this plan by adding Phase 0 to the Implementation Plan, enabling a more methodical, thoughtful approach to this project. Phase 0 will permit the smoother implementation of Phase 1 and all subsequent phases of the OWIN project.

The next step in this project is the preparation of the business case study that will demonstrate to the State the reasons for proceeding with this *Implementation Plan* and will further define of the costs and schedule for the OWIN program.

Appendix A. Site equipment detail

The following pages present tables showing the sites by name and the equipment quantities for each of the mobile radio implementation phases. The following descriptions are provided as an aid to the charts.

- **Site Name – The name of the radio site**
- **Operational Region – Region of the State of Oregon that the site is located**
- **Simulcast Group – Identification of which simulcast group the site belongs**
- **Total Number of Trunked Channels – Number of trunked channels at the site**
- **VHF Simulcast Channels – Number of simulcast channels at the site**
- **VHF Non-Simulcast Channels – Number of VHF channels not simulcast**
- **Trunked 700 MHz Channels – Number of 700 MHz channels at the site**
- **VHF Conventional Channels – Number of non-trunked channels at the site**
- **VHF at ODF Sites – Base radios at existing ODF sites for tactical, etc.**
- **VHF Interop Channels – number of VHF interoperability channels**
- **UHF Interop Channels – number of UHF interoperability channels**
- **800 MHz Interop Channels – number of 800 MHz interoperability channels**
- **700 MHz Data Channels – number of 700 MHz high speed wide band channels**

Phase 1 Site Name	Operational Region	Simulcast Group	Number of Channels	VHF Simulcast Channels	VHF Non-Simulcast Channels	Trunked 700 MHz Channels	VHF Conventional Channels	VHF Interop	UHF Interop	800 MHz Interop	700 MHz Data
Aldrich Mtn	Central	N/A	4		4		3	2	1	1	
Arrowwood Point	Central	N/A	4		4		2				
Burns Butte	Central	N/A	4		4		2	2	1	1	
Devine Ridge	Central	N/A	4		4		2	2	1	1	
Dixie Butte	Central	Group 15	4	4			3	2	1	1	
Elkhorn	Central	Group 15	4	4			2				
Fall Mtn	Central	N/A	4		4		2	2	1	1	
FCC Site – 57	Central	N/A	4		4		2				
FCC Site – 64	Central	Group 15	4	4			2				
Glass Butte	Central	N/A	4		4		2	2	1	1	
Keyes Summit	Central	N/A	4		4		2	2	1	1	
Pisgah Mtn	Central	N/A	4		4		2				
Tamarack	Central	N/A	4		4		2	2	1	1	
Baker Ridge ATT	Central-East	Group 22	5	5			2	2	2	2	
Beaver Ridge (USFS)	Central-East	Group 22	5	5			3	2	2	2	
Black Butte (Burns)	Central-East	N/A	5		5		2				
Cottonwood Mtn	Central-East	N/A	5		5		2	2	2	2	
Lime Hill	Central-East	N/A	5		5		2	2	2	2	
Owyhee Reservoir	Central-East	N/A	5		5		3				
Sturgill Mtn	Central-East	N/A	5		5		2				
Black Mtn	North-Central	Group 13	4	4			3	2	2	2	
Bone Point	North-Central	N/A	4		4		2	2	2	2	
Cabbage Hill ODOT	North-Central	N/A	4		4		2	2	2	2	
Coombs Canyon	North-Central	N/A	4		4		2				
Gleason Butte	North-Central	Group 13	4	4			2				
Madison	North-Central	Group 13	4	4			3				
Mt Weston	North-Central	N/A	4		4		2	2	2	2	
Sillusi Butte OSP	North-Central	N/A	4		4		2	2	2	2	
Wilkenson	North-Central	Group 13	4	4			2				

Phase 1 Site Name	Operational Region	Simulcast Group	Number of Channels	VHF Simulcast Channels	VHF Non-Simulcast Channels	Trunked 700 MHz Channels	VHF Conventional Channels	VHF Interop	UHF Interop	800 MHz Interop	700 MHz Data
Anthony Lakes – Grant	North-East	N/A	5		5		2	2	1	1	
Courtney Butte	North-East	N/A	5		5		3	2	2	1	
Devils Ridge	North-East	N/A	5		5		2				
Elk Mtn	North-East	N/A	5		5		2				
FCC Site – 11	North-East	N/A	5		5		2				
Howard Butte	North-East	N/A	5		5		2	2	2	1	
Ladd Canyon	North-East	N/A	5		5		2	2	2	2	
Mt Emily (FCC)	North-East	N/A	5		5		3	2	2	2	
Mt Fanny	North-East	N/A	5		5		2	2	2	2	
Mt Howard	North-East	N/A	5		5		2	2	2	1	
Red Mtn	North-East	Group 21	5	5			2				
Sheep Ridge	North-East	N/A	5		5		2	2	2	1	
Smith Mtn	North-East	N/A	5		5		2				
Spout Springs	North-East	N/A	5		5		3	2	2	2	
Summit Point (Solar Site	North-East	Group 21	5	5			2				
Augspurger (NW Natural)	NW-Central	Group 12	5	5			2	2	2	2	
Cedar	NW-Central	N/A	5		5		2	2	2	2	
Columbia Hills (WA)	NW-Central	N/A	5		5		2	2	1	1	
Condon	NW-Central	N/A	5		5		2	2	1	2	
Criterion Summit	NW-Central	Group 14	5	5			2	2	2	2	
Gordan Ridge	NW-Central	N/A	5		5		2				
Hood River	NW-Central	Group 12	5	5			2				
Hulse Ranch	NW-Central	Group 16	5	5			2	2	2	2	
Kent Elevator	NW-Central	Group 14	5	5			2	2	1	1	
Middle Mtn	NW-Central	Group 12	5	5			2	2	2	2	
Mt Defiance	NW-Central	Group 12	5	5			2				
Pine Grove	NW-Central	N/A	5		5		2				
Rancheria Rock	NW-Central	Group 20	5	5			2	2	1	1	
Roosevelt	NW-Central	N/A	5		5		2	2	1	2	

Phase 1 Site Name	Operational Region	Simulcast Group	Number of Channels	VHF Simulcast Channels	VHF Non-Simulcast Channels	Trunked 700 MHz Channels	VHF Conventional Channels	VHF Interop	UHF Interop	800 MHz Interop	700 MHz Data
Shaniko	NW-Central	Group 14	5	5			2				
Snowboard	NW-Central	Group 20	5	5			3				
Stacker	NW-Central	Group 12	5	5			3	2	2	2	
Tygh Ridge	NW-Central	Group 16	5	5			2				
Wasco Butte	NW-Central	Group 12	5	5			3				
Peavine	West Central	N/A	10		6	4	2				1
Agency Plains	West-Central	N/A	6		6		2	2	1	2	
Bachelor	West-Central	N/A	6			6	2	2	1	2	1
Grizzly Mtn	West-Central	N/A	6		6		3	2	1	2	
Hoodoo Butte	West-Central	N/A	10		6	4	2	2	2	1	1
Pilot Butte Comm Site	West-Central	N/A	6		6		2				
Pine Mtn	West-Central	N/A	6			6	2	2	1	2	1
Powell Butte	West-Central	N/A	6		6		2	2	1	2	
Stephenson	West-Central	N/A	6		6		2	2	1	2	
Sugarpine Butte	West-Central	N/A	6			6	3				1
Wampus	West-Central	N/A	6			6	2	2	1	2	1
Total quantity in Phase 1			367	113	222	32	162	90	69	73	6
73 sites											

Phase 2 Site Name	Operational Region	Simulcast Group	Number of Channels	VHF Simulcast Channels	VHF Non-Simulcast Channels	TRUNKED 700 MHz Channels	VHF Conventional Channels	VHF Interop	UHF Interop	800 MHz Interop	700 MHz Data
Monument Peak	Central-East	N/A	5		5		3	2	2	2	
Ashland Mtn (Day Wireless	Medford	N/A	6			6	2				1
Canyon Mtn	Medford	N/A	6			6	3	2	2	2	1
FCC Site – 230	Medford	N/A	10		6	4	2				1
Fiddler Mtn	Medford	N/A	10		6	4	2	2	1	1	1
Fielder	Medford	N/A	6			6	3				1
Glendale Remote	Medford	N/A	6			6	2				1
Halls Point	Medford	N/A	10		6	4	2	2	1	1	1
Isabelle Mtn	Medford	N/A	6			6	2	2	1	1	1
Josephine 01	Medford	N/A	6			6	2				1
Josephine 02	Medford	N/A	6			6	2				1
Josephine 03	Medford	N/A	6			6	2				1
Josephine 04	Medford	N/A	6			6	2				1
Manzanita (Round Top)	Medford	N/A	6			6	3	2	1	1	1
Onion Mtn	Medford	N/A	6			6	2	2	1	1	1
Roxy Ann	Medford	N/A	6			6	3				1
Sexton Mtn	Medford	N/A	6			6	3	2	1	1	1
Soda Mtn	Medford	N/A	6			6	3	2	1	1	1
Starveout	Medford	N/A	6			6	3	2	1	1	1
Tallowbox	Medford	N/A	6			6	3				1
Bald Ridge	Roseburg	Group 2	5	5			2				
Baldy Butte	Roseburg	Group 8	5	5			2	2	2	2	
Bolivar Mtn	Roseburg	Group 2	5	5			2				
Chilcoot Mtn	Roseburg	N/A	5			5	2				1
Dean Mtn	Roseburg	Group 8	5	5			3	2	2	2	
Dodson	Roseburg	N/A	5			5	2	2	2	2	1
Elks Peak	Roseburg	Group 8	5	5			2				
Fairview Peak	Roseburg	N/A	5			5	3				1
FCC Site - 200	Roseburg	N/A	5			5	2				1
Fill Site - Elkton	Roseburg	N/A	5			5	2				1
Gardiner Hill	Roseburg	Group 8	5	5			2				
Ivers Peak	Roseburg	Group 8	5	5			2				

Phase 2 Site Name	Operational Region	Simulcast Group	Number of Channels	VHF Simulcast Channels	VHF Non-Simulcast Channels	TRUNKED 700 MHz Channels	VHF Conventional Channels	VHF Interop	UHF Interop	800 MHz Interop	700 MHz Data
Mount Yoncalla	Roseburg	N/A	5			5	2				1
Red Butte	Roseburg	N/A	5			5	2	2	2	2	1
Scott Mtn - Douglas	Roseburg	N/A	5			5	3	2	2	2	1
Signal Tree (Kenyon Mtn)	Roseburg	Group 2	5	5			3	2	2	2	
Slide Creek	Roseburg	Group 2	5	5			2				
Table Mtn	Roseburg	N/A	5			5	2				1
Tiller Remote	Roseburg	N/A	5			5	2				1
Yellow Butte	Roseburg	N/A	5			5	2				1
Bennett Butte	South Coast	Group 5	4	4			2	2	2	2	
Bosley Butte	South Coast	Group 1	4	4			3	2	2	2	
Carpenterville	South Coast	Group 1	4	4			2	2	2	2	
Edson Butte	South Coast	Group 5	4	4			3				
Grizzly West	South Coast	Group 1	4	4			3	2	2	2	
Harbor Hill	South Coast	Group 1	4	4			2	2	2	2	
Iron Mtn	South Coast	N/A	4		4		2				
Port Orford	South Coast	Group 5	4	4			2	2	2	2	
Beaty's Butte	South-Central	N/A	4		4		2				
Black Cap	South-Central	Group 7	4	4			3				
FCC Site – 127	South-Central	Group 7	4	4			2				
Fish Rim (Adel Remote)	South-Central	Group 7	4	4			2	2	1	1	
Grizzly Peak	South-Central	N/A	4		4		2	2	1	1	
Round Pass	South-Central	N/A	4		4		3	2	1	1	
Blue Mtn (Basque)	South-East	N/A	3		3		3	2	2	2	
Mahogany	South-East	N/A	3		3		2				
Pharmacy Hill	South-East	N/A	3		3		2	2	2	2	
Pueblo Mtn	South-East	N/A	3		3		2				
Steens Mtn (FCC)	South-East	N/A	3		3		3	2	1	1	
Bailey Mtn	SW-Central	Group 6	8	5		3	2				1
Bald Mtn – Klamath	SW-Central	N/A	5		5		3	2	1	1	
Crater Lake	SW-Central	N/A	5		5		2				
Dead Indian Mtn	SW-Central	N/A	5		5		2	2	1	1	
Fill Site - Cinnamon Butte	SW-Central	Group 6	8	5		3	2	2	2	2	1
Hamaker Mtn	SW-Central	N/A	5		5		3	2	1	1	

Phase 2 Site Name	Operational Region	Simulcast Group	Number of Channels	VHF Simulcast Channels	VHF Non-Simulcast Channels	TRUNKED 700 MHz Channels	VHF Conventional Channels	VHF Interop	UHF Interop	800 MHz Interop	700 MHz Data
Hogback	SW-Central	N/A	5		5		3	2	1	1	
Pelican Butte	SW-Central	N/A	5		5		2	2	1	1	
Walker Mtn	SW-Central	N/A	5		5		3	2	1	1	
Welch Butte	SW-Central	Group 6	5	5			2				
Wolf Mtn	SW-Central	N/A	8		5	3	2	2	2	1	1
Yainax Butte	SW-Central	N/A	5		5		3	2	1	1	
Total quantity in Phase 2			371	100	99	172	167	74	55	54	33
72 sites											

Phase 3 Site Name	Operational Region	Simulcast Group	Number of Channels	VHF Simulcast Channels	VHF Non-Simulcast Channels	TRUNKED 700 MHz Channels	VHF Conventional Channels	VHF Interop	UHF Interop	800 MHz Interop	700 MHz Data
Benton 05	Central Coast	N/A	5			5	2				1
Benton 06	Central Coast	N/A	5			5	2				1
Cape Perpetua	Central Coast	N/A	5		5		2	2	2	2	
Euchre Mtn	Central Coast	N/A	5		5		3	2	2	2	
Lane 04	Central Coast	N/A	5			5	2				1
Table Mtn (Newport)	Central Coast	N/A	5		5		2				
Yaquina Head	Central Coast	N/A	5		5		2	2	2	2	
Bear Mtn	Eugene	N/A	6			6	2				1
Benton 02	Eugene	N/A	6			6	2				1
Benton 04	Eugene	N/A	6			6	2				1
Benton 07	Eugene	N/A	6			6	2				1
Buck Mtn	Eugene	N/A	6			6	2	3	3	3	1
Glenada	Eugene	Group 10	6	6			2	2	2	1	
Goodwin Peak	Eugene	Group 10	6	6			2	2	2	1	
Lane 01	Eugene	N/A	6			6	2				1
Linn 04	Eugene	N/A	6			6	2				1
Mt Hagan	Eugene	N/A	6			6	2	2	2	1	1
Mt Nebo	Eugene	N/A	6			6	3				1
Noti (Badger Mtn)	Eugene	Group 10	10	6		4	3				1
Prairie Mtn	Eugene	N/A	6			6	2	2	2	1	1
Roman Nose	Eugene	Group 10	10	6		4	3				1
Scott Mtn (Linn)	Eugene	N/A	6			6	2				1
Walker Point	Eugene	Group 10	10	6		4	2				1
Cape Lookout L190	North Coast	N/A	5		5		2	2	2	2	
Clatsop 02	North Coast	N/A	5		5		2				
Columbia 03	North Coast	N/A	5			5	2				1
Columbia 10	North Coast	N/A	5			5	2				1
Columbia 11	North Coast	N/A	5			5	2				1
Hebo Mtn	North Coast	N/A	5		5		3				
Megler Mtn	North Coast	N/A	5		5		2	2	2	2	
Neahkahnie Mtn	North Coast	N/A	5		5		2	2	2	2	

Phase 3 Site Name	Operational Region	Simulcast Group	Number of Channels	VHF Simulcast Channels	VHF Non-Simulcast Channels	TRUNKED 700 MHz Channels	VHF Conventional Channels	VHF Interop	UHF Interop	800 MHz Interop	700 MHz Data
Nicolai Mtn (ODF)	North Coast	N/A	5		5		3	2	2	2	
Rector Ridge	North Coast	N/A	5		5		3				
Tillamook Head	North Coast	N/A	5		5		2	2	2	2	
Washington 02	North Coast	N/A	5			5	2				1
Washington 03	North Coast	N/A	5			5	2				1
Washington 04	North Coast	N/A	5			5	2				1
Wickiup	North Coast	N/A	5		5		2				
Clackamas 02	NW-Central	N/A	5			5	2				1
Marion 01	NW-Central	N/A	5			5	2				1
Buxton Lookout	Portland	N/A	8			8	3				1
Chehalem Mtn	Portland	N/A	8			8	2	3	2	2	1
Columbia 01	Portland	N/A	8			8	2				1
Columbia 02	Portland	N/A	8			8	2				1
Columbia 04	Portland	N/A	8			8	2				1
Columbia 05	Portland	N/A	8			8	2				1
Columbia 06	Portland	N/A	8			8	2				1
Columbia 07	Portland	N/A	8			8	2				1
Columbia 08	Portland	N/A	8			8	2				1
Columbia 09	Portland	N/A	8			8	2				1
Columbia 12	Portland	N/A	8			8	2				1
Columbia 13	Portland	N/A	8			8	2				1
Columbia 14	Portland	N/A	8			8	2				1
FCC-BS-CLACKAMAS	Portland	N/A	8			8	2				1
Goat Mtn	Portland	N/A	8			8	2	3	3	3	1
Green Mtn MF&S Site	Portland	N/A	8			8	2	2	1	2	1
Meissner	Portland	N/A	8			8	3	2	1	2	1
Mt Hood (Timberline)	Portland	Group 28	13	8		5	2				1
Mult 01	Portland	N/A	8			8	2				1
Mult 02	Portland	N/A	8			8	2				1
Skamania	Portland	N/A	8			8	3				1
South Saddle	Portland	N/A	8			8	3				1
Washington 01	Portland	N/A	8			8	2				1

Phase 3 Site Name	Operational Region	Simulcast Group	Number of Channels	VHF Simulcast Channels	VHF Non-Simulcast Channels	TRUNKED 700 MHz Channels	VHF Conventional Channels	VHF Interop	UHF Interop	800 MHz Interop	700 MHz Data
Washington 05	Portland	N/A	8			8	2				1
Washington 06	Portland	N/A	8			8	2				1
Washington 11	Portland	N/A	8			8	2				1
Washington 12	Portland	N/A	8			8	2				1
Washington 13	Portland	N/A	8			8	2				1
West Zigzag LO	Portland	Group 28	13	8		5	2				1
Whalehead Mtn	Portland	N/A	8			8	2				1
Wilson River	Portland	N/A	8		8		2	2	2	2	
Yamhill 02	Portland	N/A	8			8	2				1
Yamhill 03	Portland	N/A	8			8	2				1
Yamhill 11	Portland	N/A	8			8	2				1
Lane 07	Roseburg	N/A	5			5	2				1
Bald Mtn - Polk	Salem	N/A	8			8	2	2	2	2	1
Bald Mtn West	Salem	N/A	8			8	3	2	2	2	1
Benton 03	Salem	N/A	8			8	2				1
Benton 08	Salem	N/A	8			8	2				1
Benton 09	Salem	N/A	8			8	2				1
Clackamas 01	Salem	N/A	8			8	2				1
Coffin Mtn (ODF)	Salem	N/A	8			8	3				1
Doane Creek	Salem	N/A	8			8	2	2	2	2	1
Green Peter (Bald Peter)	Salem	N/A	8			8	2	2	2	1	1
Halls Ridge	Salem	N/A	8			8	2	2	2	2	1
High Heaven	Salem	N/A	8			8	3	2	2	2	1
Horeb Mtn	Salem	N/A	8			8	3	2	2	1	1
Linn 01	Salem	N/A	8			8	2				1
Linn 06	Salem	N/A	8			8	2				1
Marion 02	Salem	N/A	8			8	2				1
Marion 03	Salem	N/A	8			8	2				1
Marys Peak	Salem	N/A	8			8	3	3	3	3	1
Polk 01	Salem	N/A	8			8	2				1
Polk 02	Salem	N/A	8			8	2				1
Polk 03	Salem	N/A	8			8	2				1

Phase 3 Site Name	Operational Region	Simulcast Group	Number of Channels	VHF Simulcast Channels	VHF Non-Simulcast Channels	TRUNKED 700 MHz Channels	VHF Conventional Channels	VHF Interop	UHF Interop	800 MHz Interop	700 MHz Data
Polk 04	Salem	N/A	8			8	2				1
Polk 05	Salem	N/A	8			8	2				1
Polk 10	Salem	N/A	8			8	2				1
Saddlebag Mtn	Salem	N/A	8		8		2	2	2	2	
Snow Peak	Salem	N/A	8			8	2	2	2	1	1
Yamhill 01	Salem	N/A	8			8	2				1
Yamhill 04	Salem	N/A	8			8	2				1
Yamhill 10	Salem	N/A	8			8	2				1
Lane 02	West-Central	N/A	6			6	2				1
Lane 03	West-Central	N/A	6			6	2				1
Lane 05	West-Central	N/A	6			6	2				1
Lane 06	West-Central	N/A	6			6	2				1
Lane 08	West-Central	N/A	6			6	2				1
Lane 10	West-Central	N/A	6			6	2				1
Linn 02	West-Central	N/A	6			6	2				1
Linn 03	West-Central	N/A	6			6	2				1
Linn 05	West-Central	N/A	6			6	2				1
Total quantity in Phase 3			793	46	81	666	240	60	57	52	95
112 sites											

Appendix B. System Cost Overview

The following pages present tables showing a breakdown the estimated costs of the system for each of the implementation phases. Additional detail is provided in the *OWIN Cost Estimate Document*, provided as part of the *OWIN Business Case*.

The following descriptions are provided as an aid to understanding these charts.

- Voice subsystem total
  - Total of site radio equipment, control equipment and subscriber equipment required to implement the voice radio subsystem.
- 700 MHz data subsystem total
  - Total of site radio equipment, control equipment and subscriber equipment required to implement the 700 MHz data radio subsystem.
- Microwave subsystem total
  - Total of microwave radio equipment, multiplex equipment and control equipment required to implement the microwave network subsystem.
- Site infrastructure subsystem total
  - Total of building, tower and other infrastructure required to implement OWIN.
- Transportable site subsystem total
  - Total of transportable site equipment and support systems required to implement four transportable OWIN sites
- Total licensing
  - Total estimated cost of radio and microwave licensing services.
- Total land and environmental cost
  - Total estimated cost of site environmental impact studies and remediation.
- Vendor services total
  - Total estimated cost of all vendor implementation services, including installation and other labor
- Spares total
  - Total estimated cost of spare equipment for each subsystem implement

- Vendor Contract Total
  - Total estimated cost of vendor contracts for the above items

- IV&V, QA, and Program Management
  - Total cost of independent validation and verification services, quality assurance and program management. Estimated at two percent of vendor contracted amount

- OWIN System Total
  - Total of vendor and IV&V, QA, and Program Management contact estimates

- Management and staffing costs
  - Estimate of OWIN internal management and staffing costs

- Maintenance and repair estimates
  - Estimate of maintenance costs for OWIN during the phase

- Maintenance costs offset by internal staff
  - Estimate of maintenance costs for OWIN which are offset by internal staffing

- OWIN Phase Total
  - Total of estimated costs for OWIN

Phase 0 Costs

Category	Cost Estimate
Voice subsystem total	$59,100,000
700 MHz data subsystem total	$5,660,000
Microwave subsystem total	$7,080,000
Site infrastructure subsystem total	$11,500,000
Transportable site subsystem total	$0
Total licensing	$228,000
Total land and environmental cost	$1,230,000
Vendor services total	$48,400,000
Spares total	$7,270,000
Vendor Contract Total	**$140,000,000**
IV&V, QA, and Program Management	$2,810,000
OWIN System Total	**$143,000,000**
Management and staffing costs	$3,730,000
Maintenance and repair estimates	$0
Maintenance costs offset by internal staff	$0
OWIN Phase 0 Total	**$147,000,000**

Phase 1 Costs

Category	Cost Estimate
Voice subsystem total	$47,800,000
700 MHz data subsystem total	$4,070,000
Microwave subsystem total	$6,680,000
Site infrastructure subsystem total	$15,300,000
Transportable site subsystem total	$3,150,000
Total licensing	$149,000
Total land and environmental cost	$3,050,000
Vendor services total	$63,600,000
Spares total	$6,280,000
Vendor Contract Total	**$150,000,000**
IV&V, QA, and Program Management	$3,000,000
OWIN System Total	**$153,000,000**
Management and staffing costs	$3,800,000
Maintenance and repair estimates	$5,000,000
Maintenance costs offset by internal staff	($610,000)
OWIN Phase 1 Total	**$161,000,000**

Phase 2 Costs

Category	Cost Estimate
Voice subsystem total	$47,600,000
700 MHz data subsystem total	$4,980,000
Microwave subsystem total	$7,060,000
Site infrastructure subsystem total	$12,000,000
Transportable site subsystem total	0
Total licensing	$154,000
Total land and environmental cost	$1,970,000
Vendor services total	$54,900,000
Spares total	$6,050,000
Vendor Contract Total	**$135,000,000**
IV&V, QA, and Program Management	$2,690,000
OWIN System Total	**$137,000,000**
Management and staffing costs	$10,400,000
Maintenance and repair estimates	$21,400,000
Maintenance costs offset by internal staff	($3,100,000)
OWIN Phase 2 Total	**$166,000,000**

Phase 3 Costs

Category	Cost Estimate
Voice subsystem total	$39,500,000
700 MHz data subsystem total	$5,320,000
Microwave subsystem total	$5,380,000
Site infrastructure subsystem total	$15,500,000
Transportable site subsystem total	0
Total licensing	$47,600
Total land and environmental cost	$4,590,000
Vendor services total	$75,600,000
Spares total	$5,120,000
Vendor Contract Total	**$151,000,000**
IV&V, QA, and Program Management	$3,020,000
OWIN System Total	**$154,000,000**
Management and staffing costs	$12,200,000
Maintenance and repair estimates	$29,800,000
Maintenance costs offset by internal staff	($5,500,000)
OWIN Phase 3 Total	**$191,000,000**

OWIN Total Costs

Category	Cost Estimate
Voice subsystem total	$194,000,000
700 MHz data subsystem total	$20,000,000
Microwave subsystem total	$26,200,000
Site infrastructure subsystem total	$54,300,000
Transportable site subsystem total	$3,150,000
Total licensing	$579,000
Total land and environmental cost	$10,800,000
Vendor services total	$242,000,000
Spares total	$24,700,000
Vendor Contract Total	**$576,000,000**
IV&V, QA, and Program Management	$11,500,000
OWIN System Total	**$588,000,000**
Management and staffing costs	$30,100,000
Maintenance and repair estimates	$56,200,000
Maintenance costs offset by internal staff	($9,200,000)
OWIN Project Total By Phase	**$665,000,000**