Intelligent Transportation Systems Maintenance Plan

Volume Two:
Technical Appendices

Prepared by

Chris Strong, Research Associate
Robb Larson, Adjunct Assistant Professor of Mechanical Engineering
Alan McAllister, Research Assistant

of the

Western Transportation Institute
Department of Civil Engineering
College of Engineering
Montana State University - Bozeman

for the

State of Oregon
Department of Transportation
Technical Services
Traffic Management Section
Intelligent Transportation Systems Unit

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GLOSSARY OF ABBREVIATIONS

ADOT	Arizona Department of Transportation
ATMS	Advanced Traffic Management System
ATR	Automatic Traffic Recorder
AVC	Automatic Vehicle Classification
AVI	Automatic Vehicle Identification
AVL	Automatic Vehicle Location
CAD	Computer-Aided Dispatch
Caltrans	California Department of Transportation
CCTV	Closed-Circuit Television
CDPD	Cellular Digital Packet Data
CMS	Changeable Message Sign
COATS	California-Oregon Advanced Transportation System
COMET	CorridOr ManagEment Team
CPU	Central Processing Unit
CSEPP	Chemical Stockpile Emergency Preparedness Program
CVO	Commercial Vehicle Operations
DAS	Department of Administrative Services
DB	Design-Build
DBM	Design-Build-Maintain
DBW	Design-Build-Warrant
DOT	Department of Transportation
DSAS	Downhill Speed Advisory System
FMS	Freeway Management System
FTE	Full Time Employee
GPS	Global Positioning System
HAR	Highway Advisory Radio
HazMat	Hazardous Materials
HTCRS	Highway Travel Conditions Reporting System
ICTM	Integrated Corridor Traffic Management
ILD	Inductive Loop Detection
IS	Information Services
ITS	Intelligent Transportation Systems
LED	Light-Emitting Diode
LOS	Level of Service

MCTD	Motor Carrier Transportation Division
MLT	Maintenance Leadership Team
Mn/DOT	Minnesota Department of Transportation
O&M	Operations and Maintenance
ODOT	Oregon Department of Transportation
ORS	Oregon Revised Statutes
OSP	Oregon State Patrol
PAD	Passive Acoustic Detection
PDA	Personal Digital Assistant
PECOS	Performance Controlled System
RPU	Remote Processing Unit
RWIS	Road and Weather Information System
SC&DI	Surveillance, Control & Driver Information
SCATS	Sydney Coordinated Adaptive Traffic System
SSI	Surface Systems Incorporated
STIP	Statewide Transportation Improvement Program
T&M	Time-and-Materials
TDS	Transportation Data Section
TMC	Transportation Management Center (for Caltrans District 7)
TMOC	Traffic Management Operations Center (same as Region 1 TOC)
TOC	Transportation Operation Center
TOS	Traffic Operation System (for Caltrans District 7)
TSMC	Traffic Systems Management Center (for WSDOT)
TSSU	Traffic Signals Services Unit
TWI	Texas Weather Instruments
TxDOT	Texas Department of Transportation
VMS	Variable Message Sign
VSLS	Variable Speed Limit Systems
WIM	Weigh-in-Motion
WSDOT	Washington State Department of Transportation
WTI-MSU	Western Transportation Institute at Montana State University – Bozeman

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APPENDIX A STAKEHOLDER MEETING ATTENDANCE

Stakeholder meetings were held from May 24-27, 1999 in Salem, Oregon and Portland, Oregon. ODOT participants were selected in order to represent a broad geographical and technical cross-section across the agency. ODOT participants in these stakeholder meetings include:

Regional Electricians, May 24, 9 – 11 AM, Salem

Duc Phan, Region 1
Joe Searcy, Region 1
Louis Palazzolo, Region 2
Brian Henry, Region 3
Terry Brock, Region 3
Larry Gettle, Region 4
John Taylor, Region 5
Dave Stiefvater, Region 5
Marsha Duncan, Region 5
Mark Rodgers, Traffic Signals Services Unit

TOC Managers, May 24, 1 – 3 PM, Salem

Dennis Mitchell, Region 1
Dan Dollar, Region 2
Michael Spaeth, Region 3
Dave Neys, Region 4
Marsha Duncan, Region 5
Chuck Larsen, Information Services
Mark Rodgers, Traffic Signals Services Unit

Motor Carrier Transportation Division, May 24, 4 – 5 PM, Salem

Gregg Dal Ponte, MCTD
David McKane, MCTD
Dave Fifer, MCTD
Randal Thomas, MCTD
Chuck Larsen, Information Services

Information Services, May 25, 9 – 11 AM, Salem

Marc Williams
Henry Christensen
Ron Winterrowd
Dennis Jorgenson
William Schlichtman
Marilyn Teleck
Chuck Larsen

Transportation Data Section, May 26, 8:30 – 10 AM, Salem

Tim Thex, Transportation Data Section
Dara Gayler, Transportation Data Section
Jim Batliner, Region 2 Traffic

Traffic Signals Services Unit, May 26, 4 – 5 PM, Salem

Ed Fischer, Traffic Manager
Mark Rodgers, TSSU Manager
Darin Harper, TSSU
Charles Close, TSSU
Robert Fynn, ITS Unit

ITS Executive Steering Committee, May 27, 8:30 – 10 AM, Salem

Bill Ciz
Ed Fischer
Kevin Haas
Gary Johnson
Chuck Larsen
Galen McGill
David McKane
Norm McLachlan

District Managers, May 27, 10 – 11 AM, Salem

Darryl Ficker, Finance
Mo Dichari, District 1
Brent Pierso, District 1
Karla Keller, Region 1
Ron Kroop, District 2A
Larry Olson, District 2B
Charlie Sciscione, District 2C
Kathryn Ryan, Region 2
Bob Wood, District 4
Don Ehrich, District 5
Ted Paselk, District 7
John Vial, District 8
Sam Wilkins, District 9
Mike Buchanan, District 13
Doug Tindall, State Maintenance Engineer

Additional fact-finding trips were made to two of Oregon's TOCs. The following ODOT staff participated in discussions held at the TOCs.

Region 1 TOC (Transportation Management Operations Center), May 25, 1 – 4 PM, Portland

Bill Ciz, Region 1 Traffic Manager
Dennis Mitchell, Region 1 Traffic Engineer
Tom Beggs, Information Services
Jack Marchant, Information Services

Region 2 TOC (Western Regional Dispatch Center), May 26, 1 – 3 PM, Salem

Dan Prodzinski, Region 2
Curtis Cole, Information Services
James Wittenberg, Region 2
Tom Beggs, Information Services
Chuck Larsen, Information Services

APPENDIX B TRANSPORTATION AGENCY MAINTENANCE PLANS

This appendix highlights the six transportation agency plans that were reviewed for this maintenance plan.

B.1 Metropolitan Area Plans

The literature review indicated that the most extensive maintenance planning for ITS has been done in metropolitan areas. This section analyzes four plans based on metropolitan areas, produced through the California Department of Transportation (Caltrans), the Washington State Department of Transportation (WSDOT), the Minnesota Department of Transportation (Mn/DOT) and a plan developed for the national ITS architecture. The first three plans were designed specifically for existing systems, whereas the fourth plan is intended as a blueprint to identify the resources necessary to maintain new ITS infrastructure deployments in a variety of regional settings.

B.1.1 Caltrans District 7

The Caltrans document forecasts the operations and maintenance requirements for the Traffic Operation System (TOS) and Transportation Management Center (TMC) in Los Angeles and Ventura Counties (6). The plan predicts maintenance costs over a ten-year period (1996-2006), with annual requirements gradually increasing as new elements are added to the system. The report evaluates maintenance for TMC hardware and support, as well as the following ITS devices.

- Closed-Circuit Television (CCTV) Cameras
- Variable Message Signs (VMS)
- Ramp Metering
- Vehicle Detection Systems
- Highway Advisory Radio (HAR)
- Changeable Message Signs (CMS)
- TOS Communication System

The Caltrans plan emphasizes the importance of maintenance documentation to track, document, and budget future maintenance tasks. Once a problem in the ITS system is identified, a “trouble ticket” or job control number is opened with information on the problem including a general description, and the part of the system it concerns. An appropriate support group is then assigned to systematically make repairs, documenting all equipment and repair time requirements. The Caltrans plan divides maintenance management into five staffing support groups responsible for specific maintenance categories:

- field support engineers, who are trained on field equipment and responsible for corresponding scheduled and unscheduled maintenance activities;
- system engineers, who are responsible for technical support, and maintenance of the TMC computer system;

- TMC users/operators, who are responsible to report difficulties/problems in the system, thus preventing breakdowns;
- technicians, which "consist of the electrical maintenance workforce"; and
- contract staff, who are responsible for contracted maintenance activities.

In addition to these support groups, the plan describes two seven-person technician teams who are responsible for communications and TOS/TMC terminal equipment and twisted-pair, coaxial, and fiber optic cable maintenance, respectively. While each support group is assigned a specific responsibility, frequently they are required to collaborate to maintain certain ITS elements.

Maintenance is divided into categories of scheduled maintenance and unscheduled maintenance. Both preventative maintenance and repair maintenance are included in each of these categories. Preventative maintenance is considered primarily a scheduled maintenance activity, although it is also included in the unscheduled maintenance category. For example, if a repair takes place at a given site a technician might also perform preventative maintenance at the same site. Repair maintenance is primarily an unscheduled maintenance activity that is prioritized in order to organize backlogged maintenance tasks. Tasks are divided into four priority levels.

1. Immediate response including overtime and after-hours call-back
2. Requires early attention should be undertaken by next work day
3. Requires early attention should be undertaken within 72 hours
4. Should be undertaken within one month

All repair and preventative maintenance tasks are prioritized on the basis of public safety, traffic service, preservation of facility/operational integrity, and general appearance of equipment to the public.

The plan recommends that some of the maintenance responsibilities be provided by contractors, due either to the specialized nature of some sub-systems or because of manpower limitations. Training is recommended for tasks regularly performed, but Caltrans would rely on outside support if the cost of training is deemed greater than contract/vendor support. The manufacturer generally covers failed components for the local area network and computer, and replacement of these components is not the responsibility of Caltrans staff. For equipment not covered by manufacturer warranty, the plan includes an extensive list of parts that should be kept in stock along with specialty tools that may be necessary.

Once responsibility for maintenance tasks was established, the Caltrans report determined scheduled and unscheduled maintenance support costs for each element based on the required hours of labor, travel time, spare parts and agreements, training, tools, and test equipment necessary to maintain each of the system devices. The combined labor costs (derived from assumed labor salaries), and maintenance support costs were then totaled to determine the required funding for the entire Caltrans system per year over the given ten-year period. This plan acknowledges that the costs of the Caltrans system will rise as elements approach their expected life, however, does not examine the associated replacement costs.

The Caltrans report addresses many of the same goals as the ODOT ITS plan, and provides a sound methodology for estimating maintenance budgets. As a regional plan, however, it makes assumptions about travel time that would not be as applicable to a statewide plan. It also does not provide much information on how personnel will be trained to perform maintenance activities.

B.1.2 Washington State Department of Transportation – Seattle area

The Surveillance, Control, and Driver Information (SC&DI): Implementation and Operations Plan outlines the ITS system operated by the Washington State Department of Transportation (WSDOT) for metropolitan Seattle (7). This plan was written for WSDOT as an SC&DI system expansion guide, and "also to allow other agencies to observe the progress on the system." The subsystems used and analyzed in the SC&DI system are:

- surveillance, including vehicle detection system, CCTV cameras, computer aided dispatch (CAD), scanner, and Northwest Region Radio Dispatch;
- control, including ramp meters; and
- driver information, including VMS, HAR, commuter information telephone line, Internet, and direct access to the central computer.

The WSDOT report outlines its recommended maintenance model within this document, describing maintenance tracking and documentation procedure. WSDOT uses a fundamental three-step tracking procedure.

1. Report the problem.
2. Verify and repair the problem.
3. Log the maintenance activity.

Traffic Systems Management Center (TSMC) operations staff and SC&DI maintenance personnel perform the majority of the repair maintenance tasks within this system. To ensure a "smoothly operating system," WSDOT emphasizes the importance of "direct contact between the SC&DI engineers and the maintenance technicians." All performed maintenance activities are logged into a Microsoft Access database where they can be used for forecasting future maintenance needs and costs, and for tracking system problems.

System maintenance has been divided into two categories: preventative maintenance and repair of malfunctions, or repair maintenance. While WSDOT affirms the importance of preventative maintenance, it recognizes that most preventative maintenance does not follow any given schedule. In general, preventative maintenance is performed while a technician is at the location for repairs on another system. For this reason, WSDOT keeps accurate records of preventative maintenance as it is performed to avoid duplicating maintenance tasks unnecessarily. This report included a table of the ideal frequency for preventative maintenance activities on each of the given ITS devices.

To avoid slow repair of malfunctions on crucial equipment, each of the given ITS components is prioritized in this plan according to the amount of time necessary to make a repair, and the importance of the ITS equipment. The document lists recommended response times for each device. To further increase efficiency of repairs, spare parts are stored for ITS components that frequently are in need of repair, and an inventory is kept for reordering information.

The plan lists the staff required to adequately operate the TSMC, and their respective monthly salaries. The staff includes freeway operations, SC&DI operations, flow, and software engineers, as well as flow operators, computer programmers, and traffic system operations specialists. Unfortunately, the relationship between maintenance tasks discussed and the tabulated staffing levels required to perform these tasks is not provided in this document. WSDOT offers maintenance training for technicians to learn software and equipment used in the ITS system, so that staff can further their ability to perform system repairs. When enough interest is shown in additional training classes, WSDOT provides the class for its staff, either directly or indirectly through other institutions.

The maintenance and personnel costs are provided along with power, phone and vehicle costs to determine the total monthly cost of operating and maintaining the SC&DI system. The estimate for SC&DI maintenance costs, including parts, labor, and equipment, is $115,000 per month or $1,380,000 annually, which is expected to increase as preventative maintenance is incorporated into maintenance procedures. Personnel costs are determined using average hourly salaries. This plan assumes that all new or planned ITS equipment will be on line by the year 2000. The procedures for bringing new equipment on line are suggested in this report, so that SC&DI system failure will not occur due to faulty equipment.

ODOT staff has identified this report as a good model for ODOT's ITS maintenance plan. Indeed, the SC&DI plan provides clear maintenance procedures, preventative maintenance schedules, and budgets. It does not, however, establish a clear relationship between the number and type of device deployed, and the maintenance staff needed to maintain them.

B.1.3 I-494 Corridor – Minneapolis area

The Integrated Corridor Traffic Management (ICTM) Project is a federally-funded advanced technology implementation test designed to demonstrate improved traffic along the Interstate 494 corridor in Minneapolis/St. Paul. The ICTM Maintenance Plan report was submitted to the I-494 ICTM Operations Committee to describe the maintenance roles and responsibilities of the agencies participating in the ICTM project (5). This maintenance plan reviews the maintenance requirements of the following ICTM/ITS systems and devices:

- CCTV cameras,
- emergency vehicle signal preemption systems,
- ramp meters,
- video detection systems,
- loop detectors,
- traffic control signs (fixed & portable VMS, route guidance, static signs),
- HAR signs,
- signal controllers,
- hardware interconnect systems,
- fiber optic communications systems, and
- twisted pair cable.

Because several agencies are involved in the ICTM project, each incoming system error is monitored by a system operator who notifies the appropriate agency of possible system failures. The agency then dispatches the on-call technician to repair the failed system, at least temporarily, and log the repair activities performed and further repair requirements. This work log is then faxed to the system operator who tracks future activities to ensure the problem is rectified. The final results of maintenance activities are logged and kept on record.

Maintenance activities are divided into preventative, critical, and non-critical maintenance tasks. This report gives a limited list of required maintenance tasks on traffic signal components, CCTV and Autoscope (video detection) equipment. For other devices, the ICTM maintenance plan requires agencies working on the ICTM project to incorporate a preventative maintenance plan into their existing maintenance plan. The ICTM plan recommends that preventative maintenance be performed "at time intervals as specified by the equipment suppliers/manufacturers." Estimations on the required preventative maintenance tasks and costs are also provided in this report for each individual component.

Critical and non-critical maintenance costs are tabulated in this report for each system component in the ICTM project. These tasks are performed based on their priority and importance to the overall system. Each ITS element is prioritized, and the maintenance activities are identified as critical or non-critical tasks based on its importance to the overall system. Minimal repairs may be made on lower priority components, to ensure higher priority systems remain operational. Estimated annual replacement and service costs are tabulated in the ICTM maintenance plan. Support for these figures is not clearly explained in the report; however, some assumptions are listed with these figures.

All new equipment is required to have a minimum one-year warranty according to the contract provided by manufacturers of the equipment. The manufacturers are also required to provide support during the equipment test period along with maintenance training for new equipment. This report assumes all maintenance will be performed using in-house support, except in the case of specialty equipment requiring detailed maintenance. The plan identified the following specialized equipment as requiring outside support:

- Sydney Coordinated Adaptive Traffic System (SCATS) hardware and software,
- CCTV systems,
- VMS,
- communication systems, and
- video detection systems.

The use of outside support will eliminate the need to stock expensive equipment for infrequent specialized maintenance tasks. This report recommends that all agencies involved should develop a procurement process, which would allow staff to hire outside assistance without unnecessary delays.

The report lists new equipment which will be installed and estimated quantities; however, the report simply addresses the maintenance costs for a fully operational system. The replacement costs of equipment are assumed to be identical to the original costs, and maintenance costs are assumed to be the same with newly implemented equipment as with older equipment. Based on the cost of repairs and replacement estimations, the annual maintenance cost for each system component is tabulated in this report along with the person-hour requirements to perform the maintenance tasks. The costs of maintenance are estimates based on manufacturer reliability predictions and assumptions made by the report itself.

This plan shares many common elements with the purpose of the ODOT plan. It places great emphasis on coordinating activities between different jurisdictions, and on prioritizing maintenance activities. The biggest drawback in the ICTM plan in relation to ODOT's goals is that it is geographically narrow in scope.

B.1.4 National ITS Architecture

The ITS Cost Analysis Document (8) is a segment of the ITS National Architecture program whose purpose is "to produce a high-level estimate of the expenditures associated with implementing the physical elements and the functional capabilities of ITS services," and also "to provide a costing tool for ITS implementers." The document provides cost estimates for individual ITS equipment packages, develops deployment packages for three generic geographic areas, and then produces final cost estimates for ITS in each of these areas.

An extensive array of ITS equipment packages is discussed in this document, along with the life cycle of each component, its unit price, comparative technologies, and retail price. Component information varies based on the availability of data. This document assesses the non-recurring expenditures and recurring expenditures, in five-year increments, for the next twenty years. The non-recurring costs are considered one-time capital costs, including replacement costs at the end of the useful life of equipment. The recurring costs listed are the annual operations and maintenance costs averaged for each five-year segment.

The document then evaluates the total ITS costs associated with typical ITS infrastructure that might be deployed in major urban areas, inter-urban areas, and rural areas. Non-recurring and recurring costs are tabulated for each of these three system locations, providing a final ITS budget.

This report provides brief background information on each ITS device under evaluation, as well as specific budgeting costs for each item. However, the document is unclear as to what maintenance tasks make up the recurring costs (i.e. preventative versus repair maintenance tasks), and no budgetary distinction is made between operations and maintenance costs. Consequently, it would be difficult to assess maintenance staffing requirements based solely on this report. The more specific cost detail required by the ODOT ITS maintenance plan is not provided by this report, and therefore this report can only provide limited support in the ODOT effort.

B.2 Statewide Plans

In researching other state DOTs, it does not appear that there are any maintenance plans similar to what ODOT is pursuing. Other states have deployment plans for ITS elements or the communications infrastructure to support ITS, but these plans have not addressed future maintenance needs in great detail. Two states were identified as having made and documented systemwide efforts to identify maintenance needs for the ITS infrastructure: Arizona and Texas.

B.2.1 Arizona Department of Transportation

The Arizona Department of Transportation (ADOT) commissioned a study to develop cost models for forecasting future costs for operating and maintaining ADOT's existing and planned ITS infrastructure (9). Using ADOT's highway maintenance work management system, called the Performance Controlled System (PECOS), a majority of the operations and maintenance (O&M) costs for ADOT have been recorded including costs for several ITS devices, and this information has been used in this report to forecast future O&M costs. O&M cost estimates from other DOTs have also been used for elements that have not been adequately studied by ADOT. Cost estimates are developed for the following ITS devices:

- automatic vehicle classification, which is based on piezoelectric sensors;
- CCTV cameras;
- node room, which is the communication hub for the Phoenix Freeway Management System (FMS);
- power cabinet, which serves as the electric power service for the FMS;
- ramp meters, using both inductive loop detection (ILD) and passive acoustic detection (PAD);
- road and weather information systems (RWIS), including central processing units (CPU) and remote processing units (RPU);
- traffic monitoring systems, including existing ILD and PAD, as well as future vehicle detection stations;
- VMS;
- vehicle detection systems, for automatic vehicle counting systems deployed as part of rural ITS; and
- weigh-in-motion (WIM) systems, including piezoelectric- or bending plate-based sensors.

ADOT uses PECOS to track their O&M costs for their ITS infrastructure. The system requires that information such as type of inventory feature and labor, equipment and materials expended on the job are recorded and entered into PECOS by each maintenance organization via a dial-up communication link. Fiscal year O&M costs can then be predicted using this recorded data.

O&M costs are tabulated in this report as preventative maintenance, demand maintenance, replacement costs, and operations costs. Preventative maintenance and demand maintenance costs are subdivided into labor, equipment, materials, and man-hours categories. Preventive maintenance costs were founded on the previous year's costs and performance guidelines, which define standard labor, equipment and material quantities for various preventative maintenance activities. Demand maintenance also used the previous year's information, but due to insufficient data on the subject, the cost models used additional assumptions not listed in this report. Replacement costs were based on the device life cycle information provided by ADOT staff members and people familiar with equipment repair and breakdown history. Replacement costs listed in this report used current equipment costs, assuming that the cost of state-of-the-art equipment in the future will be the same as the cost of the state-of-the-art equipment available in the present.

Staffing requirements are listed in terms of required man-hours for each of the ITS elements tabulated. Most ITS maintenance for ADOT is centrally performed out of Phoenix, and the costs of maintaining the ITS infrastructure are evaluated as such. However, future ADOT facilities may be established at decentralized locations to monitor other elements of the system. Any decentralization of ADOT would alter the O&M costs of the system and these costs are not evaluated.

This report provides an excellent database of historical costs of maintenance on individual ITS elements. Its use of historical cost data in forecasting future maintenance needs provides a clear example of the benefit ODOT can yield in budgeting through developing a statewide maintenance management system. The document does not, however, describe the maintenance model used for processing ITS maintenance, nor does it address training or contracting issues.

B.2.2 Texas DOT

The Texas Department of Transportation (TxDOT) commissioned a study, completed by the Texas Transportation Institute, which sought to provide a policy-level analysis of the funding issues associated with ITS and advanced traffic management system (ATMS) operations and maintenance (10). This study intended to lay out an accurate method of predicting the O&M costs for their ITS/ATMS system, and to identify options for obtaining appropriate funding levels. This report covers more than sixty ITS devices, which are divided into the following categories.

- Traffic Management Center. This includes all elements associated with traffic management centers, including facility utilities and security, computers, transmission and multiplexing equipment, associated software and hardware, and CCTV video display.

- Field Communications/Processing. This includes communications media, processing satellites, communication hubs, and controller cabinets.

- Surveillance Elements. Elements included in this plan include various freeway-monitoring devices, weather and environmental sensors.

- Traffic Control Elements. This includes all elements associated with traffic control, such as traffic signals and ramp meters.

- Traveler Information Elements. All elements used to convey traveler information to the motorist are included in this, such as VMS, HAR and kiosks.

- Incident/Emergency Response Elements. All elements used to monitor and manage freeway incidents are included in this category, such as freeway service patrols, portable VMS, and incident management vehicles.

The report develops a table, which includes O&M cost estimates for each element on a per unit basis. Elements are listed by category, along with the estimated maintenance costs, operations costs, and key cost assumptions for each element. Maintenance costs includes both preventative and repair maintenance necessary to keep the system operating at "tolerable" levels. The cost assumptions listed identify which components make up the operations and maintenance costs. This table gives TxDOT a budgeting technique for their system and indirectly a method for establishing funds. However, as the report states, "The table does not provide guidelines for determining appropriate operations or maintenance staffing levels, only the estimated cost per employee." The primary emphasis of this report is "funding issues associated with ITS/ATMS O&M," and not establishing a maintenance plan for ITS/ATMS systems.

The financial and budgetary aspects of running the TxDOT's system are extremely detailed in this report. The funding difficulties of the existing and future system are discussed, as well as possible solutions to funding problems. This report also gives recommendations for the reinvestment of funds into the current ITS system for upgrading or replacing equipment.

The estimates of maintenance costs for each element by unit could be an approach for the ODOT ITS maintenance plan. However, the report does not provide adequate detail for a maintenance plan, relying on others to develop plans within allotted funding levels.

APPENDIX C ALTERNATIVE MAINTENANCE MODELS

This appendix will summarize the four alternative maintenance models that were reviewed by ODOT stakeholders during August 1999, highlighting each alternative's distinctive features. This will be followed by a summary of stakeholder comments regarding these models.

Of the numerous alternatives that were developed, four alternatives were selected for presentation to ODOT staff. These particular models were selected to highlight key strategic decisions that need to be made by ODOT in deciding how ITS maintenance should be done. Three principal assumptions guided the development of maintenance model alternatives.

1. Each alternative should build upon the existing ODOT organizational structure.
2. Each alternative should include systematic logging and tracking of maintenance.
3. Additional staff will be available for ITS maintenance, although the maintenance model will be used to help identify how these staff should fit into ODOT's organizational structure.

For each of the four alternatives, a flow chart showing the repair procedure is included, along with a table highlighting roles and responsibilities.

C.1 District/Regional Maintenance

The district/regional maintenance model may be considered the base case model as it most closely reflects ODOT's current organizational structure. The model is intended to preserve maintenance functions in their existing structure within the ODOT organization; therefore, it leaves the responsibility for performing maintenance at the district and/or regional level.

Figure C-1 shows how the reporting process under this model works. Descriptively, the model works as follows:

- Problem diagnosis. Once a problem is reported, the TOC dispatches a regional electrician to diagnose the problem. It is assumed that the electrician will have adequate training to be able to successfully diagnose, if not repair, most ITS problems. If the electrician is unable to diagnose the problem, the electrician will report it to a TSSU technician. If the TSSU technician is unable to diagnose the problem, the TOC is notified and dispatches vendor service to perform a diagnosis.
- Problem repair. Whoever is able to diagnose the problem has significant responsibility in determining how the problem will get resolved. If the electrician diagnoses it and is able to fix it, the repair will be made as soon as possible. If the electrician has diagnosed the problem but is not technically competent to fix the problem, the electrician will contact the next appropriate level of support. If the problem is identified as occurring in the field device, a TSSU technician would be dispatched to complete the repair. For other problems, such as network connections,

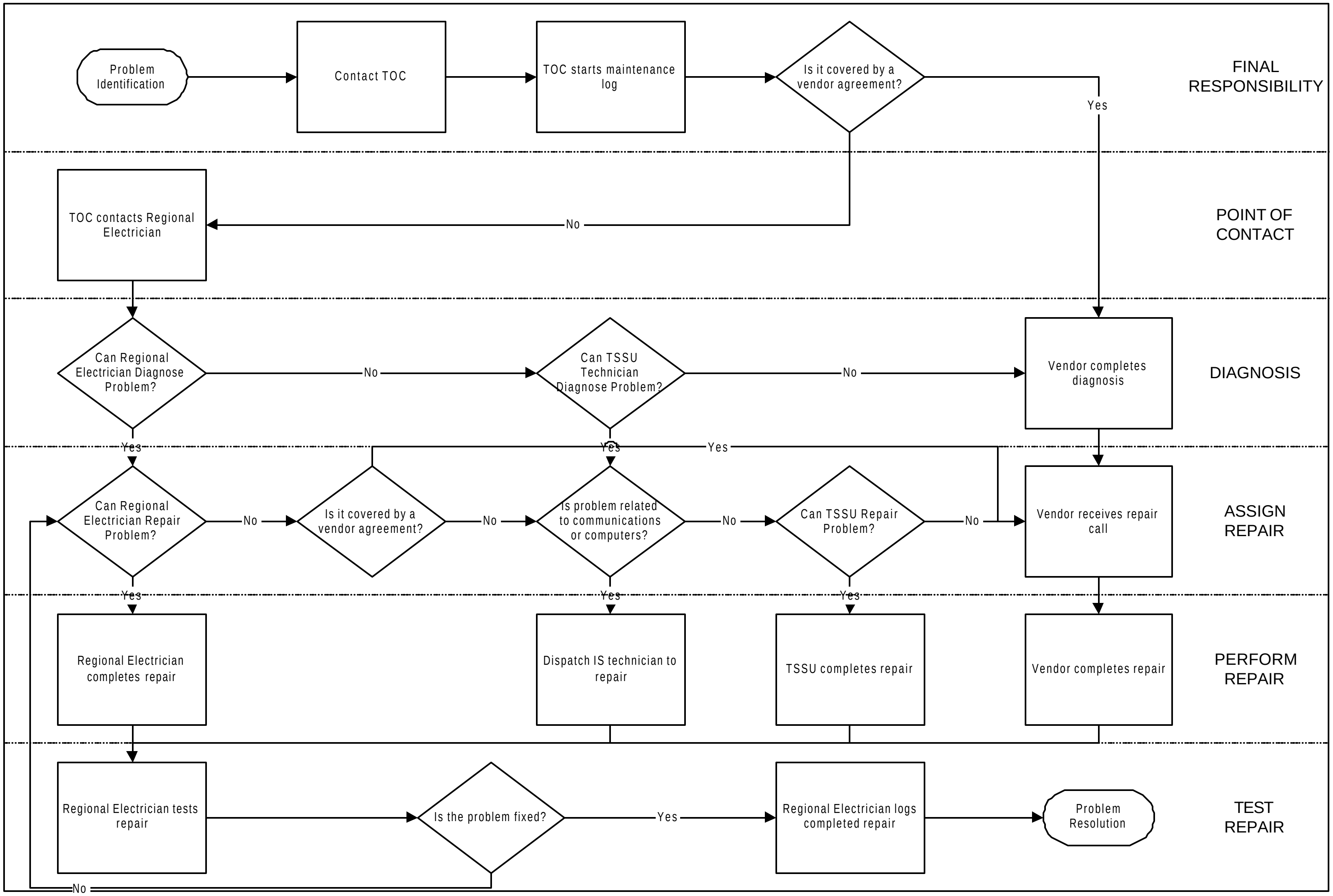

Figure C-1: Repair Process for Regional/District Maintenance Model.

communications support, and computers for back-end ITS support, an Information Services technician would be assigned. If ODOT staff is unable to repair the problem, the vendor is dispatched.

- Solution testing. After the repair has been completed, the next step is to confirm that the repair has been successful. This requires testing the ITS device to ensure that it is working properly. The regional electrician would be in the field to ensure the device is working properly, although they may need to coordinate with others to perform testing (such as sending test messages to a VMS).

- Logging and tracking. Documentation is needed to track the problem from the beginning through the repair process, and onto notification of the TOC. A paper tracking system may be used, where the paper is handed off from one technician to the other during the process, noting all maintenance tasks performed, until the repair is completed. In the long-term, this system may be supplemented or replaced with a purely computerized system, perhaps using personal digital assistants (PDA) to enter and receive data.

Table C-1 indicates roles and responsibilities for various groups within ODOT. For most groups, this model represents a preservation or expansion of existing maintenance roles. The TOCs will become a more central coordinating point for ITS maintenance, having oversight responsibility for the maintenance process. The responsibilities of regional electricians will expand such that they are able to diagnose most ITS problems and are able to test the effectiveness of repairs. They will be responsible for whether a vendor should be called instead of using existing resources. This would be done depending upon the extent of warranty coverage and upon the TOC's determination of the urgency and severity of the repair need. Electricians will also be responsible for tracking maintenance activities once a repair request has been received from the TOC. Other staffing levels perform similar functions to what they currently provide. Information Services will provide, perhaps on an on-call basis, technical support for communications and computer-related ITS repairs outside of the field device. TSSU may be summoned to provide additional technical support for the field device or sensors. Vendors may be brought in once all internal channels are exhausted.

C.2 Coordinated ITS Maintenance

An alternative to integrating ITS maintenance into the existing maintenance process is to remove all ITS maintenance responsibility from the districts and regions and put it into a separate organizational unit. This alternative, called the coordinated ITS maintenance model, would create a new staff position called regional ITS support coordinator. This position would be responsible for coordinating all ITS maintenance-related activities at the regional level. This model acknowledges the current reality that, due to resource constraints, ITS maintenance is not consistently being performed at the regional and district level at a level consistent with device demands. It is hoped that this separate unit would have adequate resources on its own to do ITS maintenance. If successful, this would free regional electricians from ITS activities to perform more traditional maintenance activities.

ODOT Organizational Unit / Title	Primary Role	Primary Maintenance Responsibilities
TOC	Oversight for ITS maintenance	• Initiates the maintenance process • Initiates the maintenance record
District/Regional Maintenance Staff	First line of ITS maintenance	• Determine if vendor should be first point of contact for a particular repair • Perform initial diagnosis • Repair problems to the extent they are capable • Test repairs • Complete repair log • Track entire maintenance process
Information Services	Second line of ITS maintenance	• Repair problems related to communications and computers for back-end ITS equipment including network connections to roadside devices
TSSU	Second line of ITS maintenance	• Diagnose and repair problems beyond capability of regional electricians for roadside devices and sensors
Vendors	Last line of ITS maintenance	• Fulfill vendor maintenance agreements • Diagnose and repair problems beyond ODOT capabilities

Table C-1: Roles and Responsibilities for District/Regional Maintenance Model.

Figure C-2 shows how the reporting process under this model works. Descriptively, this model works as follows.

- Problem diagnosis. Once a problem is reported, the TOC dispatches the regional ITS support coordinator. The support coordinator will be the single point-of-contact for maintenance, making decisions as to which ODOT staff are brought in and when, as well as when contract support should be utilized. The support coordinator will make the first effort at diagnosing the problem. If necessary, the regional support coordinator may seek TSSU support to help diagnose the problem. If the regional ITS support coordinator cannot diagnose the problem, the support coordinator would call in the appropriate vendor.

- Problem repair. The regional ITS support coordinator will fix the device to the extent they are capable. In some cases, they may make simple repairs for which a vendor could be called but is unnecessary to do so, such as re-booting a server. If the support coordinator is unable to fix the problem, they will direct the repair to the appropriate party. It is not expected that the support coordinator will be capable of fixing all ITS

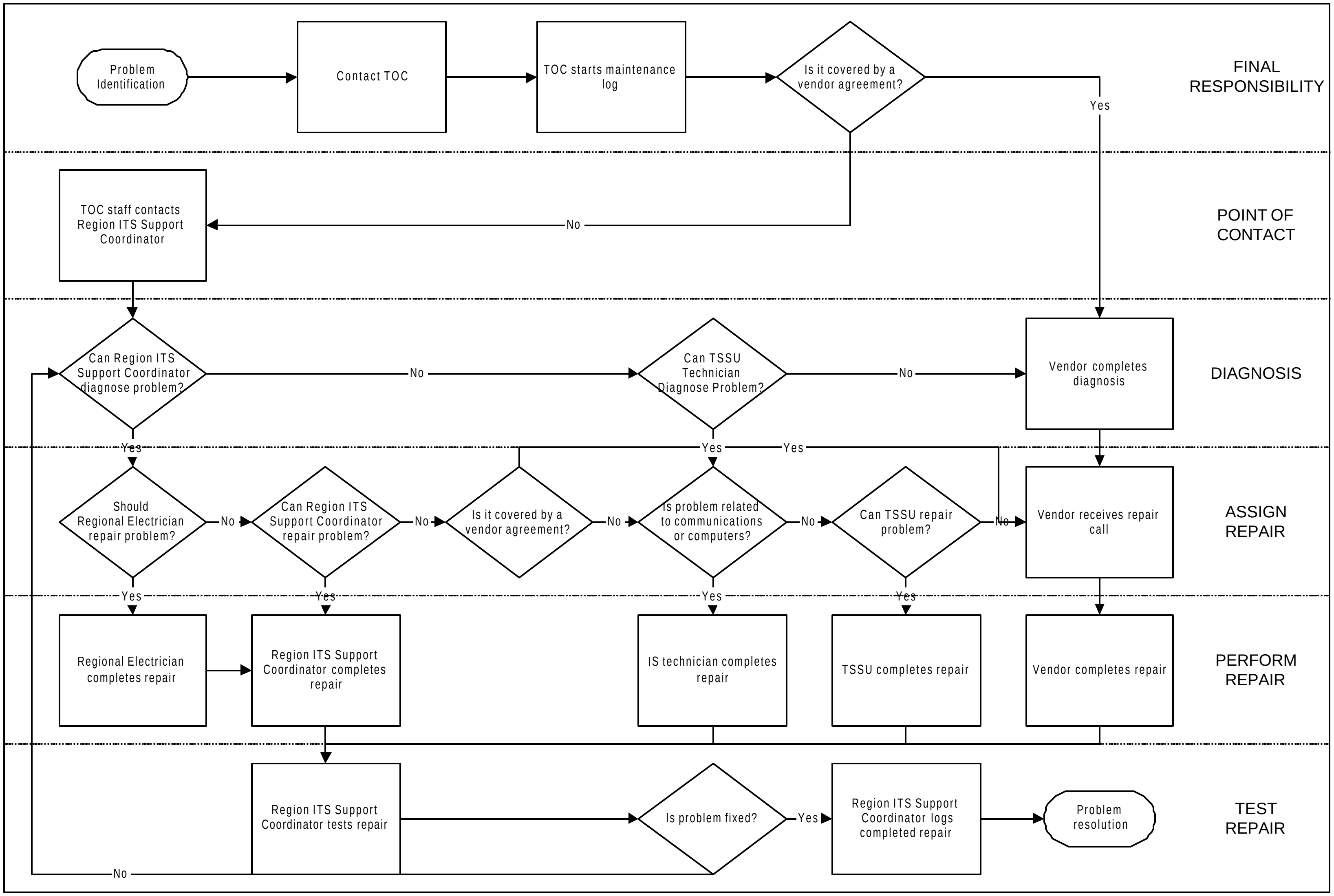

Figure C-2: Repair Process for Coordinated ITS Maintenance Model.

problems, but this individual should be able to readily identify who needs to be brought in to fix problems. As was assumed in the district/regional model, Information Services would be brought in for communications and computer-related problems outside of the field device, while TSSU would be dispatched for problems at the field device level.

- Solution testing. After the repair is completed, the support coordinator is responsible for verifying that the repair has been successful.

- Logging and tracking. The regional ITS support coordinator is responsible for logging and tracking maintenance activities upon being contacted by the TOC. The TOC will initiate a maintenance record, but it is the support coordinator's responsibility to complete the record, identifying actions taken, individuals contacted, and the corrections made.

As shown in Table C-2, the coordinated ITS maintenance model would represent a significant change in the role of the district and regional maintenance personnel in ITS maintenance. Their role under this model would be primarily to report problems, and perhaps to assist in preventative maintenance activities if appropriate, although these would need to be coordinated through the regional support coordinator. The regional electricians would also have involvement in problems for which special training, such as an electrician's license, or specialized equipment, such as bucket trucks, are required. This model puts the regional ITS support coordinator on the front line for ITS maintenance in place of the regional electrician's role under the district/regional model. The support coordinator would be expected to perform most device diagnostics, many device repairs, post-repair testing and logging. This requires a combination of an extensive skill set for the support coordinator and/or the ability to get staff with the appropriate specialized skills from throughout ODOT's organization to address the problem quickly.

C.3 Two-Tier

Instead of an "either-or" system where ITS maintenance either is done entirely within the existing maintenance structure or is done by a completely separate unit, one alternative model would be to combine the strengths of these models for a two-tiered approach based on technology. One tier would consist of "mainstream devices" – i.e. devices which have become standardized within ODOT and for which repair training is adequate for ODOT to be capable of handling nearly all diagnostic and repair capabilities in-house. This would include devices such as traffic signals, ramp meters, and road and weather information systems (RWIS). In some cases, a device may be mainstream in one region but not in another due to broader deployment experience. For example, closed circuit television (CCTV) cameras would likely be mainstream in Region 1, but they may not be mainstream yet in some of the rural regions. The second tier would be comprised of "emerging technologies" – i.e. devices which may be limited or non-standardized in deployment. Emerging technologies would be classified not necessarily as technologically new technologies, but technologies that are relatively new to ODOT. Therefore, this would include new technologies such as travel time estimation and automatic incident detection systems, as well as older but non-standardized technologies such as variable message signs (VMS).

ODOT Organizational Unit / Title	Primary Role	Primary Maintenance Responsibilities
TOC	Oversight for ITS maintenance	• Initiates the maintenance process • Initiates the maintenance record
Regional ITS Support Coordinators	First line of ITS maintenance	• Determine if vendor should be first point of contact for a particular repair • Perform initial diagnosis • Repair problems to the extent they are capable • Test repairs • Complete repair log • Track entire maintenance process
District/Regional Maintenance Staff	Second line of ITS maintenance	• Identify device failures • Provide early notification • Perform maintenance requiring specialized equipment, such as bucket trucks • Perform maintenance requiring specialized training, such as an electrician's license
Information Services	Second line of ITS maintenance	• Repair problems related to communications and computers for back-end ITS equipment including network connections to roadside devices
TSSU	Third line of ITS maintenance	• Diagnose and repair problems beyond capability of support coordinator and electrician for roadside devices and sensors
Vendors	Last line of ITS maintenance	• Fulfill vendor maintenance agreements • Diagnose and repair problems beyond ODOT capabilities

Table C-2: Roles and Responsibilities for Coordinated ITS Maintenance Model.

Over time, perhaps as long as five to ten years, it is hoped that emerging technologies would become “mainstreamed.” As devices are mainstreamed, the support coordinators would be responsible for ensuring electricians are adequately trained to perform diagnostic and repair maintenance.

The repair process for this model is shown in Figure C-3. The two-tiered model looks slightly more complicated than the previous alternatives analyzed because it has an additional decision layer based on whether a ITS technology has been mainstreamed yet. However, the model is fundamentally similar to the coordinated ITS maintenance model in that it provides for the support coordinator to be the single point-of-contact once the TOC learns of an ITS device failure. The process itself differs depending upon what type of ITS device is in need of repair.

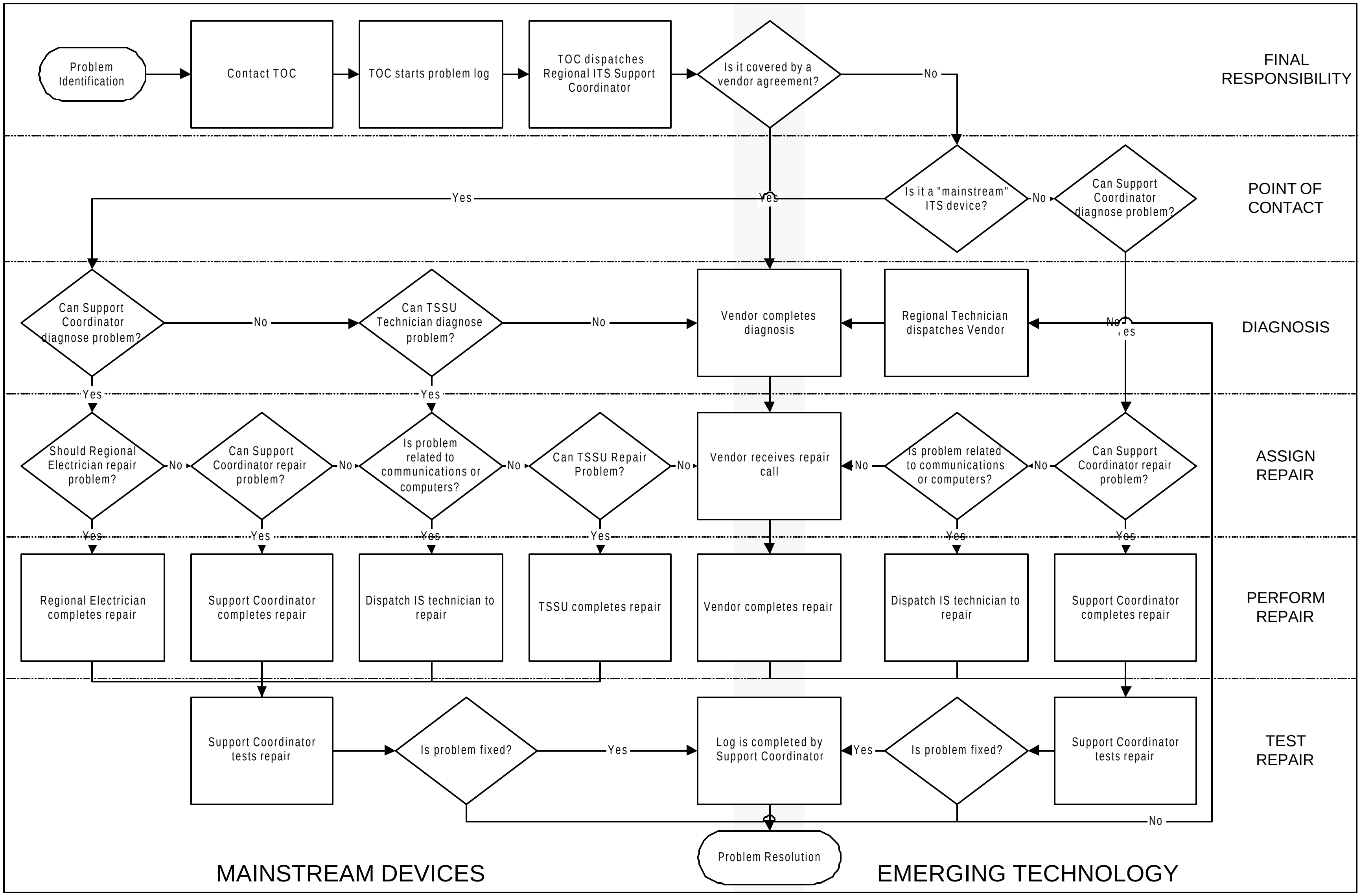

Figure C-3: Repair Process for Two-Tier Maintenance Model.

- Mainstream devices. If the device has been mainstreamed, regional electricians should be able to fully diagnose and repair most problems on most occasions. Once the problem is diagnosed, the electrician will complete the repair, or if the electrician is unable to repair the problem, Information Services, TSSU or ultimately the vendor may be contacted. This parallels current maintenance practices on traffic signals, where TSSU is called in if the regional electricians are unable to satisfactorily resolve a signal malfunction. It should be emphasized, however, that even on mainstream devices the support coordinator is the point-of-contact responsible for tracking maintenance and ensuring that all maintenance activities are accurately logged.

- Emerging technologies. If the device has not yet been mainstreamed, then the regional ITS support coordinator will be the first line of repair. In some cases, non-mainstreamed devices will have vendor warranties covering maintenance for a certain period of time. In most cases, however, the support coordinator may need to be well acquainted with several technologies of the same device in order to be able to perform diagnostics and most simple repairs. For communications and computer-related problems, the support coordinator would dispatch Information Services for support. The vendor would be used as a final line of support.

Table C-3 highlights the roles and responsibilities of ODOT staff under a two-tiered approach. At the district or regional maintenance level, electricians will need to be in a continual learning mode in order to become familiar with technologies as they are mainstreamed. Because increased deployments would place a greater maintenance burden on the districts, this model requires that districts need to be able to expand staffing levels as the number of mainstream devices increases. The regional support coordinators would continue to be the single point-of-contact for maintenance, and would have a role in training the regional electricians, but their larger responsibility would be to handle the maintenance of emerging technologies. Like the regional electricians, the support coordinators will need to be in a continual learning mode in order to stay abreast of current and future ITS deployment technologies.

C.4 Contractor-Based

The final model alternative to be considered parallels what is being done by ODOT's Motor Carrier Transportation Division: rely on a contractor to perform and track all maintenance activities. This would enable ODOT to maintain additional ITS technologies and devices without having to be concerned about staffing constraints. It frees ODOT of the responsibility of learning new technologies, and – as Figure C-4 indicates – it can potentially simplify the maintenance process by reducing the number of hand-offs among ODOT staff.

The Motor Carrier Transportation Division has expressed satisfaction with its current contract maintenance arrangement. They have what is termed an "extended warranty" provided by the original equipment manufacturer to perform maintenance services adequate to keep their devices in good working order. The contract includes performance specifications for reporting, tracking, and response time.

ODOT Organizational Unit / Title	Primary Role	Primary Maintenance Responsibilities
TOC	Oversight for ITS maintenance	• Initiates the maintenance process • Initiates the maintenance record
Regional ITS Support Coordinators	First line of ITS maintenance	• Determine if vendor should be first point of contact for a particular repair • Coordinate repair activities • Track entire maintenance process Mainstream Devices • Lead field repair efforts after unsuccessful repair Emerging Technologies • Diagnose most ITS problems • Repair problems to the extent they are capable • Test repairs • Complete repair log
District/Regional Maintenance Staff	First line of ITS maintenance for mainstream devices; no responsibility for emerging technologies	Mainstream Devices • Perform initial diagnosis • Repair problems to the extent they are capable • Test repairs • Complete repair log Emerging Technologies • No ITS maintenance responsibilities
Information Services	Second line of ITS maintenance	• Repair problems related to communications and computers for back-end ITS equipment including network connections to roadside devices
TSSU	Third line of ITS maintenance for mainstream devices; no responsibility for emerging technologies	Mainstream Devices • Diagnose and repair problems beyond capability of regional electricians for roadside devices and sensors Emerging Technologies • No maintenance repair responsibilities
Vendors	Last line of ITS maintenance for mainstream devices and emerging technologies	• Fulfill vendor maintenance agreements • Diagnose and repair problems beyond ODOT capabilities

Table C-3: Roles and Responsibilities for Two-Tier Maintenance Model.

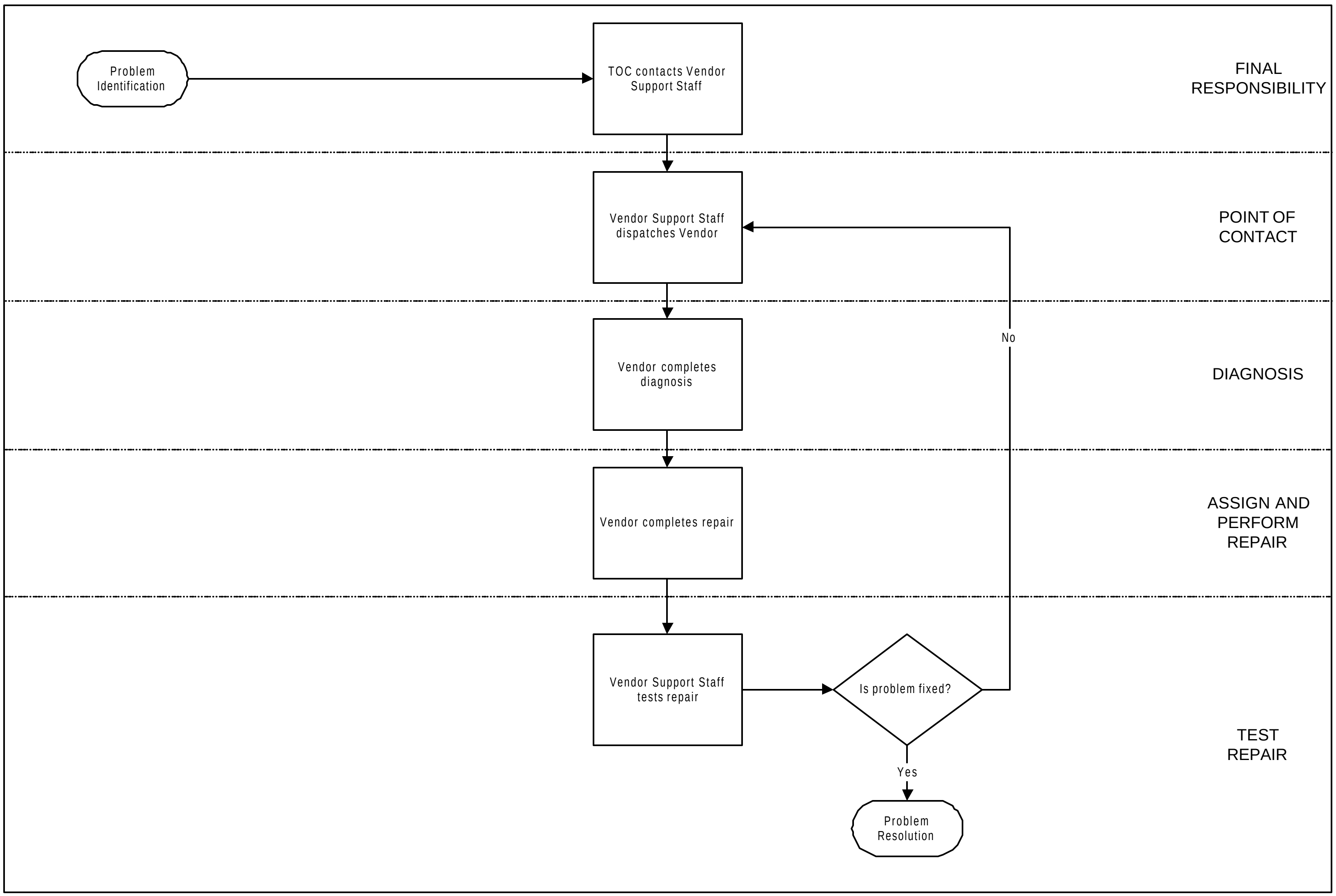

Figure C-4: Repair Process for Contractor-Based Maintenance Model.

ODOT Organizational Unit / Title	Primary Role	Primary Maintenance Responsibilities
TOC	Oversight for ITS maintenance	• Initiate the maintenance process
Contract Support Staff	ODOT interface with ITS maintenance vendor	• Contact the contractor to perform a repair • Identify and coordinate handoffs between contractors, and between vendor and ODOT • Test all repairs to ensure repair has been satisfactory • Track contractor performance in meeting obligations
Contractors	Perform ITS maintenance	• Diagnose all problems • Repair all problems • Log and track all maintenance tasks
Information Services	Perform ITS maintenance related to ODOT's wide-area network	• Perform communications and computer-related maintenance issues as identified by contract
District/Regional Maintenance Staff, TSSU	Limited role in ITS maintenance	• Perform maintenance requiring specialized equipment, such as bucket trucks • Perform maintenance requiring specialized training, such as an electrician's license • Perform basic repairs (i.e. rebooting a server)

Table C-4: Roles and Responsibilities for Contractor-Based Maintenance Model.

Under a contractor-based model, there will be a need for some coordination between contractor-supported infrastructure and ODOT-supported infrastructure. This is especially true for any interfaces that a device has with ODOT's wide-area computer network or proprietary communications links. Consequently, this model includes a contract support staff position who would be responsible for understanding where the contractor's area of responsibility ends and where ODOT staff needs to assist.

As Table C-4 shows, a purely contractor-based model greatly reduces the ITS maintenance responsibilities of ODOT staff. On the other hand, a purely contractor-based model may be difficult to implement on a statewide level without being prohibitively expensive.

C.5 Comparison of Alternatives

Table C-5 presents a table comparing each of the four model alternatives that have been presented. The table summarizes some of the information about each alternative's maintenance process, as well as presenting key advantages and disadvantages of each alternative.

	District/Regional Maintenance Model	Coordinated ITS Maintenance Model	Two-Tier Maintenance Model	Contractor-Based Maintenance Model
Description	Perform all maintenance through districts and regions	Coordinate ITS maintenance activities through a separate ITS maintenance unit	Coordinate ITS maintenance based on whether technology is mainstream or emerging	A contractor performs all maintenance activities
Identification	Once problems are identified, they are reported to the TOC	Once problems are identified, they are reported to the TOC	Once problems are identified, they are reported to the TOC	Once problems are identified, they are reported to the TOC
Initial Handoff	The TOC reports problems to the regional electrician	The TOC reports problems to the regional ITS support coordinator	The TOC reports problems to the regional ITS support coordinator	The TOC reports problems to the contract support staff
Verification – who is involved in diagnosis?	• Regional electrician • TSSU • Vendor	• Regional ITS support coordinator • TSSU • Vendor	Mainstream Devices • Regional electrician • TSSU • Vendor Emerging Technologies • Regional ITS support coordinator • Vendor	• Contractor
Repair – who is involved in repair?	• Regional electrician • Information Services • TSSU • Vendor	• Regional ITS support coordinator • Regional electrician • Information Services • TSSU • Vendor	Mainstream Devices • Regional electrician • Information Services • TSSU • Vendor Emerging Technologies • Regional ITS support coordinator • Information Services • Vendor	• Contractor • Information Services

Table C-5: Comparison of Four Alternative Maintenance Models.

	District/Regional Maintenance Model	Coordinated ITS Maintenance Model	Two-Tier Maintenance Model	Contractor-Based Maintenance Model
Logging and Tracking	• TOC initiates maintenance log • TOC tracks maintenance process • Regional electrician logs all maintenance activity until problem is resolved	• TOC initiates maintenance log • Regional support coordinator tracks maintenance process • Regional support coordinator logs all maintenance activity until problem is resolved	• TOC initiates maintenance log • Regional support coordinator tracks maintenance process Mainstream Devices • Regional electrician logs all maintenance activity until problem is resolved Emerging Technologies • Regional support coordinator logs all maintenance activity until problem is resolved	• The contractor is responsible for all logging activities • Contract support staff tracks maintenance process
Advantages and Disadvantages				
Advantages	• Provides clear maintenance process • Maintains current organizational structure • Allows maintenance priorities to be set and followed at a regional level • Promotes mainstreaming of ITS into transportation system • Makes good use of existing diagnostic capabilities within ODOT	• Provides clear maintenance process • Eases district work burden • Strengthens the relationship between design, operation and maintenance of ITS • Improves statewide coordination for procurement, purchasing, standardization, and vendor management • Establishes single point-of-contact for all regional ITS maintenance activities • Enables specialization of skills at first level of support • Simplifies logging, tracking, performance monitoring and evaluation activities	• Provides maintenance process • Provides some relief to district work burden • Simplifies repair process for emerging technologies by involving fewer parties • Addresses technological evolution and training • Uses existing diagnostic capabilities in ODOT • Improves statewide coordination for procurement, purchasing, standardization, and vendor management • Allows for integration between design, operations and maintenance of ITS	• Provides maximum simplicity for handling maintenance • Gives TOCs greater control over meeting response time through contract • Allows for easier integration of new technology • Enables ODOT to provide adequate maintenance even in event of hiring freezes • Greatly reduces maintenance burden on districts

Table C-5: Comparison of Four Alternative Maintenance Models. (continued)

	District/Regional Maintenance Model	Coordinated ITS Maintenance Model	Two-Tier Maintenance Model	Contractor-Based Maintenance Model
Advantages and Disadvantages (continued)				
Disadvantages	• Requires significant training to address current deficiencies • Increases district maintenance burden unless districts are able to add staff • Discourages resource sharing across regions • Does not recognize statewide aspect of ITS and the connectedness of devices • May underprovide ITS maintenance due to competing priorities with non-ITS maintenance • Preserves disconnection between design, operations and maintenance of ITS	• Adds travel time by duplicating trips made by electricians • Discourages mainstreaming of ITS into transportation system • Limits career path for regional electricians	• Adds additional level of complication to logging and tracking • Requires increase in regional/district staffing levels to maintain increasing number of mainstream devices • Requires identification of which devices are mainstream and which are emerging, and what the transition point is	• Increases difficulty in containing maintenance costs • Significantly underutilizes or reduces in-house technical capabilities • Discourages mainstreaming of ITS into transportation system • Requires high-quality contractors with good service • Assumes one-size-fits-all vertical integration by contractors

Table C-5: Comparison of Four Alternative Maintenance Models. (continued)

C.6 Stakeholder Meetings

A maintenance model can be successfully and effectively implemented onto an existing organizational structure only if there is "buy in" from individuals throughout the organization. Consequently, a series of stakeholder meetings between WTI and ODOT staff were held in August 1999 to discuss and compare alternatives. It was hoped that these meetings would result in a broad consensus regarding a preferred maintenance model. In order to avoid artificially manufacturing consensus, separate meetings were held with different groups in order to encourage dissenting opinions to be aired. Meetings were held with the following five groups:

- Transportation Operation Center (TOC) managers,
- Transportation Data Section (TDS),
- Information Services (IS),
- Traffic Signals Systems Unit (TSSU), and
- Maintenance Leadership Team (MLT).

The meetings focused on ensuring that stakeholders had a working understanding of each of the alternative models, and then soliciting feedback. It was emphasized that these models were not intended to be "finished products," so suggestions for improvements and modifications were encouraged. The following were some of the highlights of the discussion:

- <u>No one expressed any preference for the district/regional maintenance model</u>. This model closely reflects how most ITS maintenance is currently done. Therefore, this reflected a desire among stakeholders across the board to improve the maintenance model.

- <u>Having a single point-of-contact was a popular model component</u>. This ensures that there is follow-through on problems until they are resolved. Even though the two-tier maintenance model is more complicated than the district/regional maintenance model, the extra layers of complication would be transparent to stakeholders because the support coordinator would be responsible for tracking all of the activity.

- <u>A support coordinator position brings a connection between operations and maintenance</u>. Some stakeholders said that ITS device failures are often not viewed as critical maintenance needs because maintenance staff do not understand the operational necessity of the new technology.

- <u>Stakeholders were generally averse to using a purely contractor-based approach</u>. Stakeholders readily cited the benefits of the contractor-based approach, especially its ability to bypass existing staffing resource constraints. However, stakeholders generally agreed that this alternative would be expensive, "scary," difficult to implement because of integration with ODOT's network, and would leave ODOT vulnerable to situations where in-house skill is necessary such as emergencies or contractor bankruptcy. It was agreed that contractors would appropriate in some circumstances, and that none of the other alternatives preclude the selective use of contractors.

- The success of the two-tier and coordinated ITS maintenance models is highly dependent upon finding an appropriately skilled support coordinator. Stakeholders felt that the support coordinator would need to be somewhat of a generalist with enough knowledge about various ITS devices to ask the right questions.

- Stakeholders had a broad consensus in support of the two-tier alternative. Stakeholders commented that this combined the strengths of the district/regional and coordinated ITS maintenance models, while allowing contractors to be used to compensate for skills or resources shortfalls.

APPENDIX D PRIORITIZATION GUIDELINES IN OTHER PLANS

This appendix highlights the salient facts about repair prioritization guidelines for two of the maintenance plans reviewed in Chapter 2 that provided such information, as well as the Minnesota Department of Transportation's Orion project.

- Surveillance, Control, and Driver Information (SC&DI) Plan. In this plan developed for metropolitan Seattle, each ITS device is assigned a response time "based on its relative necessity to the daily operation of the [Traffic Systems Management Center]." (7) Table D-1 lists the response times developed for SC&DI. As can be seen, SC&DI places priority emphasis on safety-related systems (i.e. reversible lane control) and on key data collection links (i.e. some surveillance cameras). Systems that are intended only for traveler information, such as variable message signs (VMS) and highway advisory radio (HAR), are given lower priority. The plan notes that, in all cases, "these response times are meant for normal conditions and will be modified during special circumstances."

- Caltrans District 7 TOS/TMC Maintenance Master Plan. This plan develops four priority levels based on response time. Reasons for maintaining ITS equipment are ranked in order of decreasing importance: public safety, traffic service, preservation of facility / operational integrity, and general appearance of equipment to public (6). Table D-2 indicates how these criteria were translated into a maintenance priority list. This plan puts higher priority on the equipment that is most necessary to preserve the integrity of the system. Note that none of the devices in Table D-2 have recommended response times exceeding 72 hours, even though none of the devices are explicitly related to public safety.

Device	Response Time
• Ramp meters (cabinet, controller, signal head and standard warning beacon, demand loop, communication) • Data station circuit • Closed-circuit television (CCTV) systems (adjacent camera not operational) • Reversible lane control and warning equipment	Immediately
• Individual data station • Diagnose failed loops (other than demand loop) • Recut/resplice ramp meter loops (other than demand loop) • Variable message sign (VMS) systems	One week
• CCTV systems (adjacent cameras still operational)	Two weeks
• Highway advisory radio (HAR) systems	One month
• Recut/resplice other loops (mainline, exit ramp, etc.)	Two months

Table D-1: SC&DI (Seattle) Recommended Response Times for Repair.

Device	Response Priority
• Data node (communication system) • SONET node (except if single video equipment inoperative) • Transportation Management Center (except if single video equipment inoperative) • Variable Message Signs (VMS) – multiple signs on circuit	1 - Immediate
• Closed-Circuit Television (CCTV) – multiple cameras on circuit • Ramp Metering System and Vehicle Detection Stations – multiple sites on circuit • SONET node (single video equipment inoperative) • Transportation Management Center (single video equipment inoperative) • Video node (communication system) • VMS – single sign	2 - Next business day
• CCTV – single site • Ramp Metering System and Vehicle Detection Stations – single site	3 - Within 72 hours

Table D-2: Caltrans District 7 Repair Priorities.

(Source: 6)

- Minnesota Department of Transportation (Mn/DOT) Orion Project. Orion is a partnership between several governmental agencies to implement ITS projects in the Twin Cities. A maintenance plan was developed specifically for their Arterial Traffic Status system, a project that is designed "to collect and display real-time traffic status information for agency traffic engineers who are responsible for the management of day-to-day traffic operations on the arterial roadways in the Twin Cities." (69) As shown in Table D-3, the Orion project emphasizes safety-related repairs over operational repairs.

Category	Types of Failures
Critical failures that impact the safety of the public	• Loss of electrical power at signal • Traffic signal in an all red conflict flash • A malfunctioning traffic signal
Critical failures that impact efficient operation of signal systems or traffic management	• Communication interconnect failures • Local detector failures
Non-critical failures	• Loop detectors not critical to signal operation • Failure of Arterial Traffic Status system components, e.g. modems, lightning suppression

Table D-3: Orion (Mn/DOT) Repair Priorities.

(Source: 69)

APPENDIX E RESULTS OF PRIORITIZATION SURVEYS

Surveys were distributed in June 1999 to members of the ITS Executive Steering Committee, the TOC Managers and the District Managers in order to determine how ODOT stakeholders perceive the repair priority of different ITS deployments (12). The survey forms are included as Appendix F.

This appendix explores the findings of these surveys.

E.1 Executive Steering Committee

The Executive Steering Committee was asked to prioritize how maintenance should be performed based on the primary device function. The following primary device functions were presented as options:

- traffic control,
- safety,
- public perception / high-profile,
- information dissemination, and
- liability / legislative mandate.

The Executive Steering Committee considered liability or legislative mandate to be dominant. If there is a requirement in the law, such as the Oregon Administrative Rules or the Oregon Revised Statutes, or is in professional standards documents, such as the Manual for Uniform Traffic Control Devices, then the committee felt the device should be maintained, regardless. As such, the committee did not believe that priorities should be ranked based on liability or legislative mandate. Moreover, the committee believed that liability could be associated with each of the other device functions, so that one always assumes a certain level of liability with the level of service that is provided.

The Steering Committee ranked the other factors in order of descending priority, with safety first, followed by traffic control, public perception / high profile, and information dissemination. Regarding public perception, committee members said that public perception should play a "large role" in determining maintenance priorities, and that the public should see ODOT as reliable and responsive to public needs. Even so, public perception should be treated as a secondary concern to safety and traffic control when it comes to ITS maintenance priorities. The committee felt that prioritization of devices will differ based on situational and seasonal conditions, with rural devices likely having a higher priority during the winter and urban devices having a relatively consistent priority year-round.

E.2 TOC Managers

Two surveys out of four were returned from TOC managers, one from Region 1 (Portland) and Region 3 (Medford), which can provide a context for how maintenance priorities are perceived differently between urban and rural regions. The survey results from these two regions are shown in Table E-1.

ITS Device	Region 1 TMOC (Portland)		Region 3 TOC (Medford)	
	Priority Level	Response Time	Priority Level	Response Time
Computer-aided dispatch / emergency response / incident management	1	1 hour	1	Less than 1 hour
Highway Advisory Radio (HAR)	NA	NA	10	1 week
Highway Travel Conditions Reporting System	6 (tie)	48 hours	5 (tie)	24 hours
Incident response vehicles (includes VMS, AVL, cell phones, on-board computers, etc.)	4	48 hours	5 (tie)	24 hours
Pre-trip traveler information (e.g. 800-numbers, Internet, cable TV, kiosks)	8	48 hours	3 (tie)	24 hours
Ramp meters	3	24 hours	NA	NA
RWIS	9 (tie)	1 week	8 (tie)	1 week
Signal preemption (e.g. transit, emergency vehicles)	9 (tie)	1 week	3 (tie)	24 hours
Surveillance cameras	5	48 hours	8 (tie)	1 week
Traffic signals	2	1 – 2 hours	2	1 hour
Variable message signs	6 (tie)	48 hours	5 (tie)	24 hours

NA = Not applicable

Table E-1: Comparison of TOC Manager Prioritization Survey Results.

(Source: 13)

In examining Table E-1, it is interesting to note the similarities between prioritization in urban and rural regions. In both regions, the top priority is in responding to and managing incidents, and the second maintenance priority is traffic signals. For both of these items, response to the problem should ideally occur within two hours. This indicates that public safety is a dominant concern in both urban and rural settings. At similar priorities in each region are also incident response vehicles, variable message signs (VMS), the Highway Travel Conditions Reporting System (HTCRS), and road and weather information systems (RWIS).

Significant differences between the two regions were found for signal preemption equipment and pre-trip traveler information, where these ranked as a higher maintenance priority in Region 3 than in Region 1, and for surveillance cameras, which were ranked as a higher priority in Region 1. Ramp metering, which exists only in Region 1, was rated as a relatively high maintenance priority, while highway advisory radio (HAR), which exists only in Region 3, was rated as a relatively lower maintenance priority.

These rankings are rather broad, so respondents were asked to identify whether or not certain ITS devices of the same type were more important than others. Region 3 cited several RWIS stations – on Interstate 5 at Siskiyou Summit, Sexton Summit and the Medford Viaduct and US Route 199 at Hayes Hill – which would have a recommended repair response time of only 1 hour, compared to one week for RWIS in general. In region 1, three camera locations – Interstate 5 southbound at Terwiliger, Interstate 5 southbound at the Morrison Bridge ramp, and on top of the Metro building – and three VMS locations – Interstate 5 northbound at Columbia, Interstate 5 northbound at Wilsonville, and Interstate 84 westbound at 24th – were listed as higher priority locations. At these locations, a response time of 24 hours was recommended, versus the

	Region 2		Region 3				Region 4		Region 5					
	District 5		District 7		District 8		District 9		District 12		District 13		District 14	
ITS Device	PL	Time	PL	Time	PL	Time	PL	Time	PL	Time	PL	Time	PL	Time
Commercial vehicle systems (e.g. weigh-in-motion, downhill speed advisory system)	3				8	1 week			4					
Field warning systems (e.g. icy bridge, high water, low-visibility)	1	ASAP			7	1 week							2	
Highway Advisory Radio (HAR)	7	Schedule			6	24 hrs*								
RWIS	5	Schedule	3	48 hrs	5	48 hrs	2	36 hrs	3		3	ASAP *	2	
Signal preemption (e.g. transit, emergency vehicles)	5	Schedule	2	24 hrs	4	48 hrs			1		4	1 day		
Surveillance Cameras			4	48 hrs	2	24 hrs			3		5	1 week		
Traffic signals	1	ASAP	1	8 hrs	1	1 hr			1		1	2 hrs	1	< 48 hrs
Variable message signs	2	ASAP			3	24 hrs	1	8 hrs	2		2	ASAP *	2	

PL = Priority Level
* - Winter only

Table E-2: Comparison of District Manager Prioritization Survey Results.
(Source: 13)

48 hours normally recommended by Region 1 for VMS and cameras. Region 1 also cited the RWIS at the Interstate 205 Glen Jackson Bridge as a high-priority ITS device, requiring a response time of 48 hours whereas other RWIS sites were recommended to have a one-week response time.

While Table E-1 provides a helpful comparison between urban and rural priorities, its results should not be extrapolated on a statewide basis because there may be significant differences in priorities across rural regions within ODOT based on local needs, such as the severity and extent of adverse weather-related conditions.

E.3 District Managers

Surveys were also sent to district maintenance managers, who have the day-to-day responsibility for maintenance in the districts. Because the districts represent a smaller geographic area than the regions, not all devices may be present in all districts. Table E-2 summarizes the responses from several districts. As was true with the TOC managers, the District Managers placed a high priority on traffic signals above other types of ITS maintenance. VMS were generally considered to be a high maintenance priority among the districts with the device. RWIS and CCTV cameras were rated as higher priorities by some districts than by others. A couple of the district managers responded that prioritization can vary by seasons, with winter conditions increasing the priority of RWIS, VMS and HAR deployments.

The district managers also identified several ITS devices that seem to be more critical than others in terms of repair priority. These include:

- Camera locations – Siskiyou Summit on Interstate 5 and Interstate 84 at Milepost 271;
- VMS locations on Interstate 5 at Mileposts 16 and 30 and on Interstate 84 at Mileposts 263 and 286; and

- RWIS stations at Siskiyou and Sexton Summits on Interstate 5 and on Interstate 84 at Mileposts 269 and 274.

District managers were also surveyed about the maintenance priority of commercial vehicle systems. District managers do not currently perform any maintenance on commercial vehicle ITS deployments, because this maintenance is handled through a vendor contract. If district managers were to inherit responsibility for these systems through a lapsing of the contract agreement, it appears that it would generally take a lower priority than other ITS devices.

APPENDIX F REPAIR PRIORITIZATION SURVEY FORMS

Executive Steering Committee Repair Prioritization

One of the objectives of the ITS Maintenance Plan is to establish a schedule for prioritizing repairs to ITS devices. The following tables will help us to understand how you believe ITS maintenance should be prioritized, based on the functions of each device.

Please prioritize how maintenance should be performed based on the primary device function, with 1 = highest priority and 6 = lowest priority.

Device Function	Priority	Device Function	Priority
Traffic Control		Safety	
Public Perception / High-Profile		Information Dissemination	
Liability / Legislative Mandate		Other ______________________	

Should priorities for ITS maintenance depend on their location in the state? For example, should there be different sets of priorities for urban and rural settings? Please explain.

What role, if any, should the public's perception or usage of an ITS device (e.g. camera on the Web page) play in determining the maintenance priority?

Do you have any other comments about how repairs to ITS devices should be prioritized?

Figure F-1: Prioritization Survey Form for Executive Steering Committee.

TOC Region ____ Repair Prioritization

One of the objectives of the ITS Maintenance Plan is to establish a schedule for prioritizing repairs to ITS devices. The following tables will help us to understand, at the TOC level, which ITS devices are most critical to daily operations.

Priority:	Please rank the ITS devices with 1 = highest priority and 13 = lowest priority. If this device is not present in your region, leave the priority blank.
Response time:	How many hours, days or weeks is it acceptable for a piece of equipment to be inoperable?
Not Responsible for Maintenance:	Please check this box if your TOC has this device, but you do not believe you are responsible for maintenance of this item.

ITS Device	Priority	Response Time	Not Responsible for Maintenance
Traffic signals			
Ramp meters			
Signal preemption (e.g. transit, emergency vehicles)			
Highway Advisory Radio (HAR)			
Surveillance cameras			
Variable message signs			
RWIS			
Incident response vehicles (includes VMS, AVL, cell phones, on-board computers, etc.)			
Advanced traffic management system			
Highway Travel Conditions Reporting System (HTCRS)			
Computer-aided dispatch / emergency response / incident management			
Pre-trip traveler information (e.g. 800-numbers, Internet, cable TV, kiosks)			
Field warning systems (e.g. downhill speed advisory, icy bridge, high water)			
Other ___________________________			

Figure F-2: Prioritization Survey Form for TOC Managers.

Are there any surveillance cameras which have a higher repair priority than other cameras? If so, which ones?

Camera Location (please be specific)	Response Time
1	
2	
3	

Are there any variable message signs which have a higher repair priority than other VMS? If so, which ones?

VMS Location (please be specific)	Response Time
1	
2	
3	

Are there any RWIS stations which have a higher repair priority than other RWIS stations? If so, which ones?

RWIS Station (please be specific)	Response Time
1	
2	
3	

Do you have any other comments about how repairs to ITS devices should be prioritized?

Figure F-2: Prioritization Survey Form for TOC Managers. (cont.)

Region ____ District ____ Repair Prioritization

One of the objectives of the ITS Maintenance Plan is to establish a schedule for prioritizing repairs to ITS devices. The following tables will help us to understand, at the district level, which ITS devices are most critical to daily operations.

Priority:	Please rank the ITS devices with 1 = highest priority and 9 = lowest priority. If this device is not present in your district, leave the priority blank.
Response time:	What is an acceptable response time to fix this type of device?
Not Responsible for Maintenance:	Please check this box if your district has this device, but you do not believe you are responsible for maintenance of this item.

ITS Device	Priority	Response Time	Not Responsible for Maintenance
Traffic signals			
Ramp meters			
Signal preemption (e.g. transit, emergency vehicles)			
Highway Advisory Radio (HAR)			
Surveillance cameras			
Variable message signs			
RWIS			
Commercial vehicle systems (e.g. weigh-in-motion, downhill speed advisory system)			
Field warning systems (e.g. icy bridge, high water, low-visibility)			
Other ______________________			

Figure F-3: Prioritization Survey Form for District Managers.

Are there any surveillance cameras which have a higher repair priority than other cameras? If so, which ones?

Camera Location (please be specific)	Response Time
1	
2	
3	

Are there any variable message signs which have a higher repair priority than other VMS? If so, which ones?

VMS Location (please be specific)	Response Time
1	
2	
3	

Are there any RWIS stations which have a higher repair priority than other RWIS stations? If so, which ones?

RWIS Station (please be specific)	Response Time
1	
2	
3	

Do you have any other comments about how repairs to ITS devices should be prioritized?

Figure F-3: Prioritization Survey Form for District Managers. (cont.)

APPENDIX G INFRASTRUCTURE DESCRIPTION

For the purposes of this appendix, ODOT's existing and planned ITS devices are divided into nine broad categories[1]:

- data collection,
- traffic management,
- incident detection,
- incident management and response,
- pre-trip traveler information,
- en-route traveler information,
- commercial vehicle operations,
- communication systems, and
- maintenance coordination.

Each device's operations will be briefly described, as well as its integration with or similarity to, if any, other ITS devices. An estimate of the existing and planned deployment schedule is provided. Finally, there is a brief discussion of each device's maintenance needs.

G.1 Data Collection

Many of ODOT's ITS devices are designed to gather data about traffic and weather conditions for reporting into other systems. Eight such devices are discussed in this section.

G.1.1 Automatic Traffic Recorders

Automatic traffic recorders (ATRs) are used to record traffic volumes at fixed locations throughout the state. These are often, but not always, deployed in response to federal regulations. They consist of a vehicle detection device (usually an inductive loop detector), a controller that records detector actuations, and a controller cabinet. ATRs are connected by telephone line, so that their operation can be verified remotely.

	Region					State
	1	2	3	4	5	Total
Existing	26	26	26	23	26	127
STIP	1	4	2	1	0	8
Existing + STIP	27	30	28	24	26	135
Strategic Plan	2	16	3	2	3	26
Existing + Strategic Plan	29	46	31	26	29	161

Table G-1: Deployment Schedule for Automatic Traffic Recorders.

As Table G-1 shows, ODOT currently has about 130 ATR stations located throughout the state, with a fairly even distribution across the five ODOT regions (71). Several more are currently under construction as part of the STIP, and there are many more proposed sites for ATRs that might be constructed after the current STIP.

[1] There may be some devices that could be classified as ITS devices that are not included in this plan. It is assumed that maintenance procedures for these devices are already adequate.

Maintenance procedures for ATRs have been established and followed by the Transportation Data Section (TDS); therefore, specific maintenance needs for these devices will not be discussed. It should be understood, however, that as the number of ATR sites in Oregon increases, there would be a corresponding increase in the need for device maintenance, based on the procedures that are already in place.

G.1.2 Speed Zone Monitoring Stations

Similar in technology to ATRs, speed zone monitoring stations are used to measure traffic speeds at fixed locations throughout the state. They consist of a pair of inductive loop detectors, a controller that records detector actuations and calculates vehicle speed, and a controller cabinet. As Table G-2 indicates, ODOT currently has a fairly even distribution of speed zone monitoring stations across the state (72). No additional installations are currently planned in either the STIP or the Strategic Plan.

	Region					State
	1	2	3	4	5	Total
Existing	4	8	4	9	9	34
STIP	0	0	0	0	0	0
Existing + STIP	4	8	4	9	9	34
Strategic Plan	0	0	0	0	0	0
Existing + Strategic Plan	4	8	4	9	9	34

Table G-2: Deployment Schedule for Speed Zone Monitoring Stations.

Because there is currently no active federal regulation for speed zone monitoring stations, maintenance of the speed zone monitoring stations has been a lesser priority than for the ATRs. The similarity of technology between the two types of devices means that the maintenance needs of speed zone monitoring stations will be similar. TDS has been responsible for maintenance and upkeep of speed zone monitoring stations, and has established repair procedures. Consequently, specific maintenance needs for these devices will not be discussed.

G.1.3 Closed-Circuit Television Surveillance

One effective tool for traffic monitoring is a system of closed-circuit television (CCTV) cameras set up along major travel routes and high-accident locations. CCTV enables ODOT operators to have additional "eyes" in the field to verify where traffic problems are occurring and how they may be cleared. The cameras may be operated remotely from the TOC to pan, tilt and zoom for different perspectives from the same fixed point.

Table G-3 shows the current and future deployment of CCTV by ODOT. The Transportation Management Operation Center (TMOC), the TOC for Region 1, has a long-term goal of locating cameras at one-mile intervals along the freeway system. For other regions, cameras are being located in high-accident or other critical areas.

There are two basic different camera configurations that ODOT uses. Figure G-1 shows the standard, still camera configuration that is typically used for rural locations. This configuration takes still camera images and melds them with weather data. The weather data and camera image are fed into a character generator before feeding into the RealCam 5000. The RealCam captures

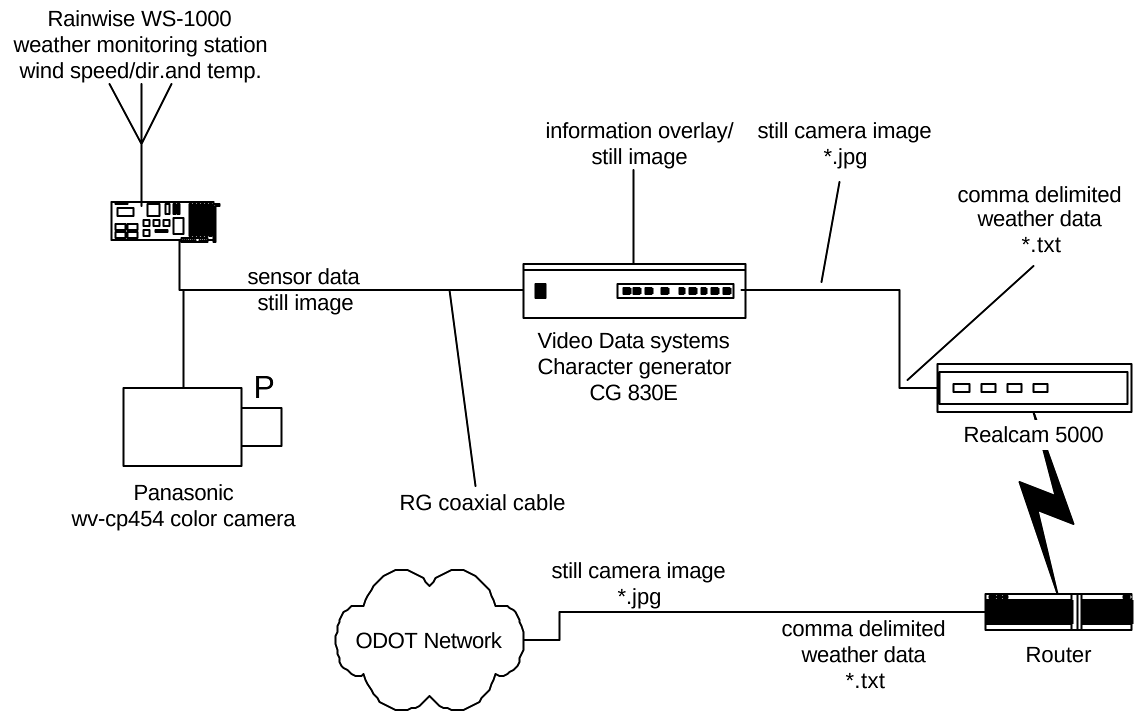

Figure G-1: Architecture for Still Camera.

(Source: ODOT)

the camera image, compresses it into a JPEG format file, and prepares it to be downloaded via a phone line (73) to the wide-area network. Normally, camera images are downloaded every few minutes.

The second configuration, which uses live camera images, is used exclusively in Region 1. Figure G-2 shows how the system architecture is set up. The TMOC uses video switching to alternate images viewed at the TMOC between different camera locations. This allows operators to more efficiently view locations that require TMOC intervention. These camera images do not include weather data.

Recent improvements in camera technology have significantly reduced the need for repair maintenance of the cameras themselves. In Region 1, where the newest generation of cameras is deployed, TMOC staff reports that equipment is generally upgraded before repair maintenance is necessary. Older generations of cameras, deployed in other parts of

	Region					State
	1	2	3	4	5	Total
Existing	39	5	1	10	1	56
STIP	7	2	0	5	17	31
Existing + STIP	46	7	1	15	18	87
Strategic Plan	73	38	40	25	13	189
Existing + Strategic Plan	119	45	41	40	31	276

Table G-3: Deployment Schedule for Closed-Circuit Television Cameras.

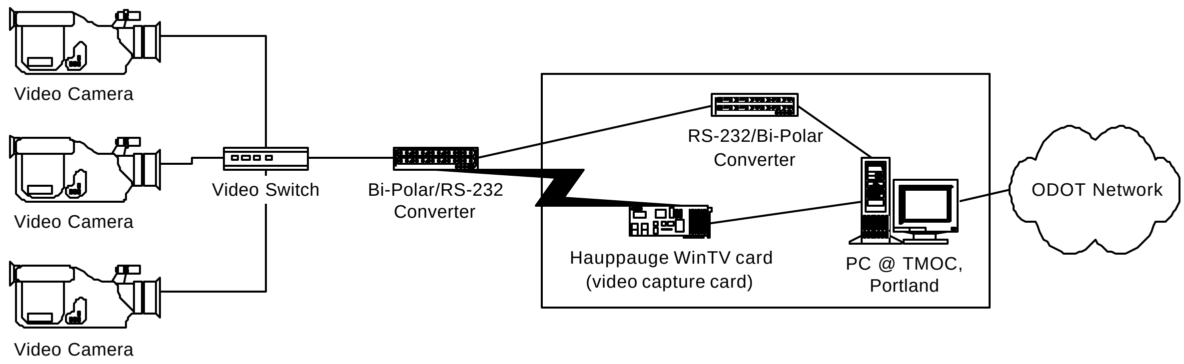

Figure G-2: Architecture for Real-Time Cameras in Region 1.
(Source: ODOT)

the state, have had problems with weather exposure to cables, which require on-site repair work. The Rainwise weather units, according to the manufacturer, require little maintenance which ODOT staff can perform (74).

There are many communication media that are used to transmit camera images to the TOCs, depending upon the location. The fiber optics backbone, which will connect the field cameras in Region 1 to the TMOC, will be shared by several ITS devices; its maintenance needs will be addressed in section G.8.1. The radio communications system, which is used for locations for which telephone access is difficult, was provided by ODOT prior to the implementation of ITS. It is assumed that there are negligible marginal maintenance costs associated with the additional radio traffic. ODOT also uses microwave relay through a cable television company as well as landline communications provided by the telephone company. In both of these cases, maintenance is outside of ODOT's jurisdiction.

Several solid-state pieces of equipment, such as modems, routers and packet radio transmitters, are required to convert and transmit the camera image over the communications media. There are other solid-state devices used in conjunction with cameras in Regions 1 and 4, including the video switch mentioned in Region 1, which are located indoors. Preventative and repair maintenance needs for these components are typically low (75), and often repairs cannot be done by ODOT staff due to the specialized nature of the components (76).

In Region 1, there are other components in the CCTV system which are necessitated by the use of real-time video. A camera server is used to take "snapshots" of the various camera locations and transmit them to ODOT's Web page. The server will need regular re-booting and system maintenance in order to ensure it operates efficiently. A software package installed in Region 1 allows the operators to use the video switch to select which cameras to view. The software will need to be updated or upgraded periodically. Finally, there is also a wall of video monitors in Region 1 used to show, at a glance, dozens of camera images from around Region 1. These monitors will need repair every few years.

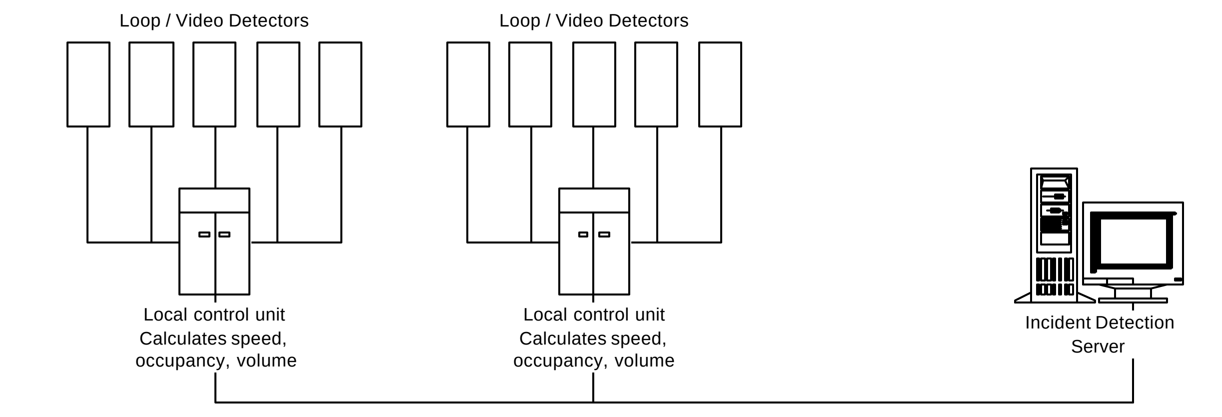

Figure G-3: Proposed Architecture for Regionwide Video Detection.

G.1.4 Video Detectors

Additional video detection equipment may be installed beyond a system of remotely controlled CCTV cameras. The purpose of this detection equipment would be to detect traffic flow parameters such as volume, speed and occupancy.

There are two different architectures that may be used for video detection, depending upon the end purpose. Figure G-3 shows how video detection would be used on a systemwide deployment. In this case, multiple video detectors throughout the region are continually collecting images from the field. Field processors interpret the images to determine traffic flow characteristics such as speed, occupancy and volume. The traffic flow data is sent to a central server at the TOC, where the data is analyzed.

Alternatively, video detection may be used in an intersection-based application, as is currently done in Valley Junction and is proposed in the STIP, to identify the presence of vehicles. In these cases, it may serve as a substitute for inductive loops or other detection technologies at a semi-actuated or fully actuated traffic signal, as shown in Figure G-4. In this case, actuations from the detector would go into a signal controller located in the field, which might influence signal timing patterns.

	Region					State
	1	2	3	4	5	Total
Existing	0	4	0	0	0	4
STIP	0	1	0	1	0	2
Existing + STIP	0	5	0	1	0	6
Strategic Plan	100	0	0	0	0	100
Existing + Strategic Plan	100	5	0	1	0	106

Table G-4: Deployment Schedule for Video Detectors.

Table G-4 shows the existing and planned deployment of video detection systems in ODOT. Currently, there are video detectors set up on Interstate 5 in Salem and on Oregon Route 18 in Valley Junction on an experimental basis. There are two short-term projects for video detection, one in Region 2 on Oregon Route 22 and in

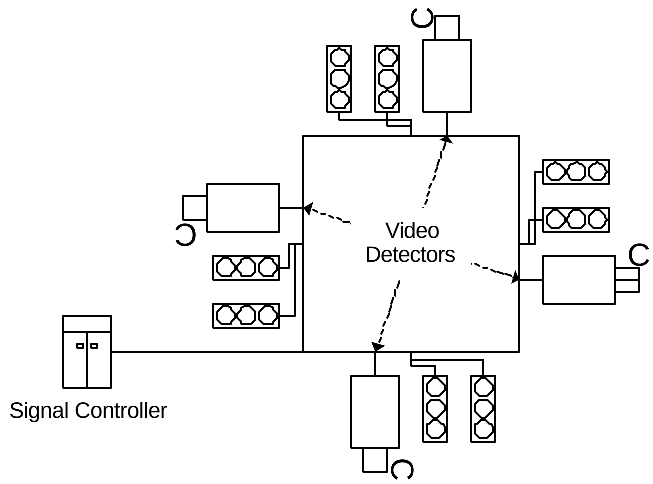

Figure G-4: Proposed Architecture for Intersection Video Detection.

Region 4 in Bend. There are long-term plans for regional installation of video detection in Region 1. This system of detectors would serve primarily as a data source for regionwide incident detection, which is discussed in section G.3.3.

According to one video detection system manufacturer, maintenance needs for video detection systems have proven very minimal. The customer may perform annual lens cleanings, but it is recommended that the vendor perform most major maintenance (77). Repair maintenance should be necessary only rarely, such as in cases of lightning or knockdowns.

G.1.5 Road and Weather Information System

Road and weather information systems (RWIS) are used to gather key meteorological data near major roadways. Data collected by RWIS may have several applications, including expediting decisions on weather-induced closures or detours, providing pertinent traveler information, and assisting in deployment of roadway maintenance vehicles. In rural areas, RWIS can provide an initial warning about potentially hazardous conditions, giving TOC operators the ability to respond to conditions more quickly.

	Region					State
	1	2	3	4	5	Total
Existing	6	4	1	8	1	20
STIP	3	5	3	7	19	37
Existing + STIP	9	9	4	15	20	57
Strategic Plan	5	15	20	22	9	71
Existing + Strategic Plan	14	24	24	37	29	128

Table G-5: Deployment Schedule for Road and Weather Information System Stations.

Table G-5 shows ODOT's existing and planned deployment of RWIS. RWIS are currently located on a limited basis, primarily in Regions 1, 2 and 4. ODOT is planning to deploy RWIS more aggressively in the future, especially in the more rural parts of the state.

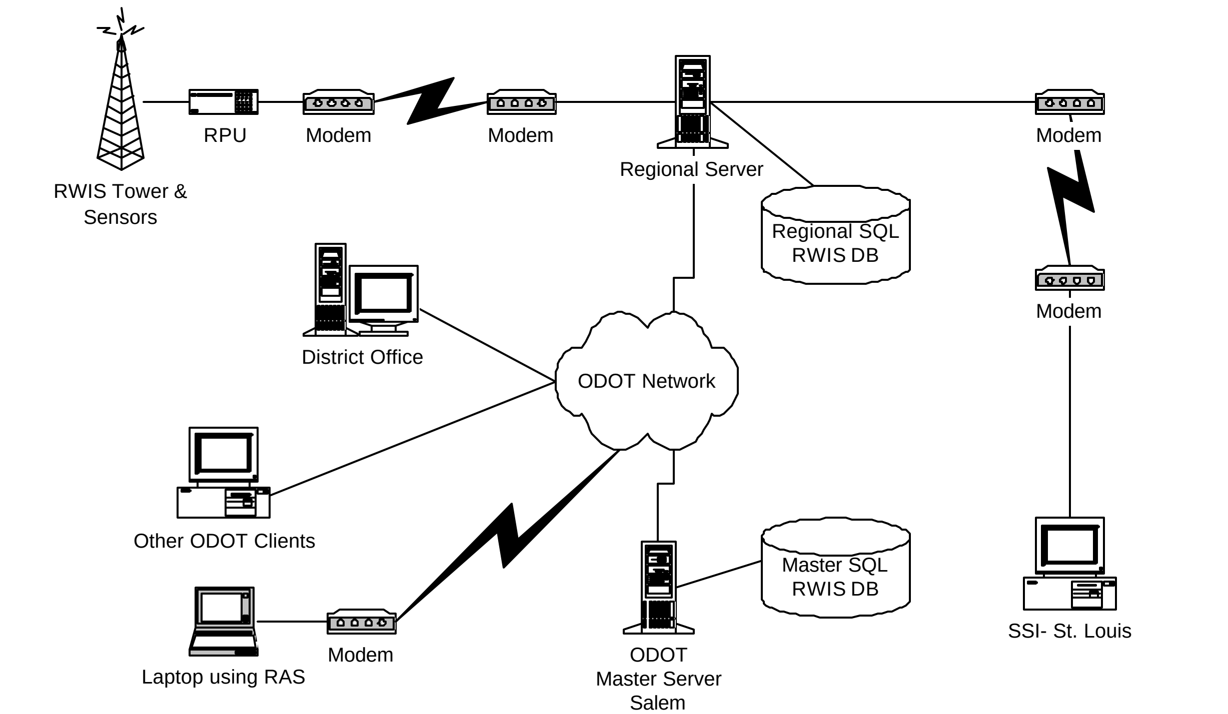

Figure G-5: Architecture for RWIS Configuration with SSI Stations.

(Source: ODOT)

ODOT has used several different architecture configurations to support RWIS, based on the RWIS vendor's technology as well as the availability of communications infrastructure. The vendor most often used by ODOT for RWIS installations currently is Surface Systems Incorporated (SSI). A typical SSI architecture is shown in Figure G-5. Field sensors collect atmospheric data relating to temperature, wind speed and direction, relative humidity, and precipitation. In addition, sensors are embedded in the roadway to measure road surface temperature and moisture to help identify precursors to icy conditions. The sensors continuously collect data, which is stored on a remote processing unit collocated with the sensors. In addition to remote weather sensors, there are regional RWIS servers located in each of ODOT's regions. The regional servers use software developed by SSI to poll each RPU every ten minutes to extract the latest weather data. Once the measurements from each of the RPUs are loaded onto the regional servers, the data is sent to three different locations. First, the data is sent via modem to SSI in St. Louis for commercial applications. Second, the data is replicated into a regional database. Third, the data is sent to the ODOT wide-area network, where it is put onto a central RWIS server. The central server has its own database, so that there is a duplicate of the databases stored at the regions. Once the RWIS data is on the ODOT network, ODOT has developed several database queries to extract and display weather data from the vendor-supplied database. SSI maintains ownership over many maintenance aspects of the system, including the polling software and the databases (78), while ODOT is responsible, in general, for field sensors and associated equipment, as well as regional and central servers.

The second vendor used by ODOT for RWIS installations is Texas Weather Instruments (TWI). As shown in Figure G-6, data collected from the servers is again transmitted to a central

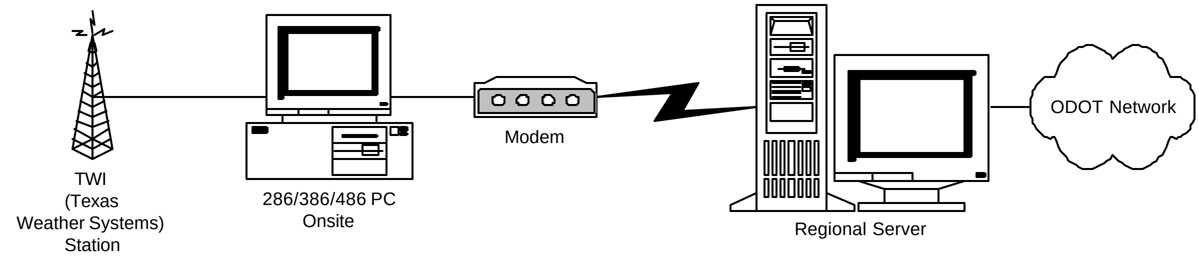

Figure G-6: Architecture for RWIS Configuration with TWI Stations.

(Source: ODOT)

regional server. The regional server transmits the information to ODOT's wide-area network, where the data may be disseminated. The TWI installations differ from the SSI installations primarily in that the TWI stations do not use pavement sensors.

Recommendations for sensor equipment maintenance vary between the two manufacturers. For SSI, annual cleanings of the various sensors are recommended (66). TWI recommends monthly cleaning of the rain collector equipment (79); however, since ODOT does not appear to use data on precipitation accumulation as a part of its RWIS information given to the public, it may be adequate to visit these sites annually as well. The remote servers are expected to have similar maintenance needs whether it is a SSI or a TWI system, with the need for regular visual inspection and re-booting.

Like CCTV, RWIS utilizes many different communications systems in order to attempt to reduce operations costs. Many sites use landline telephone communications. Where telephone service is either not available or would require long-distance toll charges, ODOT utilizes a couple of different systems. For some TWI stations, ODOT uses its radio system to transmit data. This requires the use of special packet radio devices that convert data between a text file format and a format that can be transmitted via radio. For some SSI stations, ODOT has used some dial-up routers that have proven to be very sensitive to the quality and level of power supplied (78). Based on field experience in Oregon, the most persistent communications problem for RWIS is associated with these dial-up routers. ODOT is in the process of replacing these routers, which will reduce the associated maintenance needs.

The RWIS system is very data-intensive and relies on the integrity of several servers and their respective databases. Maintenance on these servers is focused primarily on preventative maintenance, primarily performing regular re-booting and diagnostic checks.

G.1.6 Travel Time Estimation

Obtaining real-time estimates of travel time through a corridor would allow the notification of emergency response crews in the event of non-recurring congestion as caused by a roadway incident or accident, and the dissemination of real time travel information to assist in en-route route choice. There are several methods available for estimating travel time. ODOT is investigating deploying a system in metropolitan Portland that would calculate travel times based on when the same vehicle license plate number passes two or more video checkpoints. It has been recommended that checkpoints would be spaced between one and three miles apart (80). Based on readers spaced at two-mile intervals aimed in each direction, Table G-6 provides an estimate for the number of checkpoints that would need to be deployed.

	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	0	0	0	0	0	0
STIP	0	0	0	0	0	0
Existing + STIP	0	0	0	0	0	0
Strategic Plan	80	0	0	0	0	80
Existing + Strategic Plan	80	0	0	0	0	80

Table G-6: Deployment Schedule for License Plate Readers for Travel Time Estimation.

The basic components of a travel-time estimation system using automated license plate readers, shown in Figure G-7, are as follows.

- Camera. The camera is used to capture the image of the vehicle's license plate as it passes the system installation point. Just about any type of camera can perform this function, from monochrome to color or digital to normal. A digital color camera is the most recommended because of the increased speed of data transfer and assistance in plate identification.

- Light source. A light source is required, depending on the type of camera, to allow for operation at night and in poor visibility conditions. The light is typically timed to turn on at the same time as the camera to save energy and avoid too much motorist distraction. Infrared lighting is the most common light source used. It is undetectable to the human eye but most cameras will pick it up.

- Triggering mechanism. The triggering mechanism is intended to fire the image-capturing components (i.e., the camera and light source) of the license plate reader when a plate is within the camera's field of view. The two types of triggering

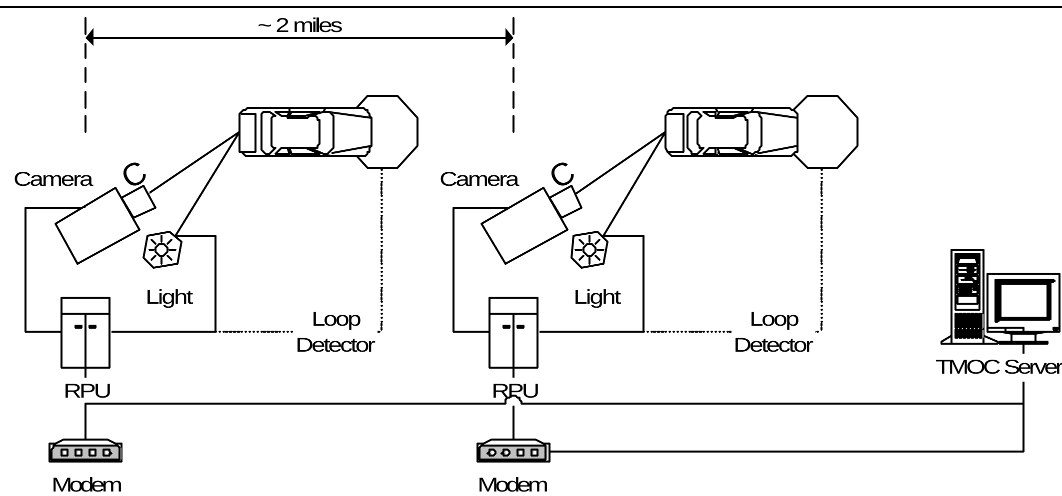

Figure G-7: Proposed Architecture for Travel Time Estimation.

mechanisms available are external and internal. An external trigger causes an image to be captured when a vehicle is detected by a sensor on the road surface. Internal triggers within the reader itself require an image processing algorithm to recognize when a plate enters the camera's field of view.

- Image processing algorithm. The image processing algorithm is used to identify the plate within the captured image, identify its state of origin and read its alpha-numeric code. The types of processing algorithms used are decision trees and neural networks.

- Remote processing unit. To control the triggering mechanism, run the image processing algorithm and transmit the plate identification to the TOC, it will be necessary to have "intelligence" in the field in the form of a remote processing unit. This would simply be an environmentally hardened microcomputer.

To measure travel times will require real-time communication from each of the checkpoints to a central server. This will be provided by the same fiber optics network used by the Region 1 CCTV cameras. The server will match observations collected at different checkpoints to identify vehicles that have passed between two or more checkpoints. After the server calculates average travel times, this information could be transmitted to the public through a variety of means, including the Internet, commercial radio, or other en-route traveler information systems.

The primary maintenance need of the travel time estimation system is the proper upkeep of the remote processing units at each checkpoint. In addition to the preventative maintenance needs typical for a field computer, there is the possibility of cabinet knockdown due to the proximity of the cameras to the roadway. According to one vendor of such systems, maintenance needs have proven to be very minimal (81). The travel time server is also expected to need regular re-booting and database pruning in order to ensure the system operates efficiently and effectively during times of peak congestion.

G.1.7 Automatic Vehicle Location

Automatic vehicle location (AVL) is a technology by which information about a vehicle's location may be transmitted automatically to a remote destination. For this technology to be implemented, vehicles are equipped with an in-vehicle unit that integrates a global positioning system (GPS) receiver, a modem, a display unit and a simple keypad. The in-vehicle unit is, in turn, connected with sensors on the vehicle that may characterize the vehicle's activity. A computer receiver records vehicle locations and then transmits this information to the appropriate operator.

In ODOT's ITS Strategic Plan, it was originally intended that AVL would be used as a system for regionwide estimation of travel times in Portland (3). ODOT is no longer looking at using AVL for that type of application; instead, the following two applications are being examined for AVL:

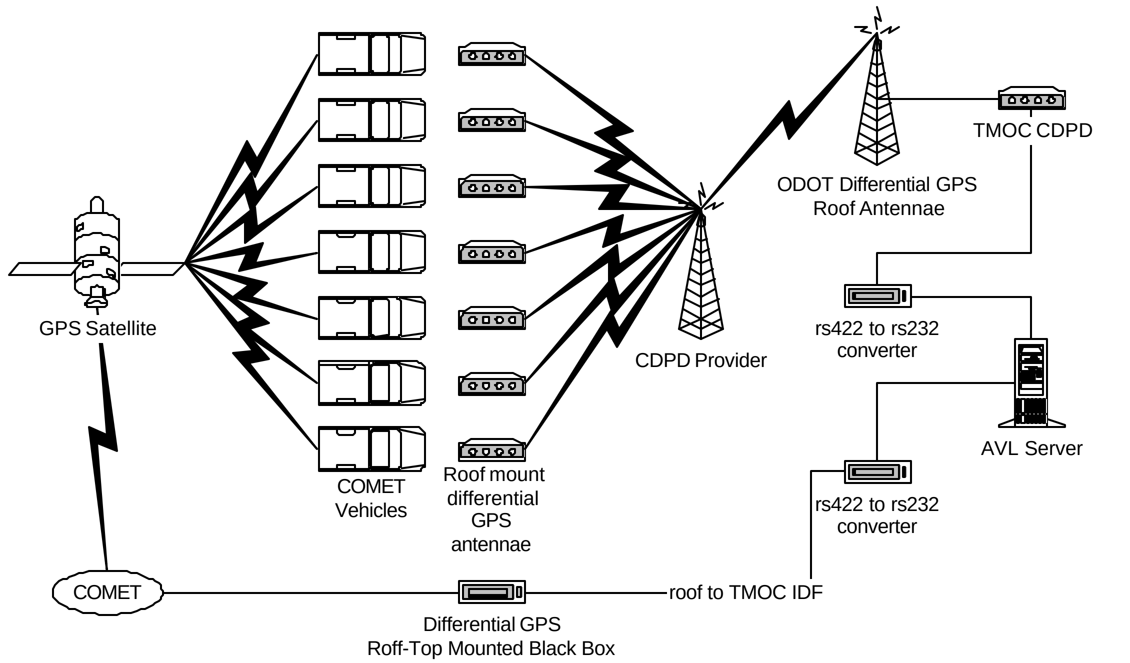

Figure G-8: Architecture for Automatic Vehicle Location.

- Incident response vehicles. AVL is currently in use on the seven incident response vehicles[2] in Region 1. The AVL system currently in use on these vehicles is shown in Figure G-8. Vehicle locations are identified through the use of satellites and roof-mounted, magnetic differential GPS antennae on the top of each vehicle. The vehicles communicate via cellular digital packet data (CDPD) radio modems to a roof antenna located at the TMOC. Information from the vehicles is combined with information from the satellite to determine vehicle locations. Having AVL enables the TMOC to dispatch vehicles more efficiently to incidents when they have been identified through CCTV, police reports or other means. For AVL, on-board sensors can indicate information such as whether the on-board VMS is activated or whether the vehicle's doors are open or closed.

- Maintenance vehicles. ODOT is testing the use of AVL to assist in highway maintenance in Region 4. This type of application would enable a maintenance district office to direct maintenance vehicles to restore roadways to normal operations more efficiently during inclement weather. Sensors can indicate whether the plow is raised or lowered, whether the spreader (for salt or sand) is on or off, and what the spreading rate is. The primary difference between the architecture used to support this AVL application and the architecture used to support incident response vehicles in Region 1 is that CDPD has limited coverage in rural regions. Consequently, low-band radio would likely be used for vehicle-to-center communications under a maintenance vehicle management program.

[2] These vehicles will be discussed in detail in section 3.2.4.2.

Table G-7 shows the deployment schedule for AVL in Oregon. The STIP includes four additional incident response vehicles in Region 2 – one for each district – each of which is assumed to be equipped with AVL. Provided the AVL field test in Region 4 is successful, it is anticipated that about 100 maintenance vehicles per region will be equipped with AVL.

	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	7	0	0	0	0	7
STIP	0	4	0	40	0	44
Existing + STIP	7	4	0	40	0	51
Strategic Plan	100	100	100	60	100	460
Existing + Strategic Plan	107	104	100	100	100	511

Table G-7: Deployment Schedule for Vehicle Probes.

Much of the maintenance of the system is – and will continue to be – handled by the vendor. The vendor is responsible for the in-vehicle units, which seldom have significant maintenance problems and require no preventative maintenance. According to one vendor, the most significant maintenance concern with the vehicle component of AVL has been the performance of the in-vehicle sensors, which are typically not provided by the vendor (82). These sensors may need regular inspection and testing to ensure they are working properly (83). ODOT's maintenance responsibility is currently limited to maintaining the AVL servers, located in each region. Low-band radio, if ODOT does use this as the communications media for AVL, would also become ODOT's maintenance responsibility. The vendor is responsible for providing the satellite system that supports the GPS, the in-vehicle probes, as well as the center-based software. Because the AVL support software has become somewhat mainstream, no special training or vendor involvement is required for software upgrades (82).

G.2 Traffic Management

The purpose of traffic management devices is to allow operators, especially at the Transportation Operation Center (TOC) level, to make better use of the existing transportation infrastructure to meet the public's needs.

G.2.1 Traffic Signals

Traffic signals represent one of the oldest ITS devices. Traffic signals may be installed not only for safety reasons – i.e. to better manage conflicting movements at intersections – but also to improve mobility for traffic on side streets trying to cross or access a major arterial. ODOT has many traffic signals under its jurisdiction, although the organization tries to delegate the maintenance responsibility for these signals to municipalities or counties where possible.

Traffic signals have well-established maintenance procedures, not only relating to how staff are summoned to diagnose and repair a malfunctioning signal, but also relating to logging and tracking the repair process.

G.2.2 Ramp Metering

Ramp metering systems are essentially traffic signals governing a one-legged approach onto an expressway. They are a relatively older technology designed to improve expressway capacity and safety by controlling the rate at which vehicles enter the flow of traffic. Most metering systems are operated during peak-period conditions when mainline volumes are heaviest. A typical ramp metering system consists of vehicle detectors on the ramp and possibly on the mainline, a traffic signal, a local traffic signal controller, and communications links between these components.

Table G-8 shows the existing and future deployment of ramp metering systems in Oregon. These systems are currently exclusively located in the Portland metropolitan area due to the severity of peak-period traffic congestion. The Strategic Plan includes a more ambitious implementation of ramp meters, with all entry ramps in Portland eventually being metered, and as many as one hundred additional ramp meters to be installed between the Eugene, Salem and Medford metropolitan areas.

	Region					State
	1	2	3	4	5	Total
Existing	64	0	0	0	0	64
STIP	26	0	0	0	0	26
Existing + STIP	90	0	0	0	0	90
Strategic Plan	60	65	35	0	0	160
Existing + Strategic Plan	150	65	35	0	0	250

Table G-8: Deployment Schedule for Ramp Metering.

To improve the effectiveness of ramp metering systems, they are typically connected to a central operating center. In Region 1, existing ramp meters will be connected to the fiber network, which will allow the TMOC to adjust ramp metering timings in real-time based on local traffic volumes, incidents, special events, and other factors. Future installations in the other regions will likely have similar connections to the respective region's TOC.

Because of the similarities between ramp meters and traffic signals, maintenance procedures and requirements for each of these classes of devices are handled in the same way. The maintenance needs of the fiber network required to support ramp metering systems will be discussed in Section G.8.1.

G.2.3 Traffic Signal Preemption for Emergency Vehicles

Many traffic signals have special equipment that temporarily alters the intersection's signal timing to allow an emergency vehicle to pass through. The equipment interfaces with conventional Type 170 traffic signal controllers. ODOT has emergency vehicle preemption in use at hundreds of traffic signals across the state, as shown in Table G-9 (84).

An architecture schematic for this technology is shown in Figure G-9. An emergency vehicle has an in-vehicle device that communicates its presence to the intersection signal controller through a detector. Once the detector is activated, a signal is sent to the controller to bypass its current timing sequence and give green to the direction from where the emergency vehicle is coming for a pre-determined length of time. Once the green time passes, the intersection resumes its normal signal timing pattern. ODOT uses optical-based detection with an in-vehicle strobe light used to send light to an optical detector mounted on the signal mast (84).

	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	206	104	59	51	23	443
STIP	0	0	0	0	0	0
Existing + STIP	206	104	59	51	23	443
Strategic Plan	0	0	0	0	0	0
Existing + Strategic Plan	206	104	59	51	23	443

Table G-9: Deployment Schedule for Emergency Vehicle Signal Preemption.

ODOT will continue to use this technology in the future by both retrofitting existing intersections and installing the equipment at new signals. Maintenance for both special controller cards like emergency vehicle preemption and the optical detection equipment is covered under existing procedures.

G.2.4 Preferential Traffic Signal Treatment for Transit Vehicles

Traffic signals may also be programmed to provide preferential treatment to transit vehicles. Region 1 uses preemption equipment for light rail transit vehicles, giving the light rail system right-of-way over other vehicle traffic, so traffic signals at any at-grade intersections will be turned to red when a light rail train is passing through.

Traffic signal prioritization may also be used in order to improve on-time performance and reduce travel times for transit. Like signal preemption, the technology involves communication between a transit vehicle and the intersection signal controller via detection equipment. Instead of automatically giving green to the transit vehicle, the prioritization card in the controller will merely extend green time to the direction the vehicle is coming from if the light is currently green. In this way, the transit vehicle will be able to clear the intersection without having to wait

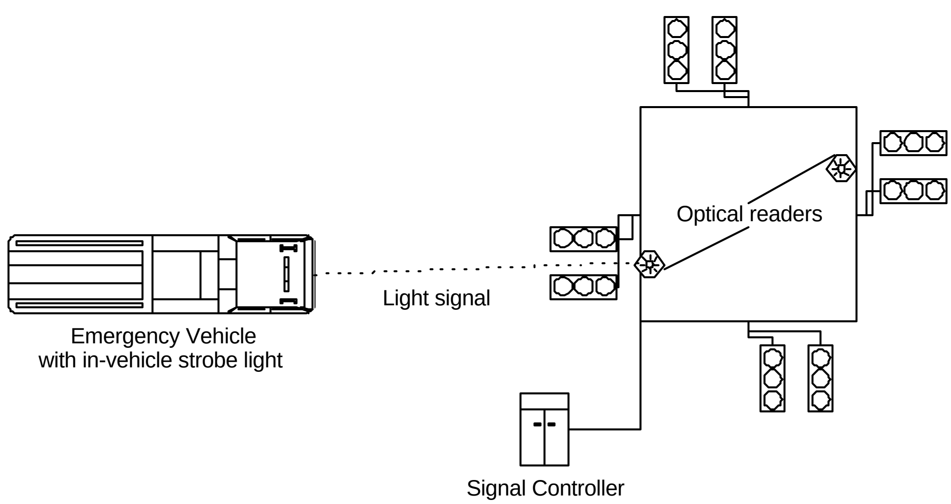

Figure G-9: Architecture for Signal Preemption.

an additional cycle.

	Region 1	2	3	4	5	State Total
Existing	17	0	0	0	0	17
STIP	0	0	0	0	0	0
Existing + STIP	17	0	0	0	0	17
Strategic Plan	0	100	0	0	0	100
Existing + Strategic Plan	17	100	0	0	0	117

Table G-10: Deployment Schedule for Preferential Signal Treatment for Transit.

Preferential signal treatment for transit vehicles is currently limited in application to Region 1, as shown in Table G-10. The table includes only preemption equipment used in connection with light rail transit (84). In addition, the Strategic Plan includes funding for prioritization equipment at 100 intersections outside of metropolitan Portland. The two transit systems with the largest fleets after Tri-Met are in Region 2 – in Eugene and Salem (85) – so it is assumed that all 100 equipped intersections would be in Region 2 as well.

Maintenance for these devices is covered under existing procedures.

G.2.5 Advanced Traffic Management System

An Advanced Traffic Management System (ATMS) is a system that is concerned with the overall management of traffic to improve network capacity, reduce user delays, and improve safety. To do this, an ATMS collects and analyzes field data on traffic conditions, and assists in assessing network congestion, adjusting traffic signal timing, providing drivers with real-time information on potential alternatives, and detecting incidents. For an urban TOC, the ATMS is a primary tool for managing regional traffic.

	Region 1	2	3	4	5	State Total
Existing	1	0	0	0	0	1
STIP	0	0	0	0	0	0
Existing + STIP	1	0	0	0	0	1
Strategic Plan	0	1	1	1	1	4
Existing + Strategic Plan	1	1	1	1	1	5

Table G-11: Deployment Schedule for Advanced Traffic Management Systems.

As Table G-11 indicates, ODOT's deployment goal for ATMS in the long-term is to have one operating system in each of ODOT's five regions[3]. The TMOC in Portland has installed ATMS software first developed for metropolitan Atlanta. The system is a UNIX-based network system with Windows NT interfaces for the operators. It is capable of interfacing with CCTV, VMS, ramp meters and other ITS systems in order to optimize the transportation system's operations. It is a scaleable system; therefore, it may be installed in a smaller version at ODOT's other TOCs at a future date.

For the purposes of this analysis, the ATMS is defined to include only the computer and communications equipment necessary to support ATMS functions. Region 1 was used as a

[3] This long-term goal assumes a new TOC is initiated in Region 5.

model for estimating maintenance needs in other regions because it has the most advanced ATMS deployment to date. Region 1 utilizes two servers – a graphical user interface (GUI) server and a database/communications server. Each of these servers will have regular preventative maintenance activities. There are approximately 20 workstations and/or laptops in Region 1 which are used by TOC staff in fulfilling the operation of the TOC, and hence should be considered as part of the ATMS maintenance needs (76). It is assumed that other regions would have fewer staff members, and consequently would not need as many computers. For the other regions, it is assumed that there would be two operator consoles, the two required server machines, and two machines for the TOC manager – one desktop and one notebook.

As ODOT deploys an increasing volume of technology and desires increased functionality, the ATMS software will need to be upgraded and updated. Because the software is written on a UNIX platform, it is anticipated that the software modifications will be developed centrally in Salem, where any ODOT UNIX expertise would reside. After testing of the software, upgrades would be installed at the other regions in the state to ensure consistency of operations across the state.

In addition to the maintenance needs associated with the computer hardware and software, there will be maintenance associated with communications inside the TOC. Failure of the local-area network due to worn cables could deactivate the ATMS, so regular inspection of the in-building communications is recommended.

G.3 Incident Detection

The Federal Highway Administration has estimated that at least 60 percent of highway congestion is caused by incidents (86). Therefore, one of the most important aspects of successful traffic management is being able to detect incidents quickly. ODOT is considering implementation of several ITS solutions that would expedite incident detection.

G.3.1 Callboxes

One incident detection mechanism used by many departments of transportation is emergency callboxes, located strategically along expressways to help motorists report incidents and breakdowns more quickly. In Oregon, as shown in Table G-12, callboxes have been installed only in Region 3. They were installed on the Medford Viaduct primarily because geometric constraints on the viaduct mean that incidents or breakdowns will more than likely be blocking travel lanes, creating an additional safety hazard.

	Region					State
	1	2	3	4	5	Total
Existing	0	0	4	0	0	4
STIP	0	0	0	0	0	0
Existing + STIP	0	0	4	0	0	4
Strategic Plan	0	0	0	0	0	0
Existing + Strategic Plan	0	0	4	0	0	4

Table G-12: Deployment Schedule for Callboxes.

ODOT's callboxes are environmentally sealed, heavy-duty, telephone handsets. They are hard-wired directly to a dispatch center at Central Point in Region 3 such that a motorist picking up the handset would be directly connected to the dispatch center in order to verbally report the incident. There are neither telephone keypads nor automatic call classification procedures associated with the callbox system.

The callboxes are currently being upgraded, with new field units to be deployed in the fall. The previous models were not very resistant to vandalism and were susceptible to environmental damage as well, requiring significant maintenance activities every 3 to 4 months. According to vendor recommendations, the new units should need little maintenance. Preventative maintenance, in the form of seeing if calls go through, is recommended every three or four weeks. Because of the sophisticated nature of the electronics within the call boxes, repair maintenance would need to be directed to the vendor (87).

G.3.2 Cellular Call-in

To expedite detection and reporting of incidents, many jurisdictions have worked with local cellular phone providers to provide a universal, cellular call-in telephone number. Calls to these telephone numbers are often the first reports of incidents (88). In one case study, response time to incidents was reduced by 10 to 15 minutes when the Massachusetts State Police developed a single statewide phone number for reporting incidents (89). As cellular phone market penetration increases, this could be an even more critical component to the quick detection and response to incidents. ODOT currently has telephone numbers available for reporting incidents that may be accessed by cellular phone users, but the telephone numbers change across jurisdictions and are generally not easy to remember.

To create a cellular call-in program, ODOT would coordinate with cellular phone providers to arrange for an easy-to-remember number (such as *999) to be made available on a statewide basis. As a public service, the cellular telephone companies may absorb the cost of creating the program (90). Once the program is in place, maintenance of the program would be minimal from ODOT's perspective. ODOT would have maintenance responsibility over roadside signage that indicates the phone number; this maintenance could be included with other sign maintenance programs with negligible additional cost. Maintenance of the cellular phones and cellular phone transmitters would be the responsibility of the cellular phone companies and subscribers.

G.3.3 Automatic Incident Detection Systems

The previous two incident detection methods strive to reduce response time to incidents by making it easier for human observations to be provided to an operations center. An alternative to simply improving the channels for human reporting is to utilize technology to automatically identify incidents. Such systems may be called automatic incident detection systems.

The system's functionality is based on the development of an algorithm that identifies incidents based on key traffic flow parameters such as occupancy, volume and speed. The algorithm reviews the data collected from the detectors and attempts to identify anomalies that might suggest the presence of an incident, such as sudden reductions in travel speed or volume. These algorithms are not faultless: an algorithm may sometimes identify an "incident" when actually there is none (i.e. a "false alarm") or it may fail to identify an incident that has actually occurred. There is ongoing research to improve incident detection algorithms in order to reduce the number of “false alarms” and missed incidents.

	Region					State
	1	2	3	4	5	Total
Existing	0	0	0	0	0	0
STIP	0	0	0	0	0	0
Existing + STIP	0	0	0	0	0	0
Strategic Plan	1	0	0	0	0	1
Existing + Strategic Plan	1	0	0	0	0	1

Table G-13: Deployment Schedule for Regionwide Automatic Incident Detection Systems.

Incident detection systems have most commonly been used in metropolitan areas by relying on a system of field detectors. ODOT is looking to implement this type of application in Region 1, as shown in Table G-13. The architecture for this type of deployment was depicted in Figure G-3 in connection with the discussion on regionwide video detection. In order to be of value, the system requires continuous, real-time communications from the field detectors to the incident detection server. This would allow the server to poll the field units every 10 to 60 seconds to obtain the latest in traffic flow information. In Region 1, this would likely be provided by the same fiber optics network which is used by CCTV, ramp metering and other ITS devices.

ODOT is also looking to deploy, on a test basis, intersection-based incident detection. The architecture for this type of deployment is indicated in Figure G-10. For this type of system, a remote processing unit located in the field would execute the incident detection algorithm. When an incident has been identified, the field unit transmits a message to the TOC. Communication needs for this type of system are less demanding than a regionwide deployment because there is no need for continuous, real-time communications between the intersection and the TOC.

As Table G-14 indicates, ODOT is planning to test video-detection based incident

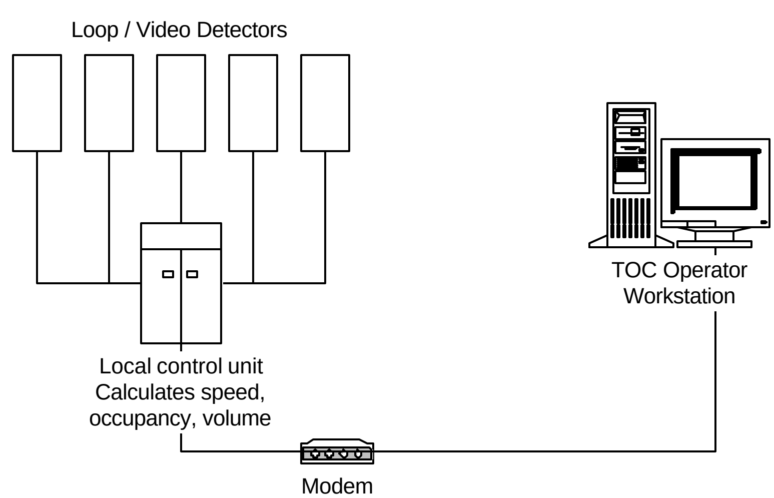

Figure G-10: Proposed Architecture for Intersection-Based Incident Detection.

detection at a couple of test high-accident locations using an intersection-based deployment.

	Region					State
	1	2	3	4	5	Total
Existing	0	0	0	0	0	0
STIP	0	1	0	1	0	2
Existing + STIP	0	1	0	1	0	2
Strategic Plan	0	0	0	0	0	0
Existing + Strategic Plan	0	1	0	1	0	2

Table G-14: Deployment Schedule for Intersection-Based Incident Detection Systems.

The automatic incident detection system relies upon accurate detector data; consequently detector maintenance, which was discussed in Section G.1.4, is a major priority. The software algorithm may need fine-tuning and upgrading every couple of years in order to incorporate the results of on-going research. The most significant maintenance issue with this system is likely the intelligence, either at the TMOC for regional incident detection or at individual intersections. These machines will need regular preventative maintenance (such as database management and re-booting) to ensure they are operating efficiently. The intersection-based computers should need little in terms of hardware upgrades. If detection points from major arterials in Region 1 are incorporated into the regional incident detection system, the incident detection server may need to be upgraded to handle the additional data processing requirements.

G.4 Incident Management and Response

In addition to detecting incidents, quick response to incidents is essential to aiding victims of incidents as well as restoring the transportation capacity of the network. Several systems may assist in expediting incident management and emergency response.

G.4.1 Computer-Aided Dispatch

Computer-aided dispatch (CAD) assists in dispatching police and emergency personnel to various calls for help. It is primarily a database system that records the calls as they come in, giving the location, type of call, and other pertinent information.

The system is designed primarily around the needs of the Oregon State Police (OSP), which supports the CAD mainframe and network connections to the TOCs. The TOCs may use information from the CAD system for a variety of incident management and response purposes, including dispatching incident response vehicles, providing information to motorists both pre-trip and en-route, and dispatching repair services for potential malfunctioning equipment.

All of the TOCs except for the TMOC are collocated with the OSP dispatch functions. In Portland the TMOC's ATMS, along with information provided by surveillance cameras, enables them to provide additional information to OSP on incident location and severity.

The CAD database and system is maintained and updated by the OSP. ODOT's maintenance responsibilities for the system are limited to the CAD terminals used by ODOT staff, and all the communications within the dispatch center to link the terminals to communications from the central CAD database (91).

Table G-15 indicates the number of ODOT workstations on which CAD is operated. These workstations will need maintenance typical for any computer. Because ODOT has limited in-house expertise in CAD diagnostics, however, repair maintenance needs often require more time than for other computer systems in order to include travel time from Salem.

	Region 1	2	3	4	5	State Total
Existing	0	5	2	2	0	9
STIP	0	0	0	0	0	0
Existing + STIP	0	5	2	2	0	9
Strategic Plan	0	0	0	0	0	0
Existing + Strategic Plan	0	5	2	2	0	9

Table G-15: Deployment Schedule for Computer-Aided Dispatch Stations.

G.4.2 Incident Response Vehicles

One effective tool in reducing both the safety hazard and time delay caused by incidents or stalled vehicles is to have a fleet of vehicles ready to assist in clearing disabled vehicles from the roadway. ODOT's best-established program for incident response is Portland-based COMET, which stands for CorridOr ManagEment Team. COMET vehicles regularly patrol major travel routes to keep them free from major obstructions, to provide emergency motorist assistance, and to improve on-scene incident management (92). Each COMET vehicle is equipped with several ITS devices, including:

- an automatic vehicle location (AVL) in-vehicle unit;
- a laptop computer;
- cellular phone communications;
- high-band and low-band radio communications; and
- on-board variable message signs.

As shown in Table G-16, the TMOC currently has seven COMET vehicles. The STIP includes provision for one additional incident response vehicle for each district within Region 2.

	Region 1	2	3	4	5	State Total
Existing	7	0	0	0	0	7
STIP	0	4	0	0	0	4
Existing + STIP	7	4	0	0	0	11
Strategic Plan	0	0	0	0	0	0
Existing + Strategic Plan	7	4	0	0	0	11

Table G-16: Deployment Schedule for Incident Response Vehicles.

Maintenance for the vehicles themselves would be considered as part of traditional fleet maintenance activities. The ITS devices on-board the incident response vehicle have unique maintenance activities. For truck-mounted VMS, maintenance needs are typically relatively low, focusing on sign cleaning. Many of the vehicles currently employ flip-disk matrix VMS, which have the tendency to stick or change during travel. Moreover, these signs have often had power supply problems. These VMS are being upgraded to displays using light-emitting diode (LED) matrices, which are more stable during transit and have more reliable power (93). Wireless communication systems, such as cellular phone and radio equipment, are maintained through the private sector and OSP respectively. The vehicles' laptop computers typically are used for incidental activities, such as assisting in record keeping or in providing additional messages to the on-board VMS beyond the messages which are already programmed (76). Consequently, maintenance needs for the laptop computers will be fairly low. Maintenance of the in-vehicle AVL equipment was discussed in Section G.1.7.

To preserve the effectiveness of the incident response vehicles, their down-time must be minimized. To help in this effort, regular inspection and testing is recommended to ensure that, as a minimum, the VMS, AVL and on-board communications systems are functioning effectively. It is envisioned that preventative maintenance activities for all of the ITS devices on the incident response vehicles would be performed in the same time frame in order to minimize down-time. Because maintenance of many components, such as the in-vehicle AVL units and cellular phones, are provided through vendors or contractors, the on-board VMS will be ODOT's most significant maintenance concern. Repair needs for the VMS should decrease in frequency and severity as the signs are replaced and upgraded.

G.4.3 Pre-planned Detour Routes

One effective tool for incident response is to have a set of pre-planned detour routes on hand. These routes would be developed "off-line" by ODOT staff or consultants, and would identify alternative routes in the event that an incident is blocking a segment of a freeway. According to ODOT's statewide ITS strategic plan, several hundred pre-planned detour routes will be developed as shown in Table G-17.

	Region					State
	1	2	3	4	5	Total
Existing	0	0	0	0	0	0
STIP	0	0	0	0	0	0
Existing + STIP	0	0	0	0	0	0
Strategic Plan	500	100	100	50	0	750
Existing + Strategic Plan	500	100	100	50	0	750

Table G-17: Deployment Schedule for Pre-planned Detour Routes.

A set of pre-planned detour routes may be integrated with other ITS deployments. For example, in Mn/DOT's Integrated Corridor Traffic Management project on the I-494 corridor, VMS were installed at expressway access points. When significant congestion is identified, the VMS direct motorists to pre-determined detour routes, as shown in Figure G-11. A more low-tech approach to this has been deployed in Harrisburg, Pennsylvania, where color-coded detour routes were developed in conjunction with highway construction projects. These routes were indicated in the field by static signs (94). This type of system would not be as flexible to specific traffic conditions.

There are two principal types of maintenance activities that would be associated with pre-planned detour routes.

- Route development. Over time, due to changes in land use or construction projects, there may be a need to change detour routes. This type of maintenance would require a traffic engineering analysis that is beyond the scope of this maintenance plan.

- Route selection. To maximize their effectiveness, detour routes should be able to be automatically deployed based on incident location. There should be regular preventative maintenance to ensure that detour routes are selected appropriately.

To maximize the utility of pre-planned detour routes, it is important to have roadside signage to indicate when detours are in effect, and how motorists should respond. Maintenance of any additional signage required to improve the effectiveness of this device is not included in this analysis.

Figure G-11: Detour Signage for ICTM Project.

(Source: 95)

G.4.4 Hazardous Material Response

A special type of incident response is necessary when hazardous materials (HazMat) are involved in order to properly address their consequences and cleanup. This type of incident response involves the electronic tagging of HazMat shipments on commercial vehicles, integrated with a database that would denote vehicle contents. This database would, in turn, be immediately available to emergency response vehicles if necessary. ODOT is planning to implement a statewide system as a part of their Strategic Plan. Examples of tested systems include (96):

- Tranzit Xpress. This system, tested in a field operational test in eastern Pennsylvania, is based on a relational database as well as GPS capabilities. The information dispatching/operations center collects HazMat information from the motor carrier, and communicates with vehicles via cellular modem to transfer shipping orders and to maintain status information. Vehicles were equipped with on-vehicle electronics systems, which include external and internal communications systems, electronic asset tags, a hand-held personal computer device in the cab, and a global positioning system. A mapping product was used to display vehicle locations.

- Operation Respond. This system provided a central point for dissemination of HazMat information. HazMat carriers provide information to a central database. Emergency personnel responding to an incident would read ID numbers off of the vehicle and report them to the information center, where the dispatcher would learn appropriate protocol and response procedures. This system was tested in Atlanta, Buffalo and Houston.

Both systems were effective in accelerating response times to HazMat-related transportation incidents. Tranzit Xpress appeared to have higher initial and operational costs, so a system like Operation Respond may be more reasonable to implement. Currently in Oregon, a special registration is required for motor carriers in Oregon who wish to transport HazMat (97). Installing a system modeled after Operation Respond would require motor carriers to identify all HazMat shipments and provide information about their contents to a central dispatch center.

To maintain the integrity of a HazMat response system, it is recommended that ODOT set up a separate server to manage the HazMat shipments database. Shippers would enter data into this system fairly frequently in order to provide information about shipments currently on Oregon's highways. Maintenance needs would therefore focus on preserving the integrity of the server and the database.

G.5 Pre-trip Traveler Information

ITS devices can be used to provide travelers with information before their travel in order to assist them in making appropriate route and/or mode choice decisions to save time and reduce the risk of accidents. The devices listed in this section represent the primary systems by which ODOT assembles and disseminates information to the traveling public[4].

G.5.1 Alphanumeric Paging

One of the most common means for travelers to find out information about incidents, construction delays and other traffic-related information is through commercial media, including television and radio. To facilitate this, ODOT works with the local media in Region 1 to improve dissemination about incident information through an alphanumeric paging system.

Every operator workstation at the TMOC has access to client-server software that enables pages to be sent to the local media. When a TMOC operator identifies an incident, the operator types in a page message. Upon prompting, the server will send one page message to a paging service that, in turn, pages all of the local media (76). This system is not currently integrated with the Region 1 ATMS, but it may be in the future.

ODOT relies on a commercial paging service that is responsible for ensuring the integrity of the paging units and the supporting communications infrastructure. Consequently, the maintenance needs for this system from ODOT's perspective are negligible.

G.5.2 Highway Travel Conditions Reporting System

The Highway Travel Conditions Reporting System (HTCRS) is a component of Oregon's advanced traveler information system. HTCRS is a database application that allows ODOT personnel across the state to provide information about road conditions and incidents (98). The

[4] Travelers may, on their own, use other sources for pre-trip information, including commercial media or motor clubs.

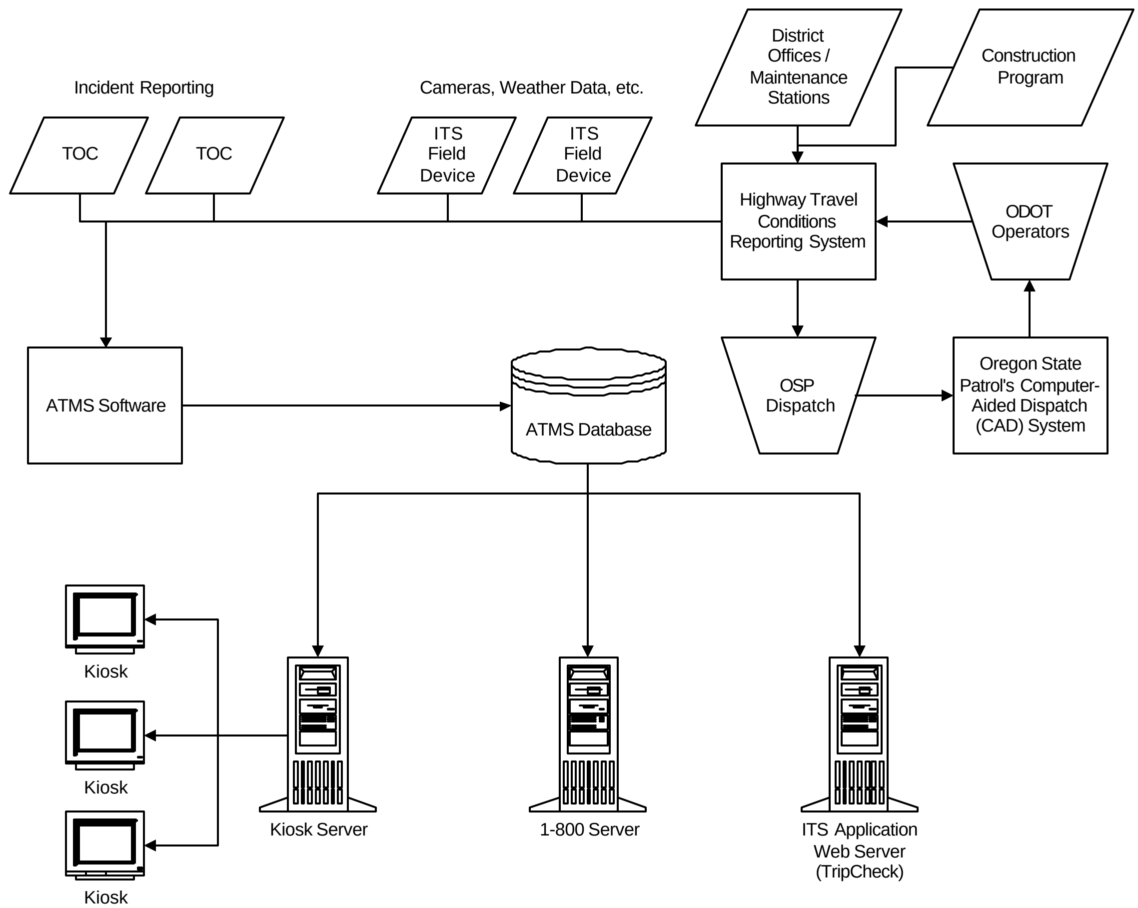

Figure G-12: Relationship Between Traveler Information System Elements.

relation of the HTCRS to other traveler information systems is shown in Figure G-12. It is intended to be a secondary information source beyond information collected from cameras, RWIS and other field devices. The HTCRS database will be structured such that information from this database may be read by the ATMS and thereby disseminated to other information systems, such as kiosks, to allow users to find detailed traveler information for specific parts of the state.

Related to the HTCRS will be an application that will interface with OSP's CAD system. The application will, through both manual and automatic filtering, identify recent entries in the CAD database which require some type of ODOT intervention. The interface will preserve some of the data fields created by the CAD system, such as time and location of the report, and will allow for additional fields of data to be created, such as number of lanes blocked (99). This works toward the long-term goal of having a single entry input system.

Because this application is being developed in-house, application development and de-bugging time needs to be considered as a part of the maintenance plan. Application development and database maintenance will occur centrally in Salem as a "preventative maintenance" activity.

Once the application is operating satisfactorily, it is likely that upgrades will occur due to the desire for increased functionality.

G.5.3 800-number Information

One way of disseminating information collected by HTCRS is through the use of an 800-number. ODOT provides a toll-free number for in-state residents (1-800-977-6368) as well as a telephone number for out-of-state residents (1-503-588-2941) (100). The 800-number is operated on a statewide basis and is updated to reflect the latest highway and weather conditions. The service is responsive to the traveler's specific needs, allowing motorists to review conditions on specific routes or in specific parts of the state. It is heavily used during the winter months, averaging between 150,000 and 250,000 calls per month (91).

The hardware for the system is located in the Western Regional Dispatch Center in Salem. The system includes five servers and dozens of telephone lines. One server houses current traveler data. This server is responsible for receiving data updates, sending data packet updates onto the other servers, and receiving and directing telephone callers. The system is currently somewhat labor-intensive in that it requires manual administration and recording of new traveler information data. As HTCRS becomes better integrated, a text-to-voice conversion tool will reduce the need for direct human involvement. The system requires maintenance for preserving the integrity of the servers, and upgrading and repairing the software.

G.5.4 Internet Access

Another form of pre-trip traveler information that is becoming increasingly utilized is ODOT's Internet travel advisor, called TripCheck. TripCheck, when fully functional, will include information such as camera images, weather conditions, descriptions of ongoing road construction, and alternative travel modes. It will also geographically indicate incident locations along with estimates for anticipated potential delay at each incident location. As is shown in Figure G-12, TripCheck will get its information directly from the ATMS. It will poll the HTCRS every five to ten minutes to update TripCheck's maps (102).

Similar to HTCRS, the TripCheck application will require continual "maintenance" to incorporate additional deployments, increased functionality, as well as potential re-designs. Because TripCheck has also been developed in-house, ODOT would be responsible for all of this maintenance. Operation of the TripCheck application will also require a dedicated server, which will require regular maintenance activity to preserve its efficiency and integrity.

G.5.5 Kiosks

Kiosks are another form of information dissemination that ODOT is considering implementing in the future. These are stand-alone cabinets with a computer that would be linked to the statewide ATMS database. The kiosks may have the potential to be linked to other information as well, such as lodging and recreation information. Kiosks are typically located at areas where large numbers of people are making travel-related decisions, such as major employers, shopping centers, highway rest areas, truck stops, airports, and transit transfer centers.

ODOT currently does not have any kiosks deployed, as shown in Table G-18. Some kiosks are included in the current STIP for Region 5, although ODOT staff members have expressed reservations about the maintenance and deployment details of putting kiosks in Region 5. The strategic plan proposes the deployment of 237 kiosks, with 117 kiosks in metropolitan Portland. It is assumed that the other kiosks would be scattered across the state.

	Region					State Total
	1	2	3	4	5	
Existing	0	0	0	0	0	0
STIP	0	0	0	0	0	0
Existing + STIP	0	0	0	0	0	0
Strategic Plan	117	30	30	30	30	237
Existing + Strategic Plan	117	30	30	30	30	237

Table G-18: Deployment Schedule for Kiosks.

Figure G-12 showed one potential system architecture design for kiosk deployment in Oregon, where kiosks receive regular information updates from a central server. This is similar in architecture to that used in several kiosk deployments (104, 106). Kiosks would be connected by dedicated phone lines to the ODOT wide-area network. Information on the kiosks would include all information provided by TripCheck, as well as potentially transit and tourism-related information.

The State of Oregon's Department of Administrative Services (DAS) currently uses a kiosk system for providing information about employment opportunities. In their experience, the most significant maintenance issues with their kiosks have been printer problems, network breakdowns, and software failures. Because kiosks are often located in areas that are not as environmentally controlled, the printers often fail due to "bad air" – i.e. poor temperature or humidity control. In addition, printers need regular maintenance to ensure that the paper supply and print quality are adequate. Network breakdowns often occur because kiosks are moved at their host sites causing physical damage to network connections. Another major source of network failures is the reliance on local networks that are out of the State of Oregon's control, which may have firewalls preventing regular updating of the kiosk information. The software application was developed in-house, so there are occasional issues with resolving code problems. To manage the 157 kiosk sites, DAS relies on a central program that polls each location every two hours. This can identify quickly when network or software problems are present (108). It is assumed that if ODOT were to implement a kiosk system that it may encounter similar problems.

Maintenance needs for a kiosk system would be focused on the computer at the kiosk itself. Typical preventative maintenance activities would include cleaning the computer screen and testing to ensure that the user interfaces (keyboard, touch-screen, etc.) function acceptably. Due to the visibility of kiosks, preventative maintenance should be performed very frequently, perhaps even monthly. Because of the frequency of maintenance and the limited technical expertise it requires, people at the site hosting the kiosk may be the best qualified to perform this type of maintenance. Repairs maintenance may be required not only due to component failures as identified earlier, but also due to vandalism.

The challenge of providing maintenance support to high-visibility and geographically scattered kiosks may be eased through the use of public-private partnerships. Locations like truck stops, shopping malls and major tourist destinations may be willing to pay for the capital, operations and maintenance costs of kiosks to serve as a host site. In addition, ODOT could consider allowing advertising on kiosk cabinets in exchange for companies paying for on-site maintenance through a contractor.

G.6 En-route Traveler Information

In addition to pre-trip information, ITS devices can be used to provide travelers with information during their travel. This information serves several functions, including warning motorists of safety hazards, and advising motorists of traffic or weather conditions that may affect their travel decisions. The devices included in this section are those over which ODOT has significant operational and maintenance responsibility, in contrast to reports carried by commercial radio.

G.6.1 Changeable Message Signs

Changeable message signs (CMS) are roadside devices that have the capability of displaying one of a limited number of fixed messages. The technology employed in CMS may vary considerably, from a radio-activated, fold-out sign that opens on a hinge, to a warning sign that is only illuminated during windy conditions. For this ITS maintenance plan, CMS are defined to include only those signs that must be manually activated by ODOT personnel[5].

Some of the current deployments in Oregon include the following.

- Icy bridge warning systems. There are two deployments on the Interstate 5 viaduct (one per direction) in Medford. This deployment consists of signs that are manually activated by remote switches whenever maintenance officials identify that icy conditions are present (109).

- Tunnel lane closure advisory. At the entrance to the Vista Ridge tunnel on the Sunset Highway (US 26) in Region 1, there are manually activated neon signs used to indicate lane closures within the tunnel (110).

- Snow zone advisory. For some of the more heavily traveled mountain passes, CMS may be used to indicate when snow tires and/or chains are required. In the past, these signs used either manually rotated drums or fold-out signs. ODOT has replaced this technology at some locations, including Cabbage Hill and Ladd Canyon in Region 5, with telephone-activated, rotating drum signs (111).

- Oversize vehicle closure. Sometimes roads will be closed to mobile homes or other large vehicles when there are significant crosswinds. In these areas, oversize vehicle closure CMS advise large vehicles to leave the roadway until conditions improve. Several systems are located in Region 4 (112).

[5] Technologies that integrate detectors with warning signs, such as the downhill speed advisory system, will be discussed in a later section.

- Bridge CMS. Each highway bridge that opens to allow maritime traffic to pass through has CMS to warn highway traffic of the bridge activity. A bridge operator manually activates these CMS whenever a maritime vessel requiring greater vertical clearance is awaiting passage under a bridge.

CMS are considered to be an ITS device, but because of the signs' lack of flexibility and their reliance on human interpretation of conditions, it is understood that ODOT is not planning any additional CMS installations beyond what is in place. ODOT would instead opt for automatically-activated warning signs, or variable message signs (VMS) that have a higher degree of message flexibility.

Maintenance for CMS focuses on two elements: the communication of the signal to the sign, and the operation of the sign itself. For communications to the sign, it seems a combination of hard wiring and radio or cellular communications are used, with minimal preventative maintenance needs. The sign displays' maintenance needs may vary considerably, based on the age of the equipment and environmental protection. Because CMS are legacy devices pre-dating most of ODOT's ITS infrastructure, it is unclear what other CMS ODOT has deployed, how many there are, and in what locations.

G.6.2 Variable Message Signs

Unlike CMS, variable message signs (VMS) are not constrained to a fixed number of messages. Messages may be programmed to describe information specific to existing conditions, including incident location, detour information, weather-related closures, and other types of information.

A typical system architecture schematic for VMS is shown in Figure G-13. Messages for the VMS are created at the TOC, and are relayed by dedicated phone line to a modem in the VMS. A processor located in the VMS interprets the message and sends signals to the sign pixels to change to reflect the new message.

There are three basic VMS technologies that may be used individually, or in combination

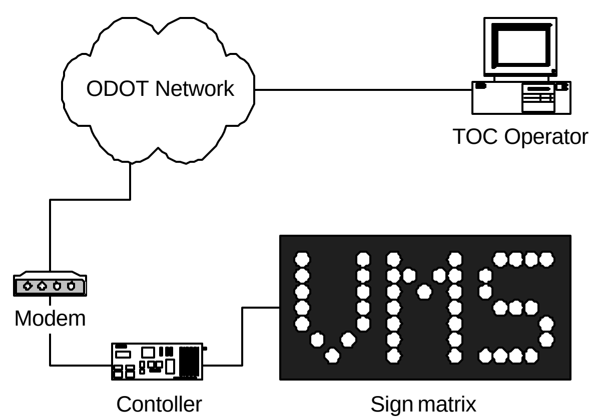

Figure G-13: Architecture for Variable Message Signs.

to achieve more optimal displays (113, 114). These base technologies include the following.

- Flip disk. This technology uses a matrix of disks with one side black and one side covered with bright, reflective material. Each disk is electromechanically flipped based on input from the controller.

- Light-emitting diode (LED). Typically, four bright LEDs are joined to create one cluster that represents a pixel on the sign matrix. The controller provides power to different pixels based on input from the controller.

- Fiber optic. This technology has two light sources and bundles of glass fibers that serve as the pixels in the matrix. Shutters in front of each pixel open and close in order to display messages.

VMS maintenance will depend heavily on the type of technology that is used. Flip disk systems require regular disk cleaning twice a year, and the electromechanical components may be susceptible to failure due to environmental conditions. LEDs are rated for 100,000 hours of continuous operation at the rated voltage (113, 115), and therefore require little maintenance. The lamps used in fiber optic systems have about 6,000 hours of rated life, which requires occasional lamp replacement (116, 117). Regardless of the matrix display used, maintenance may also be necessary on the sign housing, controller, power supply, and communications equipment. It is recommended that filters be cleaned between two and four times per year (115, 117, 118), and that components be inspected annually.

In addition to different types of sign displays, there are two types of VMS deployments: permanent and portable.

Permanent VMS. Permanent VMS are normally mounted on bridges and overpasses or on overhead trusses. Smaller permanent VMS may also be installed on the roadside, although ODOT is not currently using permanent VMS in this way.

Table G-19 shows where permanent VMS are deployed in Oregon. Many of the deployments in Oregon are concentrated in Region 1. Additional signs are included in the STIP for Regions 1, 2 and 5. According to the Strategic Plan, future deployments of permanent VMS will be restricted to Region 1. There are several signs included in the Strategic Plan inventory for Region 5 as well. These are signs

	Region					State Total
	1	2	3	4	5	
Existing	12	5	2	1	5	25
STIP	4	4	0	0	5	13
Existing + STIP	16	9	2	1	10	38
Strategic Plan	16	0	0	0	8	24
Existing + Strategic Plan	32	9	2	1	18	62

Note: ODOT is assumed to have no maintenance responsibility over CSEPP signs (Region 5 only) until after STIP expires, although they can currently be used for operations. It is assumed, as a worst case scenario, that ODOT would take over maintenance for all eight CSEPP-related VMS.

Table G-19: Deployment Schedule for Permanent Variable Message Signs.

provided in conjunction with Umatilla and Morrow Counties' Chemical Stockpile Emergency Preparedness Program (CSEPP) (119). Eight signs associated with CSEPP are already in place on roadways leading to and from the Umatilla Army Depot near the Interstate 84/Interstate 82 junction in Region 5. Under normal conditions, ODOT may use these signs to provide information about weather conditions and road closures. In the event of a chemical accident at the army depot, CSEPP would overtake the operation of these signs, providing messages indicating road closures, detours and other critical information. Maintenance of these signs is currently provided through CSEPP. Once the hazardous chemicals stored at Umatilla have been properly disposed of, ODOT will inherit full operational and maintenance responsibilities for these signs. It is assumed this will occur some time after the current STIP ends.

There are several technologies of permanent VMS currently in use in Oregon, including LED, fiber optic, and LED-flip disk hybrid signs. The variety of VMS types increases the amount of training and spare parts required for maintenance, and likely increases the time required to maintain each sign. Moreover, there has been significant variation in maintenance needs between signs due to quality of manufacturing, vandalism and other factors. Since VMS are typically replaced every ten to fifteen years, it is assumed that ODOT will have lower maintenance, standardized permanent VMS in the future.

Portable VMS. Portable VMS are normally mounted on trailers or trucks, and are transported to locations on demand. Portable VMS may be deployed due to temporary detours, incidents, construction information, or similar situations. Because of their mobility, portable VMS typically need to supply their own power. Solar-powered signs using a battery back-up are a common power mechanism, although diesel power is also used.

Table G-20 shows current and future deployment of portable VMS in Oregon. Currently, many portable VMS are deployed in Region 2, although they are scattered in different locations to maximize responsiveness. The Strategic Plan forecasts an aggressive schedule for increased VMS deployment, assuming an average of two portable VMS per city statewide.

	Region					State Total
	1	2	3	4	5	
Existing	1	19	0	3	0	23
STIP	0	0	0	2	0	2
Existing + STIP	1	19	0	5	0	25
Strategic Plan	60	80	100	97	100	437
Existing + Strategic Plan	61	99	100	102	100	462

Table G-20: Deployment Schedule for Portable Variable Message Signs.

The underlying technology used in portable VMS is similar to that used in permanent VMS. Maintenance needs for the display component are slightly less than for permanent VMS because portable VMS are typically smaller with easier maintenance access, and the sign may be transported to the technician as necessary. Field experience has found that there are significant, frequent problems with communications to portable VMS (91). Many portable VMS use cellular modems, which tend to get damaged or dislodged during transport. It is assumed that more stable systems will be found in the future which will help to reduce maintenance needs.

G.6.3 Highway Advisory Radio

Highway Advisory Radio (HAR) is a localized radio broadcast system designed to provide motorists with location-specific information, such as current traffic conditions, construction information, weather advisories, or directions to major tourist destinations. The basic system architecture for HAR is shown in Figure G-14. A low-powered AM transmitter is connected to a voice storage unit via leased telephone lines. The voice storage unit may be updated via telephone in order to reflect changes in conditions. Because HAR systems are typically localized to a 3- to 6-mile radius, roadside signage and/or beacons are used to indicate where HAR systems are present and when they are in operation.

	Region					State
	1	2	3	4	5	Total
Existing	0	0	1	0	0	1
STIP	0	0	0	0	0	0
Existing + STIP	0	0	1	0	0	1
Strategic Plan	0	0	0	0	0	0
Existing + Strategic Plan	0	0	1	0	0	1

Table G-21: Deployment Schedule for Highway Advisory Radio.

ODOT currently has one HAR installation, southbound on Interstate 5 in Ashland near Siskiyou Summit, which operates only during the winter months. It is a vertical monopole antenna system. Signs indicating the HAR system have flashing beacons that may be turned on by radio. As shown in Table G-21, no other installations are included in either the STIP or the statewide implementation plan.

Maintenance of HAR systems has become less time-consuming over time. The use of solid-state electronics has reduced periodic maintenance needs such as replacing magnetic tape. Annual periodic maintenance activities include periodically checking the HAR sign for interference from vegetation, new construction, signs or other antennae, and regularly checking the range of the signal and the power supply (120).

G.6.4 Weather and Visibility Warning Systems

Several systems, which are either currently under research or have been developed and deployed, combine aspects of CMS with RWIS technology. Figure G-15 indicates how these

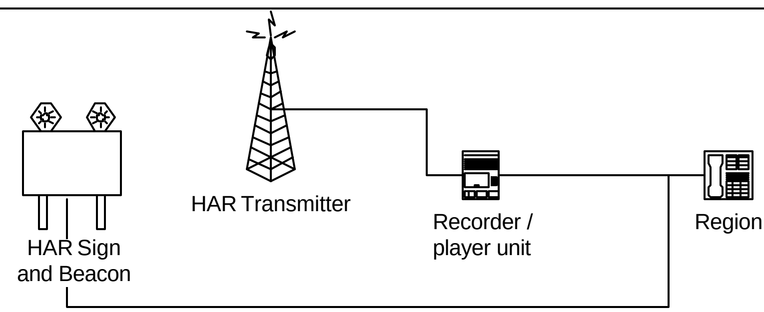

Figure G-14: Architecture for Highway Advisory Radio.

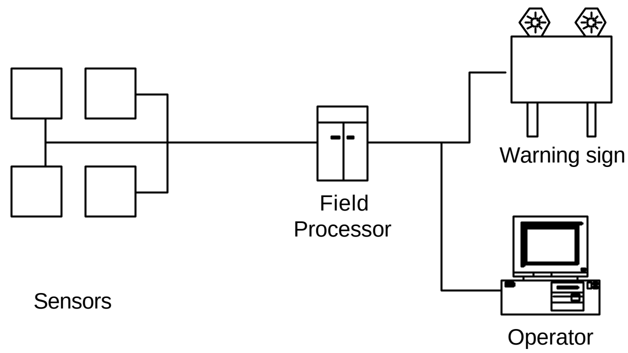

Figure G-15: Proposed Architecture for Weather and Visibility Warning Systems.

systems might function. Field sensors are used to measure weather and visibility conditions. A field processor analyzes the sensor-provided data, and will activate flashing beacons on an adjacent sign to inform motorists of a particular condition. The field processor would also have a communication link, likely by dial-up modem, to the TOC. The communications link would permit the processor to inform the operator when warnings are active as well as when self-diagnostic processes indicate there is a repair need.

Example applications of these systems include:

- Icy bridge detection systems. There is currently an icy bridge detection system located on the Quartz Creek Bridge in Region 1. As shown in Table G-22, twenty deployments were included in ODOT's Strategic Plan. Pavement sensors are used to measure temperature and moisture, as well as the presence of ice.

	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	1	0	0	0	0	1
STIP	0	0	0	0	0	0
Existing + STIP	1	0	0	0	0	1
Strategic Plan	4	4	4	4	4	20
Existing + Strategic Plan	5	4	4	4	4	21

Table G-22: Deployment Schedule for Icy Bridge Detector Systems.

- Oversize load detector systems. These systems gather information about pavement temperature, wind speed and similar conditions, in order to identify conditions when oversize vehicles would have difficulty negotiating the road. The warning sign would be used to indicate when routes are closed to larger vehicles. As shown in Table G-23, ODOT has programmed several installations of this technology in Region 4 as a part of the STIP.

These systems have function like a CMS in that they give messages only when certain weather and visibility conditions are present. These systems also have the function of an RWIS in their reliance on in-field sensors, in-field intelligence and server support. Maintenance of weather and visibility warning systems will therefore include a combination of the maintenance aspects of CMS and RWIS. Maintenance for the CMS components will usually be fairly negligible, involving annual testing to ensure that the sign is activated when appropriate conditions are present and deactivated when these conditions are absent. The sensors and field processing unit need to be regularly inspected and reset to insure proper operations. To simplify maintenance, these systems may incorporate the same sensor package and processing unit software as other RWIS systems, and may therefore rely on the same server infrastructure used by RWIS.

	Region					State
	1	2	3	4	5	Total
Existing	0	0	0	0	0	0
STIP	0	0	0	5	0	5
Existing + STIP	0	0	0	5	0	5
Strategic Plan	0	0	0	0	0	0
Existing + Strategic Plan	0	0	0	5	0	5

Table G-23: Deployment Schedule for Oversize Load Detector Systems.

G.6.5 Variable Speed Limit Systems

Variable speed limit systems (VSLS) combine VMS and RWIS technology in order to improve safety through reducing speed-related incidents. Atmospheric and surface weather sensors provide information by which posted speed limits may be adjusted on a real-time basis.

As shown in Table G-24, ODOT is planning to deploy 20 VSLS as part of the Strategic Plan. Specific locations have not been determined, but it is assumed that most locations will be in the more mountainous regions of the state where weather can create the most hazardous conditions.

	Region					State
	1	2	3	4	5	Total
Existing	0	0	0	0	0	0
STIP	0	0	0	0	0	0
Existing + STIP	0	0	0	0	0	0
Strategic Plan	2	3	5	5	5	20
Existing + Strategic Plan	2	3	5	5	5	20

Table G-24: Deployment Schedule for Variable Speed Limit Systems.

Figure G-16 shows an example of how a VSLS may be set up. Various roadway surface sensors provide information about the presence of snow, ice or moisture. Other sensors may detect local visibility, such as fog, dust and other matter. Pairs of loop detectors are embedded in the roadway surface to determine vehicle speed. The information collected from these sensors is input into a field processor. The field processor may contain algorithms for estimating appropriate speed limits based on the results of sensor data (121). An alternative to using an automated algorithm is to provide sensor information to the TOC via a radio link. The TOC could then set speed limits based on experience and professional judgment. Once a reduced speed limit has been decided upon, the field processor activates a flashing beacon warning sign along with a VMS, which indicates the revised speed limit (122).

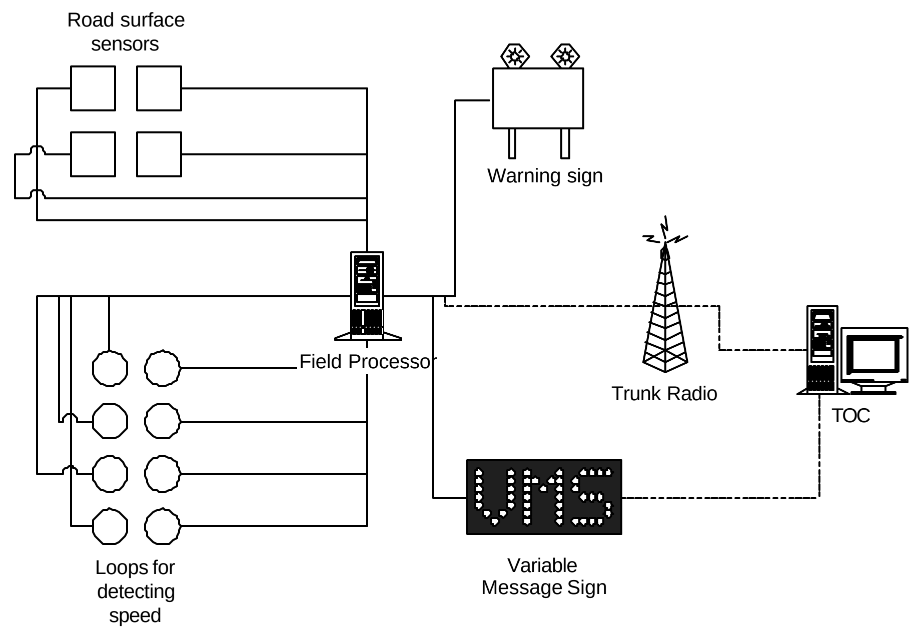

Figure G-16: Proposed Architecture for Variable Speed Limit System.

Maintenance of these systems would be similar to that required for RWIS. Because communications between the VMS and the field processing unit would be entirely in the field, VMS maintenance needs would be somewhat reduced over stand-alone VMS deployments. Because of the liability exposure that may be associated with this system (123), timely preventative and repair maintenance activities are critical. Preventative maintenance activities, including routine testing of sensors and detectors, would be vital to minimizing liability exposure.

G.6.6 Queue Detection System

The purpose of a queue detection system is to alert motorists in poor-visibility areas of upcoming queues in order to avoid rear-end collisions. As shown in Table G-25, ODOT currently has one experimental queue detection system, located in Region 2. The system works as depicted in Figure G-17. Inductive loops are installed in the road pavement based on studies of rear-end incidents at that location. The loops are connected to a timer, in order to check every four seconds whether vehicles are still present on the loop. If a vehicle continues to be present, this will activate a flashing beacon sign well upstream of the loops (124). The sign is

	Region					State
	1	2	3	4	5	Total
Existing	0	1	0	0	0	1
STIP	0	0	0	0	0	0
Existing + STIP	0	1	0	0	0	1
Strategic Plan	0	0	0	0	0	0
Existing + Strategic Plan	0	1	0	0	0	1

Table G-25: Deployment Schedule for Queue Detection Systems.

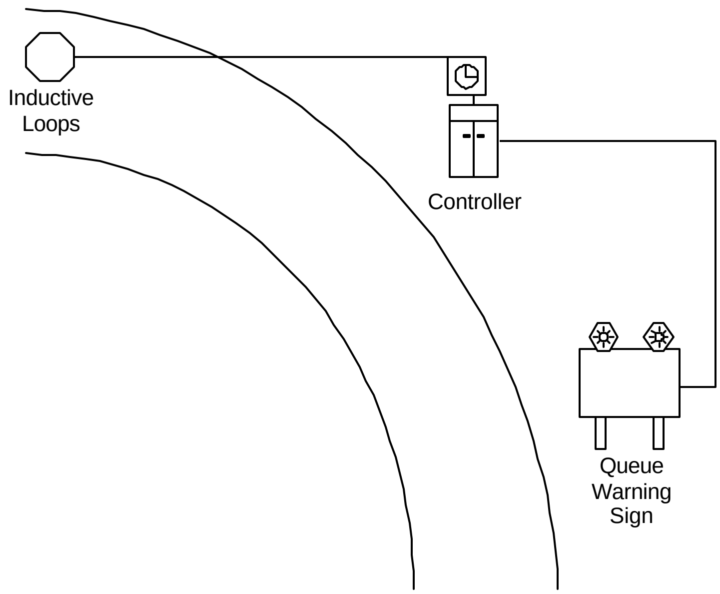

Figure G-17: Architecture for Queue Detection System.

placed such that it provides a reasonable distance for the motorist to safely slow down and avoid getting into a rear-end collision. There are currently no plans to implement this system in other parts of the state.

Maintenance of the system has been designed to be fairly simple. An LED at the timer cabinet indicates when the loop detector is occupied, providing quick diagnostics for the loop and local wiring. Annual testing should focus on ensuring that all connections from the loops to the flashing beacon are functioning acceptably, and that the timer is set at a reasonable delay.

G.7 Commercial Vehicle Operations

An important sub-system of ITS is commercial vehicle operations (CVO). While motor carriers interact with the rest of the traffic system and may be similarly aided by traffic management and traveler information systems, they also have special needs that should be considered separately.

In Oregon, ITS applications for commercial vehicles have been provided exclusively through a sole-source vendor agreement. The vendor has been responsible for the design, installation and maintenance of various motor carrier-related ITS installations throughout the state. After the initial warranty period on new installations expired, ODOT entered into an extended warranty agreement with the vendor to provide maintenance on these installations as well. The primary terms of the agreement are as follows (125).

- The vendor is responsible for maintaining the system in good working condition.
- The vendor will repair malfunctioning equipment within 48 hours of notification, and will provide documentation of corrective actions taken within 30 days of the repair.

- The vendor will perform preventative maintenance on all major systems at six-month intervals.
- The vendor will provide free software upgrades with free manuals, as well as refresher training.
- The vendor will calibrate the systems once per year.
- The vendor will provide labor, tooling, test equipment, and facilities required to perform the maintenance, and will keep adequate spare parts in a central ODOT facility to ensure prompt response times.
- Both ODOT and the vendor will keep records of maintenance activities.
- ODOT will pay the vendor $1.2 million per year.

In stakeholder meetings in May, the Motor Carrier Transportation Division expressed general satisfaction with the vendor agreement to date, and they planned to continue agreements like this for the foreseeable future. Unforeseeable developments in the future, such as unacceptable cost escalation in renewals of the extended warranty agreement or vendor refusal or inability to continue to agreements, make it necessary to consider what the maintenance needs of these devices would be if ODOT were to handle all maintenance with existing resources. This section will examine the maintenance needs for existing and future CVO systems.

G.7.1 Weigh-in-Motion Systems

The purpose of a weigh-in-motion (WIM) system is to allow vehicles to be weighed while in motion. WIM systems in the United States are designed primarily to weigh commercial vehicles at freeway speeds for the purposes of enforcing weight limits on the highways. These systems generally supplement or replace existing conventional weigh stations.

	Region					State
	1	2	3	4	5	Total
Existing	0	2	4	0	5	11
STIP	5	1	0	4	0	10
Existing + STIP	5	3	4	4	5	21
Strategic Plan	0	0	0	0	0	0
Existing + Strategic Plan	5	3	4	4	5	21

Table G-26: Deployment Schedule for Weigh-in-Motion Stations.

Table G-26 shows ODOT's planned deployment of WIM systems is primarily confined to existing weigh station locations. As of June 1999, ODOT had ten operational WIM sites, located primarily on the Interstate system. By the end of 2000, ODOT will have modernized all 21 of its weigh stations statewide to have WIM and automatic vehicle identification (AVI).

Oregon has two types of WIM installations: pre-clearance and data collection. At the pre-clearance stations, commercial vehicles with transponders are allowed to stay on the mainline,

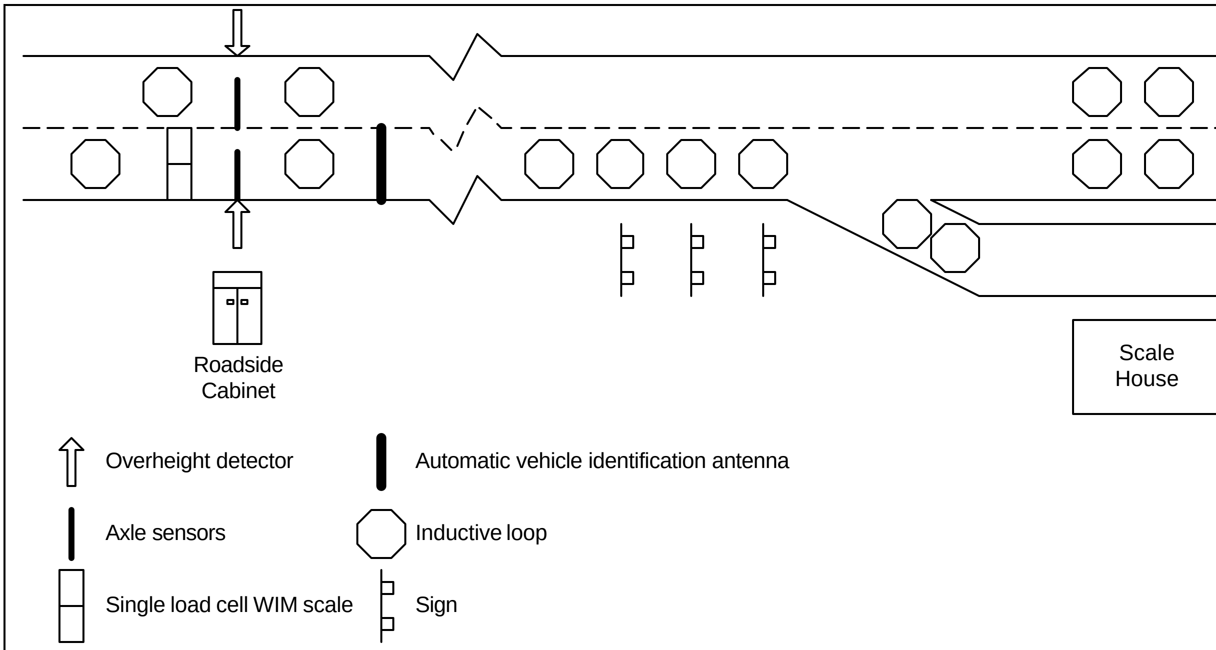

Figure G-18: Architecture for Weigh-in-Motion Site.

(Source: 126)

bypassing the conventional weigh station, and obtain clearance to continue with their trip. The data collection stations simply obtain data on the distribution of vehicles by weight.

Figure G-18 shows how ODOT typically installs its WIM sites. A cluster of equipment is installed about a mile upstream of the conventional weigh station. The equipment includes inductive loops for determining vehicle speed, axle sensors to count vehicle axles, overheight detectors, AVI sensors to read transponders, and automatic vehicle classification (AVC) equipment. This equipment is connected to a roadside cabinet, which relays information to the scale house. At the scale house, the number read from the in-vehicle transponder is checked against a central database on the state supervisory computer. The computer reviews vehicle records against data collected from the in-field equipment. If all information is acceptable, this is communicated from the scale house back to the in-vehicle transponder through a green light. If not, flashing beacons on roadside signage located closer to the scale house directs the vehicle to exit for conventional weighing and inspections.

ODOT has four different types of WIM installations, depending upon the tracking and sorting mechanisms used. These types of WIM are shown in Table G-27. The additional lane of mainline sorting for Type 1 sites creates an increase of in-road hardware and some of the equipment necessary to communicate between the scale house and the vehicle. Type 4 sites have the least equipment, because of the use of visual tracking at the gore and on the ramp instead of inductive loops.

Since ODOT's current established maintenance procedure is specified through a vendor agreement (125), it is assumed that it provides for adequate maintenance of the WIM system.

Type	Description	Locations
1	Two lanes of mainline sorting, connected to previously installed ramp sorting systems	• I-5 at Woodburn (NB & SB)
2	One lane of mainline sorting and piezoelectric lane control sorting systems on ramp	• I-5 at Booth Ranch (NB) • I-5 at Wilbur (SB)
3	One lane of mainline sorting and tracking systems at gore and on ramp	• I-5 at Ashland (NB & SB) • I-82 at Umatilla (SB) • I-84 at Cascade Locks (EB) * • I-84 at Emigrant Hill (WB) ** • I-84 at Farewell Bend (WB) • I-84 at LaGrande (EB) • I-84 at Olds Ferry (EB) • I-84 at Wyeth (WB) • US 97 at Klamath Falls (NB)
4	One lane of mainline sorting and visual tracking at gore and on ramp	• US 26 at Brightwood (WB & EB) • US 30 at Rocky Point (WB) • US 97 at Juniper Butte (NB & SB) • US 97 at Klamath Falls (SB) • OR 58 at Lowell (WB & EB) ***

* - Includes radio frequency communication system
** - Includes downhill speed advisory system
*** - Incorporates one lane of data collection

Table G-27: Types of Weigh-in-Motion Installations in Oregon.

(Source: 125)

According to the vendor, repair maintenance tasks may include servicing sensors on failure (65). Because of the vendor contract, ODOT maintenance staff would likely need to receive additional training in WIM diagnostics and repair prior to attempting to maintain the systems.

G.7.2 Downhill Speed Advisory System

The purpose of the downhill speed advisory system (DSAS) is to warn commercial vehicles of excessive traveling speeds, based on weather conditions and vehicle characteristics including weight and dimensions, through the use of VMS. It is intended to complement runaway truck ramps and potentially reduce the number of times they would be needed (123).

Table G-28 shows the current deployment schedule for DSAS in Oregon. ODOT has established one DSAS at Emigrant Hill on westbound Interstate 84, through the use of an existing WIM and VMS. A second system will be operational by the fall of 2000 on northbound Interstate 5 on the Siskiyou Pass near Ashland. This second system would require a new WIM and VMS.

A typical DSAS configuration is shown in Figure G-19. The system includes WIM equipment that measures individual vehicle weights and dimensions. A field processor determines the maximum safe speed for each vehicle based on the operating characteristics of truck braking systems. When the truck passes over an activation loop, a downstream VMS is triggered to display the calculated safe speed (123). Since the WIM and VMS will likely be separated by a relatively short distance, communications between the WIM and VMS might be provided through coaxial cable.

	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	0	0	0	0	1	1
STIP	0	0	1	0	0	1
Existing + STIP	0	0	1	0	1	2
Strategic Plan	0	4	7	7	6	24
Existing + Strategic Plan	0	4	8	7	7	26

Table G-28: Deployment Schedule for Downhill Speed Advisory Systems.

In terms of maintenance needs, DSAS maintenance needs should reflect a combination of the maintenance needs of its WIM and VMS components. Regular calibration of the WIM scales and cleaning and testing of the VMS would be necessary.

G.8 Communications Systems

In addition to the many field deployments of ITS discussed in this chapter, there are communications networks which must be maintained to ensure the integrity of the ITS infrastructure. This section will briefly discuss the maintenance needs associated with these infrastructure items.

G.8.1 Fiber Optic Networks

ODOT is installing fiber optic cable along expressways in the Portland area to satisfy the

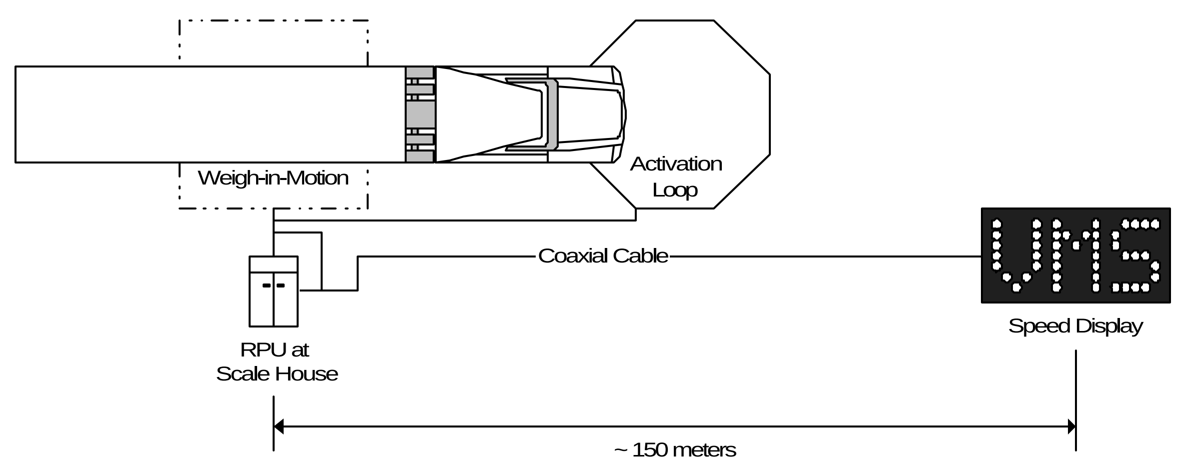

Figure G-19: Architecture for Downhill Speed Advisory System.

need for real-time communications between various ITS deployments in Region 1. Fiber optic cable has adequate bandwidth to allow for many devices, including CCTV, ramp meters, travel time estimation and video detection, to rely on the same communications links. As Table G-29 indicates, it is estimated that regionwide deployment of fiber optic along all of the Portland area's expressways would require approximately 80 miles of fiber optic cable.

	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	0	0	0	0	0	0
STIP	80	0	0	0	0	80
Existing + STIP	80	0	0	0	0	80
Strategic Plan	0	0	0	0	0	0
Existing + Strategic Plan	80	0	0	0	0	80

Table G-29: Deployment Schedule for Fiber Optic Cable (Miles).

Maintenance requirements of fiber optic systems are fairly minimal, with major problems primarily arising from damage due to digging and construction. Minor preventative maintenance must be performed on fiber optic cables in performing optical time domain reflectometer tests to test power loss once every two years for every 15 miles of cable (6).

G.8.2 Radio Communications

Another critical communications component of ODOT's ITS infrastructure is radio communications. Radio is involved primarily in locations needing limited data transmission frequency or packet size which are not accessible by cellular or land-line telephone. This includes several RWIS locations, radio consoles used by TOCs for incident management and response, and radio units located in incident response vehicles.

All of ODOT's radio systems are supported by a system of towers, buildings and antennas scattered throughout the state. Because this infrastructure was in place before ITS, it is assumed that ITS-related communications would result in negligible additional maintenance. There will be maintenance needs associated with devices that transmit or receive signals from the radio system, however. For many consoles and hand-held units, however, the cost of repair maintenance and the rate of technological advancement are quickly making replacement a more attractive option than repair. Consequently, negligible preventative maintenance is recommended for the hand-held units, and repair maintenance will seldom be inexpensive enough that it would make more sense to repair than to replace. For consoles located at the TOCs, the cost benefits of timely maintenance would be more apparent. Table G-30 shows the estimated deployment schedule for radio consoles in the TOCs around the state. Each of the consoles would require some annual preventative maintenance as well as occasional repair maintenance.

	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	4	5	2	2	0	13
STIP	0	0	0	0	0	0
Existing + STIP	4	5	2	2	0	13
Strategic Plan	0	0	0	0	2	2
Existing + Strategic Plan	4	5	2	2	2	15

Table G-30: Deployment Schedule for Radio Consoles.

G.9 Maintenance Coordination

The final element in estimating the resources required to maintain the ITS infrastructure is to examine the costs associated with coordination, tracking and logging of maintenance activities. As was discussed in Chapter 2, stakeholders agreed that there should be improvements in how maintenance is handled and coordinated through ODOT so that repairs are done in a more timely and systematic fashion. Therefore, resources need to be allocated to maintenance coordination activities, which include delegating repairs as appropriate, ensuring that all preventative maintenance tasks are performed and documented as scheduled, that all repair activities are logged, and that maintenance is tracked from the initial report until the repair is tested and found satisfactory.

The preferred maintenance model alternative recommends that the support coordinator position be used to fill this role. However, regardless of how the role is filled, there are two principal resource needs associated with maintenance coordination.

- <u>Computer support</u>. Based on the preferences for a statewide, common database for tracking maintenance activities, it is assumed that maintenance coordination in each region would ultimately be computer-based. There may be a need for a dual-entry system in the short run – i.e. a field electrician using a paper form to track device maintenance, which then is entered by a technician into a centralized database. In the long-run, it is assumed that the maintenance coordination and tracking process would be computerized from start to finish, relying on wireless communications, laptop computers, personal digital assistants (PDAs) and similar systems.

- <u>Staffing support</u>. There will also be a coordination role in terms of logging and tracking hand-offs between different maintenance groups (such as Information Services and regional electricians). For this, it is assumed that the time spent in coordinating, logging or tracking maintenance would be a small percentage of the time spent in the field on device repair.

APPENDIX H SKILL LEVEL ASSUMPTIONS

In determining the staffing resources needed to maintain ODOT's ITS infrastructure, it is necessary to develop some assumptions about how effectively and efficiently ODOT staff may be able to repair malfunctioning devices. This appendix highlights assumptions that were used to guide the number of times higher-level support would be called in for assisting in maintenance, and how long it would take them.

H.1 Diagnostic Effectiveness

The first set of assumptions deals with diagnostic effectiveness, or with what rate of success a given ODOT technician is able to diagnose a device component's problem. For field components, the following assumptions were made.

- Support coordinators would be currently able to diagnose 70 percent of problems with field components; they will be able to diagnose 90 percent of problems in the future (i.e. under the Strategic Plan). This reflects an anticipated increase in the number and capability of self-diagnostic tools.
- Of field component problems that the support coordinators are unable to diagnose, electricians are assumed to be able to diagnose 80 percent of the problems.
- TSSU technicians are assumed to be able to diagnose all problems with field devices that are unable to be diagnosed by other ODOT staff.

For communications and computer-related components (i.e. IS-type components), the following assumptions were made.

- Support coordinators are currently able to diagnose 70 percent of problems with IS-type components; they will be able to diagnose 90 percent of problems in the future.
- Of IS-type problems that the support coordinators are unable to diagnose, the first-level of IS support (likely IS-5 for field devices and IS-6 for Salem-based repairs) is assumed to be able to diagnose 80 percent of the problems.
- Higher-level IS support is assumed to be able to diagnose all problems with communications and computer components that are unable to be diagnosed by other ODOT staff.

H.2 Repair Effectiveness

The ability to diagnose a problem does not necessary imply that there is the ability to resolve the problem, especially at the support coordinator level. Consequently, a set of assumptions needed to be developed about the ability of various ODOT staff levels to be able to repair problems that have been successfully diagnosed. For field components, the following assumptions were used.

- Currently, support coordinators would be able to repair 50 percent of problems with field components; they will be able to repair 60 percent of problems in the future. This reflects an anticipated increase in modular components that may be swapped in and out without needing an electrician's license.

- Electricians are assumed to be able to repair 90 percent of the problems of field component problems that the support coordinators are unable to repair.

- TSSU technicians are assumed to be able to repair all problems with field components that are unable to be repaired by other ODOT staff.

Table H-1 shows the results of these assumptions of diagnostic and repair effectiveness for field components. Based on these assumptions, electricians currently complete most repairs, although support coordinators will be able to diagnose most problems. In the future, the most typical repair scenario will be for a support coordinator to be able to both diagnose and repair malfunctioning field components. Electricians and TSSU are anticipated to have decreasing involvement in both diagnostics and repairs.

Current

	Repaired by			
Diagnosed By	SC	Elec	TS	Sum
Support Coord	35%	32%	4%	70%
Electrician	0%	22%	2%	24%
TS	0%	0%	6%	6%
Sum	35%	53%	12%	

Future

	Repaired by			
Diagnosed By	SC	Elec	TS	Sum
Support Coord	54%	32%	4%	90%
Electrician	0%	7%	1%	8%
TS	0%	0%	2%	2%
Sum	54%	40%	6%	

Table H-1: Current and Future Repair Effectiveness for Field Components.

For communications and computer-related components, the following assumptions were made.

- Support coordinators are currently able to repair 50 percent of problems with IS-type components; they will be able to repair 60 percent of these problems in the future.

- Of IS-related problems that the support coordinators are unable to diagnose, the first-level of IS support (likely IS-5 for field devices and IS-6 for Salem-based repairs) is assumed to be able to diagnose 80 percent of the problems.

- Higher-level IS support is assumed to be able to diagnose all problems with communications and computer components that are unable to be diagnosed by other ODOT staff.

Table H-2 shows what these assumptions mean in terms of who is able to successfully diagnose and repair malfunctioning computer or communications-related ITS device components. Support coordinators are anticipated to have an increasing role in diagnostics and repair activities, while IS technicians are anticipated to have a declining role.

H.3 Diagnostic and Repair Efficiency

Not only is it expected that support coordinators will have less ability to diagnose and repair malfunctioning components, but it is anticipated that they will be less efficient in their work than ODOT technicians who have more specialized skills. For field components, the following assumptions are utilized.

Current

Diagnosed By	Repaired by SC	IS-low	IS-high	Sum
Support Coord	35%	32%	4%	70%
IS-low	0%	22%	2%	24%
IS-high	0%	0%	6%	6%
Sum	35%	53%	12%	

Future

Diagnosed By	Repaired by SC	IS-low	IS-high	Sum
Support Coord	54%	32%	4%	90%
IS-low	0%	7%	1%	8%
IS-high	0%	0%	2%	2%
Sum	54%	40%	6%	

Table H-2: Current and Future Repair Effectiveness for IS-Related Components.

- An electrician is able to diagnose or repair a problem in 80 percent of the time that a support coordinator can.
- A TSSU technician is able to diagnose or repair a problem in 90 percent of the time that an electrician is able.

Similarly for IS-related components, the following assumptions have been made.

- A lower-level IS technician is able to diagnose or repair a communications or computer-related problem in 80 percent of the time that a support coordinator can.
- A higher-level IS technician is able to diagnose or repair a communications or computer-related problem in 90 percent of the time that the lower-level technician can.

APPENDIX I EVALUATION OF TECHNOLOGICAL CHANGE

It has been said that the rate of technological innovation in ITS devices is such that one often replaces devices before one repairs them. The pace and degree of technological change will have significant bearing on ODOT's ITS maintenance needs over the next twenty years.

This maintenance plan analyzes resource requirements over three different years, with their respective technological assumptions, as shown in Table I-1. This table shows that the plan assumes a significant amount of technological change will likely occur between the completion of the current STIP and the conclusion of the Strategic Plan. While it is impossible to forecast the exact effects of technological change on maintenance needs, there are guidelines that may be observed from looking at how technology has progressed in the past several years which should affect devices into the future.

- Increased networking capability of field devices. It is anticipated that future field deployments will be designed to be more amenable to remote network communications. There will likely be improvements in solid-state equipment such as modems and routers that will improve the stability of these devices under poor power or environmental conditions.

- Self-diagnostic capability. Related to the improvements in networking capability, it is anticipated that future field deployments will improve in their ability to perform self-diagnostic activities. Field-based microprocessors will become more sophisticated and powerful, allowing devices to identify components that have failed, and perhaps also the type of repair necessary, providing information on who should be called and what parts are required.

- "Push" technology. Related to self-diagnostic capability is the ability of the device to communicate to a TOC or dispatching office that a failure of some sort has occurred. This is known as "push" technology in contrast to "pull" technology, where an operator must conduct a polling operation to identify which devices are not

Forecast Year	Technological Assumptions
Current / Immediate	▪ Keep all existing deployments ▪ Repair everything in the field
Short-Term (includes STIP)	▪ Keep all existing deployments ▪ Repair everything in the field ▪ New deployments would employ similar technology as existing deployments
Long-Term (includes Strategic Plan)	▪ Large-scale standardization of devices ▪ Non-standard devices would no longer be in the field ▪ New field devices would have to be based on scalable standards (common parts and repair procedures)

Table I-1: Technological Assumptions.

performing adequately. A combination of "push" technology and greater self-diagnostic capability should improve response time and repair efficiency.

- Modular design. As the technology being utilized in ITS devices gets increasingly sophisticated with microprocessors, field technicians will be less likely to spend time repairing device components. Instead, they will be able to swap out the bad "module" (such as a processor card) and swap in a good "module". This is currently done for traffic signal controllers: "bad" controllers are swapped out and sent to TSSU in Salem, who then send "good" controllers back to the regions. This swapping would be encouraged, as the cost of modules is likely to decline relative to the cost of labor into the future.

- Environmental protection. Many maintenance problems with earlier generations of ITS devices have occurred because of poor environmental protection, which allows water damage to key electronic components. Better manufacturing techniques and environmental protection will eliminate many of these problems, reducing the frequency of repair maintenance activities.

- Standardization. It is assumed that all devices included in the Strategic Plan will have a scalable standard in use by 2017. The effect of this is to improve ODOT familiarity with devices, and to reduce training and spare parts requirements.

- Easier access. For some devices, such as closed-circuit television (CCTV) cameras and road and weather information systems (RWIS), maintenance is made difficult by the need to use bucket trucks, lane closures or other time-consuming procedures to access the device. In the future, devices may be able to be lowered to the ground by a switch (124).

APPENDIX J TRAVEL TIME ASSUMPTIONS

Depending upon the location of a repair need and the location of the staff dispatched to make the repair, there may be four different sets of travel times. This section describes each of these combinations, and how travel time estimates were developed for each one.

J.1 Between Field Components Within Region

This set of travel times is applied when staff people qualified to do the repair are located in each of ODOT's regions, and are dispatched to make repairs within their region. This may represent the travel time between successive repairs, such as for preventative maintenance activities, or for isolated repairs, involving a simple round trip from the dispatching center.

These estimates were developed using the following steps:

- A list was made of the cities with the largest population in each Oregon county as well as cities at which ODOT district maintenance facilities are located.
- These cities were grouped within each of ODOT's five regions.
- For each group of cities within a region, travel times were calculated using the travel time utility provided on http://www.freetrip.com/.
- Average travel times were calculated within each ODOT region.
- Average travel times were rounded up to the nearest 15 minutes. An additional 15 minutes were added to travel times within Region 1 to reflect the effects of urban congestion.

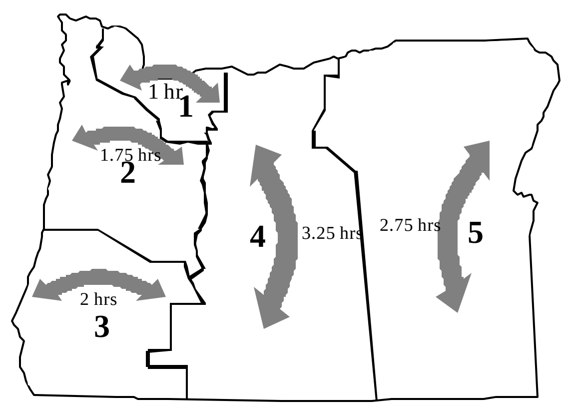

Figure J-1: Travel Time Within Regions.

The resulting travel time estimates are shown in Figure J-1.

J.2 From Centralized Support to Field Devices

For some skill levels, ODOT maintains support only in Salem. To estimate the travel time to access these devices, the following steps were used.

- Travel times between Salem and the most populous city in each county were estimated using http://www.freetrip.com/.

- Travel times were also estimated between Salem and the maintenance district facility in each district using http://www.freetrip.com/.
- Average travel times were developed for each region under each method, and then were averaged.
- The average travel time value was rounded up to the nearest fifteen minutes.

The resulting travel times are shown in Table J-2.

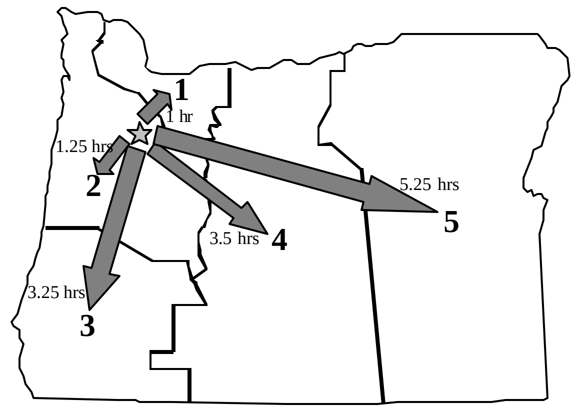

Figure J-2: Travel Time from Salem to Field Devices.

J.3 From TOC to Same TOC

Some maintenance activities are performed at the TOCs from where a maintenance technician would be dispatched. In this case, travel time would be zero for all regions.

J.4 From Region 2 TOC to Other TOCs

There may also be maintenance activities performed at the TOC that require centralized help from Salem. Travel times were estimated using http://www.freetrip.com/, with additional travel time applied in order account for congestion in Portland. The resulting travel times are shown in Table J-3.

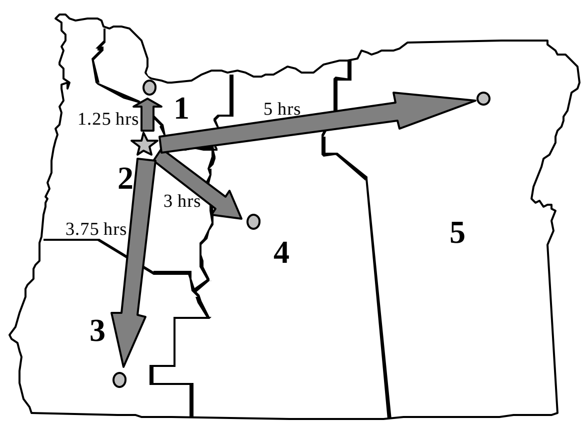

Figure J-3: Travel Times from Salem to Other TOCs.

APPENDIX K DEVICE-BY-DEVICE RESOURCE NEEDS

In order to simplify the analysis of the estimated resource needs for each ITS device, maintenance needs were estimated for several generic components that were applied to multiple devices. This appendix describes these generic assumptions, and is followed by tables showing the device-by-device estimates of resource needs, and estimates of staffing needs by classification and skill type.

K.1 Generic Components

For each generic component, a table is presented showing the typical maintenance needs expected of each component. The table quantifies estimates of annual preventative and repair maintenance activities under current technology and future (i.e. Strategic Plan) technology. Each table indicates how repairs are expected to escalate from one skill level to another, by indicating how the number of visits per year varies for different staff classifications. The abbreviations for staff classifications are provided in Chapter 6.

K.1.1 Generic Workstation

There are many workstations used for ITS operations and maintenance that are housed indoors. These machines will require some minor preventative maintenance activities, as well as periodic hardware upgrades. The resources needed to maintain a generic workstation are shown in Table K-1.

K.1.2 Generic Server

Servers will require more frequent preventative maintenance than a generic workstation both because of their importance in the computer network and because of the database / network management activities that typically occur on them. Repair maintenance will require more time

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	12.00	1.0	SC-I-PM	2.00	1.0	0.0	SC-I-D
				0.60	0.8	0.0	IS-5N
				0.12	0.7	0.0	IS-6N
				1.40	0.0	2.0	SC-I-R
				1.18	0.0	1.6	IS-5N
				0.24	0.0	1.4	IS-6N
future	12.00	1.0	SC-I-PM	2.00	1.0	0.0	SC-I-D
				0.20	0.8	0.0	IS-5N
				0.04	0.7	0.0	IS-6N
				1.80	0.0	2.0	SC-I-R
				0.88	0.0	1.6	IS-5N
				0.13	0.0	1.4	IS-6N

Table K-1: Resource Needs for Generic Workstation.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	repair	job class
current	52.00	1.0	SC-I-PM	1.00	6.0	0.0	SC-I-D
				0.30	4.8	0.0	IS-5N
				0.06	4.3	0.0	IS-6N
				0.70	0.0	2.0	SC-I-R
				0.59	0.0	1.6	IS-5N
				0.12	0.0	1.4	IS-6N
future	52.00	1.0	SC-I-PM	1.00	6.0	0.0	SC-I-D
				0.10	4.8	0.0	IS-5N
				0.02	4.3	0.0	IS-6N
				0.90	0.0	2.0	SC-I-R
				0.44	0.0	1.6	IS-5N
				0.06	0.0	1.4	IS-6N

Table K-2: Resource Needs for Generic Server.

for a server than for a generic workstation, because of the precautions that must be taken to minimize the effect on ODOT operations while maintenance is performed. The estimated resource needs required to maintain a generic server are shown in Table K-2.

K.1.3 Generic Field Computer

Many ITS devices require field intelligence in order to process data received by a set of sensors and communicate it efficiently to the TOC or a server. These field computers would not require preventative maintenance as frequently as servers, because they typically will run a narrow range of applications. Consequently, system stability should be enhanced. Repair maintenance is anticipated to occur less frequently than for a generic workstation, because there should be a lesser need for system upgrades. Table K-3 shows the resource needs estimated for a

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	repair	job class
current	6.00	1.0	SC-I-PM	1.00	2.0	0.0	SC-I-D
				0.30	1.6	0.0	IS-5N
				0.06	1.4	0.0	IS-6N
				0.70	0.0	1.0	SC-I-R
				0.59	0.0	0.8	IS-5N
				0.12	0.0	0.7	IS-6N
future	6.00	1.0	SC-I-PM	1.00	2.0	0.0	SC-I-D
				0.10	1.6	0.0	IS-5N
				0.02	1.4	0.0	IS-6N
				0.90	0.0	1.0	SC-I-R
				0.44	0.0	0.8	IS-5N
				0.06	0.0	0.7	IS-6N

Table K-3: Resource Needs for Generic Field Computer.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	repair	job class
current	0.50	4.0	SC-I-PM	0.00	0.0	0.0	
future	0.50	4.0	SC-I-PM	0.00	0.0	0.0	

Table K-4: Resource Needs for Generic Software Application.

generic field computer.

K.1.4 Generic Software

ODOT uses many software packages developed by others as a part of ITS maintenance. It is anticipated that ODOT would not be required to debug code developed by others. The only software maintenance activity that would be anticipated is either re-loading or upgrading of software perhaps every other year. More significant maintenance needs would be anticipated for software developed in-house by ODOT. Table K-4 shows the resource needs estimated for generic software maintenance.

K.1.5 Generic Environmental Sensors

Based on conversations with vendors, environmental sensors are fairly robust and do not need much in terms of maintenance. Preventative maintenance is recommended for sensor cleaning and testing. Repair maintenance would seldom be necessary, except in cases of lightning or pavement damage. Table K-5 shows the resource needs estimated for maintaining a set of environmental sensors that would be used in an RWIS deployment. Maintenance needs would be proportionally less for devices that utilize fewer sensors, such as icy bridge detection systems and variable speed limit systems.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	repair	job class
current	1.00	3.0	ELEC	0.25	1.0	0.0	SC-E-D
				0.08	0.8	0.0	ELEC
				0.02	0.7	0.0	TS-3
				0.18	0.0	4.0	SC-E-R
				0.15	0.0	3.2	ELEC
				0.03	0.0	2.6	TS-3
future	1.00	3.0	ELEC	0.25	1.0	0.0	SC-E-D
				0.03	0.8	0.0	ELEC
				0.01	0.7	0.0	TS-3
				0.23	0.0	4.0	SC-E-R
				0.11	0.0	3.2	ELEC
				0.02	0.0	2.6	TS-3

Table K-5: Resource Needs for Generic Environmental Sensors.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	repair	job class
current	1.00	1.0	SC-I-PM	0.25	3.8	0.0	SC-I-D
				0.08	3.0	0.0	IS-5N
				0.02	2.7	0.0	IS-6N
				0.18	0.0	1.3	SC-I-R
				0.15	0.0	1.0	IS-5N
				0.03	0.0	0.9	IS-6N
future	1.00	1.0	SC-I-PM	0.25	3.8	0.0	SC-I-D
				0.03	3.0	0.0	IS-5N
				0.01	2.7	0.0	IS-6N
				0.23	0.0	1.3	SC-I-R
				0.11	0.0	1.0	IS-5N
				0.02	0.0	0.9	IS-6N

Table K-6: Resource Needs for Generic Field Communications.

K.1.6 Generic Field Communications

Because of the variety of components required in providing communication between a field device and an operation center, separate maintenance estimates were developed for field communications components, such as modems and routers. Annual inspection activities are recommended, but under normal circumstances, field communications components should have few problems requiring repair maintenance. Table K-6 shows the resource needs estimated for maintaining generic field communications components.

K.1.7 Generic Flashing Beacon / Sign

Many field devices are accompanied by a roadside sign with a flashing beacon, a rotating

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	repair	job class
current	1.00	1.0	SC-E-PM	0.50	1.0	0.0	SC-E-D
				0.15	0.8	0.0	ELEC
				0.03	0.7	0.0	TS-3
				0.35	0.0	3.0	SC-E-R
				0.30	0.0	2.4	ELEC
				0.06	0.0	1.9	TS-3
future	1.00	1.0	SC-E-PM	0.50	1.0	0.0	SC-E-D
				0.05	0.8	0.0	ELEC
				0.01	0.7	0.0	TS-3
				0.45	0.0	3.0	SC-E-R
				0.22	0.0	2.4	ELEC
				0.03	0.0	1.9	TS-3

Table K-7: Resource Needs for Generic Flashing Beacon/Sign.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	repair	job class
current	1.00	2.0	SC-E-PM	0.50	1.5	0.0	SC-E-D
				0.15	1.2	0.0	ELEC
				0.03	1.1	0.0	TS-3
				0.35	0.0	3.0	SC-E-R
				0.30	0.0	2.4	ELEC
				0.06	0.0	1.9	TS-3
future	1.00	2.0	SC-E-PM	0.50	1.5	0.0	SC-E-D
				0.05	1.2	0.0	ELEC
				0.01	1.1	0.0	TS-3
				0.45	0.0	3.0	SC-E-R
				0.22	0.0	2.4	ELEC
				0.03	0.0	1.9	TS-3

Table K-8: Resource Needs for Generic Local Cable and Wiring.

drum, or some other electromechanical element. Maintenance needs for these devices are fairly minimal, requiring annual inspection and servicing (such as replacing light bulbs) and repair maintenance every couple of years. Table K-7 shows the resource needs estimated for maintaining a generic flashing beacon or sign.

K.1.8 Generic Local Cable and Wiring

Some field deployments have a significant distance between a roadside display component and the field controller or processor which is bridged through hard-wired cable. Annual inspections are recommended to preserve the integrity of the cable and wiring, with repairs necessary infrequently. Table K-8 shows the resource needs estimated for maintaining generic

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	repair	job class
current	2.00	3.0	ELEC	0.50	2.0	0.0	SC-E-D
				0.15	1.6	0.0	ELEC
				0.03	1.4	0.0	TS-3
				0.35	0.0	3.0	SC-E-R
				0.30	0.0	2.4	ELEC
				0.06	0.0	1.9	TS-3
future	2.00	2.0	ELEC	0.50	1.0	0.0	SC-E-D
				0.05	0.8	0.0	ELEC
				0.01	0.7	0.0	TS-3
				0.45	0.0	1.5	SC-E-R
				0.22	0.0	1.2	ELEC
				0.03	0.0	1.0	TS-3

Table K-9: Resource Needs for Generic Video Imaging Field Unit.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	repair	job class
current	2.00	5.0	SC-E-PM	3.00	1.0	0.0	SC-E-D
				0.90	0.8	0.0	ELEC
				0.18	0.7	0.0	TS-3
				2.10	0.0	3.0	SC-E-R
				1.77	0.0	2.4	ELEC
				0.36	0.0	1.9	TS-3
future	2.00	5.0	SC-E-PM	3.00	0.5	0.0	SC-E-D
				0.30	0.4	0.0	ELEC
				0.06	0.4	0.0	TS-3
				2.70	0.0	2.0	SC-E-R
				1.32	0.0	1.6	ELEC
				0.19	0.0	1.3	TS-3

Table K-10: Resource Needs for Generic Matrix Display Unit.

local cable and wiring.

K.1.9 Generic Video Imaging Field Unit

Cameras and video detectors have unique maintenance needs based on the need to maintain clean images. One of the most significant elements in maintaining such units is the difficulty of access, especially for surveillance cameras mounted over an urban freeway. It is anticipated that future generations of cameras will allow for easier access in order to reduce the time spent on maintenance activities. Table K-9 shows the resource needs estimated for generic video imaging field units.

K.1.10 Generic Matrix Display Unit

Variable message signs, whether portable or permanent, have common maintenance characteristics. The signs need regular inspection and testing to ensure that messages are displayed accurately. Repair maintenance may be necessary due to environmental damage, vandalism, or matrix elements that stick. Improved sign design in the future, including increasing use of self-diagnostic capability and modular elements, will reduce the time spent on maintenance in the future. Estimated resource needs for generic matrix display units are provided in Table K-10.

K.1.11 Generic Radio Communications Maintenance

From an ITS perspective, the maintenance needs associated with radio systems are fairly minimal, because maintenance of the overall radio infrastructure is beyond the scope of this plan. Annual inspection and testing is recommended for various radio field units, including consoles located at TOCs, hand-held units in incident response vehicles, and radio-activated changeable message signs. Repair maintenance is seldom recommended, because, on rare occasions that component failure occurs, it may be cheaper to replace than to repair. Table K-11 indicates the estimated resource needs for maintaining generic radio communications devices.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	repair	job class
current	1.00	0.5	IS-5R	0.25	1.0	0.0	SC-I-D
				0.08	0.8	0.0	IS-5R
				0.02	0.7	0.0	IS-6R
				0.18	0.0	3.0	SC-I-R
				0.05	0.0	2.4	IS-5R
				0.03	0.0	2.2	IS-6R
future	1.00	0.5	IS-5R	0.20	1.0	0.0	SC-I-D
				0.02	0.8	0.0	IS-5R
				0.00	0.7	0.0	IS-6R
				0.18	0.0	3.0	SC-I-R
				0.09	0.0	2.4	IS-5R
				0.01	0.0	2.2	IS-6R

Table K-11: Resource Needs for Generic Radio Communications Maintenance.

K.2 Device-by-Device Resource Estimates

The following pages include a series of tables for each ITS device summarizing their maintenance needs. For each device, the following information is provided.

- Inventory. Existing inventory reflects the best estimates of device deployment through August 1999. Inventory estimates under the STIP and Strategic Plan reflect the best understanding of likely deployment levels and locations in the future. For devices that have TOC elements and field elements – such as RWIS – separate inventory estimates are prepared for each.

- Component maintenance needs. For each of the six ITS device component types – sensors, communications, field processor/controller, software, center sub-systems and information delivery – a description is provided describing appropriate maintenance activities, along with a table quantifying those needs.

- Summary of staffing needs. On a per-device level, these tables show the annual number of visits and hours per visit for each staff classification involved in that device's maintenance.

- Travel time. For some devices, unique travel time assumptions are made outside of those developed in Appendix J.

- Staffing needs. Applying the inventory estimates to per-device maintenance estimates and the travel time assumptions, regional estimates are developed for staffing needs by classification for each device.

K.2.1 Data Collection

K.2.1.1 Automatic Traffic Recorders

Inventory Table

	Region					State
	1	2	3	4	5	Total
Existing	26	26	26	23	26	127
STIP	1	4	2	1	0	8
Existing + STIP	27	30	28	24	26	135
Strategic Plan	2	16	3	2	3	26
Existing + Strat	29	46	31	26	29	161

Sensors

Inductive loops: Used to record traffic actuations. Maintenance covered under existing procedures.

Communications

Local cable and wiring: Maintenance covered under existing procedures.

Dial-up modems: Maintenance covered under existing procedures.

Field Processor/Controller

Type 170 field controller with local firmware: Maintenance covered under existing procedures.

Controller cabinet: Maintenance covered under existing procedures.

Software

Polling software: Maintenance covered under existing procedures.

Center Sub-Systems

No other center sub-system applications.

Information Delivery

No unique information delivery components.

Staffing Needs (FTE)

No new staffing needs

K.2.1.2 Speed Zone Monitoring Stations

Inventory Table

	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	4	8	4	9	9	34
STIP	0	0	0	0	0	0
Existing + STIP	4	8	4	9	9	34
Strategic Plan	0	0	0	0	0	0
Existing + Strat	4	8	4	9	9	34

Sensors

Inductive loops: Used to record traffic actuations. Maintenance covered under existing procedures.

Communications

Local cable and wiring: Maintenance covered under existing procedures.

Dial-up modems: Maintenance covered under existing procedures.

Field Processor/Controller

Type 170 field controller with local firmware: Maintenance covered under existing procedures.

Controller cabinet: Maintenance covered under existing procedures.

Software

No software applications.

Center Sub-Systems

No center sub-system components.

Information Delivery

No unique information delivery components.

Staffing Needs (FTE)

No new staffing needs

K.2.1.3 Closed-Circuit Television Surveillance

Inventory Table

Camera Field Units

	Region					State
	1	2	3	4	5	Total
Existing	39	5	1	10	1	56
STIP	7	2	0	5	17	31
Existing + STIP	46	7	1	15	18	87
Strategic Plan	73	38	40	25	13	189
Existing + Strategic Plan	119	45	41	40	31	276

Regional Servers

	Region					State
	1	2	3	4	5	Total
Existing	1	0	0	1	0	2
STIP	0	0	0	0	0	0
Existing + STIP	1	0	0	1	0	2
Strategic Plan	0	0	0	0	0	0
Existing + Strategic Plan	1	0	0	1	0	2

Real-Time

	Region					State
	1	2	3	4	5	Total
Existing	1	0	0	0	0	1
STIP	0	0	0	0	0	0
Existing + STIP	1	0	0	0	0	1
Strategic Plan	0	0	0	0	0	0
Existing + Strategic Plan	1	0	0	0	0	1

Sensors

Dome camera: Preventative maintenance includes lens cleaning, visual inspection, testing of pan-tilt-zoom capabilities. Repair includes component replacement.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	2.00	3.0	ELEC	0.50	2.0	0.0	SC-E-D
				0.15	1.6	0.0	ELEC
				0.03	1.4	0.0	TS-3
				0.35	0.0	3.0	SC-E-R
				0.30	0.0	2.4	ELEC
				0.06	0.0	1.9	TS-3
future	2.00	2.0	ELEC	0.50	1.0	0.0	SC-E-D
				0.05	0.8	0.0	ELEC
				0.01	0.7	0.0	TS-3
				0.45	0.0	1.5	SC-E-R
				0.22	0.0	1.2	ELEC
				0.03	0.0	1.0	TS-3

Rainwise: These weather indicators are only included at rural locations as a supplement to the still camera image. Annual preventative maintenance would essentially be a visual inspection. Repair work is recommended to be sent to the vendor.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	1.00	0.5	SC-E-PM	0.00	0.0	0.0	
future	1.00	0.5	SC-E-PM	0.00	0.0	0.0	

Communications

Fiber optic network: Connects cameras to TMOC for Region 1 camreas. Same network as used for ramp meters. Maintenance considered under Communications Networks device.
Radio network: Some rural camera locations use ODOT's radio network to transmit images. Maintenance is already covered under existing procedures.

Field Communications: Modems, routers and other devices (RealCam, Kantronix, Lantronix, character generators) may be used in getting the image from the field to the TOC. Most devices are solid state and seldom have problems except as caused by power supply problems and weather damage. Preventative maintenance may be necessary to insure timely replacement of components.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	1.00	1.0	SC-I-PM	0.25	3.8	0.0	SC-I-D
				0.08	3.0	0.0	IS-5N
				0.02	2.7	0.0	IS-6N
				0.18	0.0	1.3	SC-I-R
				0.15	0.0	1.0	IS-5N
				0.03	0.0	0.9	IS-6N
future	1.00	1.0	SC-I-PM	0.25	3.8	0.0	SC-I-D
				0.03	3.0	0.0	IS-5N
				0.01	2.7	0.0	IS-6N
				0.23	0.0	1.3	SC-I-R
				0.11	0.0	1.0	IS-5N
				0.02	0.0	0.9	IS-6N

Field Processor/Controller

No field processors are in use.

Software

Allegiant software: May be used to access video switch (urban), although cameras may be used through other means. Maintenance includes periodic upgrades.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	0.50	4.0	SC-I-PM	0.00	0.0	0.0	
future	0.50	4.0	SC-I-PM	0.00	0.0	0.0	

Center Sub-Systems

Various systems are used in Regions 1 and 4 for video image processing, including video switch (Reg. 1), frequency agile demodulator, sequential switcher and video processor (Reg. 4). Preventative maintenance focuses on occasional systematic tests to ensure that all channels are functioning acceptably. Repair maintenance would be handled through vendors.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	2.00	4.0	SC-I-D	0.00	0.0	0.0	
future	2.00	2.0	SC-I-D	0.00	0.0	0.0	

Camera server: Needs preventative diagnostics and database management activities, as well as hardware replacement.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	52.00	1.0	SC-I-PM	1.00	6.0	0.0	SC-I-D
				0.30	4.8	0.0	IS-5N
				0.06	4.3	0.0	IS-6N
				0.70	0.0	2.0	SC-I-R
				0.59	0.0	1.6	IS-5N
				0.12	0.0	1.4	IS-6N
future	52.00	1.0	SC-I-PM	1.00	6.0	0.0	SC-I-D
				0.10	4.8	0.0	IS-5N
				0.02	4.3	0.0	IS-6N
				0.90	0.0	2.0	SC-I-R
				0.44	0.0	1.6	IS-5N
				0.06	0.0	1.4	IS-6N

Information Delivery

Video display wall at TMOC: Preventative maintenance is cleaning, assumed to be done by building maintenance staff. Repair maintenance would involve periodic replacement of monitors as they break (assumed one every three months).

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	0.00	0.0		4.00	1.0	0.0	SC-E-D
				1.20	0.8	0.0	ELEC
				0.24	0.7	0.0	TS-3
				2.80	0.0	2.0	SC-E-R
				2.36	0.0	1.6	ELEC
				0.48	0.0	1.3	TS-3
future	0.00	0.0		4.00	1.0	0.0	SC-E-D
				0.40	0.8	0.0	ELEC
				0.08	0.7	0.0	TS-3
				3.60	0.0	2.0	SC-E-R
				1.76	0.0	1.6	ELEC
				0.26	0.0	1.3	TS-3

Summary

Field units

current

Preventative Maintenance			Repair Maintenance		
visits per yr	hrs per visit	job class	visits per yr	hrs per visit	job class
0.00	0.0	SC-I-D	0.25	3.8	SC-I-D
0.00	0.0	SC-I-R	0.18	1.3	SC-I-R
1.00	1.0	SC-I-PM	0.00	0.0	SC-I-PM
0.00	0.0	SC-E-D	0.50	2.0	SC-E-D
0.00	0.0	SC-E-R	0.35	3.0	SC-E-R
1.00	0.5	SC-E-PM	0.00	0.0	SC-E-PM
0.00	0.0	IS-5N	0.15	2.5	IS-5N
0.00	0.0	IS-6N	0.03	2.3	IS-6N
2.00	3.0	ELEC	0.30	3.2	ELEC
0.00	0.0	TS-3	0.06	2.6	TS-3

future

Preventative Maintenance			Repair Maintenance		
visits per yr	hrs per visit	job class	visits per yr	hrs per visit	job class
0.00	0.0	SC-I-D	0.25	3.8	SC-I-D
0.00	0.0	SC-I-R	0.23	1.3	SC-I-R
1.00	1.0	SC-I-PM	0.00	0.0	SC-I-PM
0.00	0.0	SC-E-D	0.50	1.0	SC-E-D
0.00	0.0	SC-E-R	0.45	1.5	SC-E-R
1.00	0.5	SC-E-PM	0.00	0.0	SC-E-PM
0.00	0.0	IS-5N	0.11	1.7	IS-5N
0.00	0.0	IS-6N	0.02	1.7	IS-6N
2.00	2.0	ELEC	0.22	1.4	ELEC
0.00	0.0	TS-3	0.03	1.2	TS-3

Regional Servers

current

Preventative Maintenance			Repair Maintenance		
visits per yr	hrs per visit	job class	visits per yr	hrs per visit	job class
2.00	4.0	SC-I-D	0.00	0.0	SC-I-D

future

Preventative Maintenance			Repair Maintenance		
visits per yr	hrs per visit	job class	visits per yr	hrs per visit	job class
2.00	2.0	SC-I-D	0.00	0.0	SC-I-D

Real-Time

current

Preventative Maintenance			Repair Maintenance		
visits per yr	hrs per visit	job class	visits per yr	hrs per visit	job class
0.00	0.0	SC-I-D	1.00	6.0	SC-I-D
0.00	0.0	SC-I-R	0.70	2.0	SC-I-R
52.00	1.0	SC-I-PM	0.00	0.0	SC-I-PM
0.00	0.0	SC-E-D	4.00	1.0	SC-E-D
0.00	0.0	SC-E-R	2.80	2.0	SC-E-R
0.00	0.0	IS-5N	0.59	4.0	IS-5N
0.00	0.0	IS-6N	0.12	3.6	IS-6N
0.00	0.0	ELEC	2.36	2.0	ELEC
0.00	0.0	TS-3	0.48	1.6	TS-3

future

Preventative Maintenance			Repair Maintenance		
visits per yr	hrs per visit	job class	visits per yr	hrs per visit	job class
0.00	0.0	SC-I-D	1.00	6.0	SC-I-D
0.00	0.0	SC-I-R	0.90	2.0	SC-I-R
52.00	1.0	SC-I-PM	0.00	0.0	SC-I-PM
0.00	0.0	SC-E-D	4.00	1.0	SC-E-D
0.00	0.0	SC-E-R	3.60	2.0	SC-E-R
0.00	0.0	IS-5N	0.44	2.7	IS-5N
0.00	0.0	IS-6N	0.06	2.8	IS-6N
0.00	0.0	ELEC	1.76	1.8	ELEC
0.00	0.0	TS-3	0.26	1.5	TS-3

Travel Time

Reduce by 50 percent for preventative maintenance of field units because of widespread device deployment.

Staffing Needs (FTE)

Support Coordinator / IS-Diag (SC-I-D) - DAS # SC-I-D

	Region					State
	1	2	3	4	5	Total
Existing	0.05	0.01	0.00	0.03	0.00	0.08
Existing + STIP	0.06	0.01	0.00	0.04	0.03	0.14
Existing + Strategic Plan	0.13	0.06	0.06	0.09	0.06	0.40

Support Coordinator / IS-Repair (SC-I-R) - DAS # SC-I-R

	Region					State
	1	2	3	4	5	Total
Existing	0.02	0.00	0.00	0.01	0.00	0.04
Existing + STIP	0.02	0.00	0.00	0.02	0.02	0.06
Existing + Strategic Plan	0.07	0.04	0.04	0.06	0.04	0.25

Support Coordinator / IS-Preventative Maintenance (SC-I-PM) - DAS # — SC-I-PM

	Region					State
	1	2	3	4	5	Total
Existing	0.08	0.01	0.00	0.03	0.00	0.12
Existing + STIP	0.09	0.01	0.00	0.04	0.04	0.18
Existing + Strategic Plan	0.18	0.08	0.08	0.10	0.07	0.51

Support Coordinator / Elec-Diag (SC-E-D) - DAS # — SC-E-D

	Region					State
	1	2	3	4	5	Total
Existing	0.06	0.01	0.00	0.04	0.00	0.12
Existing + STIP	0.07	0.02	0.00	0.05	0.06	0.20
Existing + Strategic Plan	0.15	0.09	0.09	0.13	0.09	0.54

Support Coordinator / Elec-Repair (SC-E-R) - DAS # — SC-E-R

	Region					State
	1	2	3	4	5	Total
Existing	0.05	0.01	0.00	0.03	0.00	0.09
Existing + STIP	0.06	0.01	0.00	0.04	0.04	0.16
Existing + Strategic Plan	0.15	0.08	0.09	0.12	0.08	0.53

Support Coordinator / Elec-Preventative Maintenance (SC-E-PM) - DAS # — SC-E-PM

	Region					State
	1	2	3	4	5	Total
Existing	0.04	0.01	0.00	0.02	0.00	0.07
Existing + STIP	0.04	0.01	0.00	0.03	0.04	0.12
Existing + Strategic Plan	0.11	0.06	0.06	0.09	0.06	0.39

Info Services 5 - Networks / Servers (IS-5N) - DAS #1485 — IS-5N

	Region					State
	1	2	3	4	5	Total
Existing	0.02	0.00	0.00	0.01	0.00	0.04
Existing + STIP	0.02	0.00	0.00	0.02	0.02	0.06
Existing + Strategic Plan	0.04	0.02	0.02	0.03	0.02	0.13

Info Services 6 - Networks / Servers (IS-6N) - DAS #1486 — IS-6N

	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.00	0.00	0.00	0.00	0.01
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.01
Existing + Strategic Plan	0.01	0.00	0.00	0.00	0.00	0.02

Info Services 7 - Software (IS-7S) - DAS #1487

	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.00

IS-7S

Electrician (ELEC) - DAS #4213

	Region					State
	1	2	3	4	5	Total
Existing	0.24	0.04	0.01	0.10	0.01	0.39
Existing + STIP	0.28	0.05	0.01	0.15	0.16	0.66
Existing + Strategic Plan	0.51	0.25	0.24	0.32	0.22	1.54

ELEC

Traffic Signal Technician 3 (TS-3) - DAS #3411

	Region					State
	1	2	3	4	5	Total
Existing	0.01	0.00	0.00	0.00	0.00	0.02
Existing + STIP	0.01	0.00	0.00	0.01	0.01	0.03
Existing + Strategic Plan	0.01	0.00	0.01	0.01	0.01	0.04

TS-3

K.2.1.4 Video Detectors

Inventory Table

	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	0	4	0	0	0	4
STIP	0	1	0	1	0	2
Existing + STIP	0	5	0	1	0	6
Strategic Plan	100	0	0	0	0	100
Existing + Strategic Plan	100	5	0	1	0	106

Sensors

Video detection camera: Based on conversation with vendor, maintenance needs for video detectors are minimal. Preventative maintenance will occur once a year requiring one half-hour per location to clean the camera lens. Repair maintenance is very rare; it is assumed to occur one-half as often as repairs for cameras.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	1.00	1.0	ELEC	0.25	2.0	0.0	SC-E-D
				0.08	1.6	0.0	ELEC
				0.02	1.4	0.0	TS-3
				0.18	0.0	3.0	SC-E-R
				0.15	0.0	2.4	ELEC
				0.03	0.0	1.9	TS-3
future	1.00	1.0	ELEC	0.25	1.0	0.0	SC-E-D
				0.03	0.8	0.0	ELEC
				0.01	0.7	0.0	TS-3
				0.23	0.0	1.5	SC-E-R
				0.11	0.0	1.2	ELEC
				0.02	0.0	1.0	TS-3

Communications

Local cable and wiring: Maintenance needs covered under sensors.

Fiber optics (Region 1 only): Uses the same fiber network as ramp meters, cameras and travel time estimation. Maintenance needs covered under Communications Networks device.

Field Processor/Controller

Type 170 Controller: Same controller as used at ODOT signals and ramp meters. Additional controllers needed if there are freeway deployments. Assume half of the maintenance of a field PC.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	1.00	3.0	ELEC	0.25	2.0	0.0	SC-E-D
				0.08	1.6	0.0	ELEC
				0.02	1.4	0.0	TS-3
				0.18	0.0	3.0	SC-E-R
				0.15	0.0	2.4	ELEC
				0.03	0.0	1.9	TS-3
future	1.00	2.0	ELEC	0.25	1.0	0.0	SC-E-D
				0.03	0.8	0.0	ELEC
				0.01	0.7	0.0	TS-3
				0.23	0.0	1.5	SC-E-R
				0.11	0.0	1.2	ELEC
				0.02	0.0	1.0	TS-3

Software

No software applications.

Center Sub-Systems

No center sub-system components.

Information Delivery

No information delivery components.

Summary

	Preventative Maintenance			Repair Maintenance		
current	visits per yr	hrs per visit	job class	visits per yr	hrs per visit	job class
	0.00	0.0	SC-E-D	0.25	4.0	SC-E-D
	0.00	0.0	SC-E-R	0.18	6.0	SC-E-R
	1.00	4.0	ELEC	0.15	6.4	ELEC
	0.00	0.0	TS-3	0.03	5.3	TS-3

	Preventative Maintenance			Repair Maintenance		
future	visits per yr	hrs per visit	job class	visits per yr	hrs per visit	job class
	0.00	0.0	SC-E-D	0.25	2.0	SC-E-D
	0.00	0.0	SC-E-R	0.23	3.0	SC-E-R
	1.00	3.0	ELEC	0.11	2.8	ELEC
	0.00	0.0	TS-3	0.02	1.4	TS-3

Travel Time

Assume 75 percent reduction in travel time in Region 1 under Strategic Plan due to widespread device deployment.

Staffing Needs (FTE)

Support Coordinator / Elec-Diag (SC-E-D) - DAS #

	Region 1	Region 2	Region 3	Region 4	Region 5	SC-E-D State Total
Existing	0.00	0.01	0.00	0.00	0.00	0.01
Existing + STIP	0.00	0.01	0.00	0.00	0.00	0.01
Existing + Strategic Plan	0.08	0.01	0.00	0.00	0.00	0.08

Support Coordinator / Elec-Repair (SC-E-R) - DAS #

	Region 1	Region 2	Region 3	Region 4	Region 5	SC-E-R State Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.01	0.00	0.00	0.00	0.01
Existing + Strategic Plan	0.08	0.01	0.00	0.00	0.00	0.09

Electrician (ELEC) - DAS #4213

	Region 1	Region 2	Region 3	Region 4	Region 5	ELEC State Total
Existing	0.00	0.02	0.00	0.00	0.00	0.02
Existing + STIP	0.00	0.03	0.00	0.01	0.00	0.04
Existing + Strategic Plan	0.25	0.02	0.00	0.01	0.00	0.28

Traffic Signal Technician 3 (TS-3) - DAS #3411

	Region 1	Region 2	Region 3	Region 4	Region 5	TS-3 State Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.00

K.2.1.5 Road and Weather Information System

Inventory Table

Field Units

	Region 1	2	3	4	5	State Total
Existing	6	4	1	8	1	20
STIP	3	5	3	7	19	37
Existing + STIP	9	9	4	15	20	57
Strategic Plan	5	15	20	22	9	71
Existing + Strategic Plan	14	24	24	37	29	128

Regional Servers

	Region 1	2	3	4	5	State Total
Existing	1	1	1	1	1	5
STIP	0	0	0	0	0	0
Existing + STIP	1	1	1	1	1	5
Strategic Plan	0	0	0	0	0	0
Existing + Strategic Plan	1	1	1	1	1	5

Central Server

	Region 1	2	3	4	5	State Total
Existing	0	1	0	0	0	1
STIP	0	0	0	0	0	0
Existing + STIP	0	1	0	0	0	1
Strategic Plan	0	0	0	0	0	0
Existing + Strategic Plan	0	1	0	0	0	1

Sensors

Wind sensors: Replace bearings annually.

Air temperature and relative humidity sensors: Humidity sensor needs to be cleaned and wetted annually.

Precipitation sensors: Lenses need to be cleaned annually.

Pavement surface sensors: Sensor needs to be wiped off so it will accurately show dry vs. wet pavement.

All sensors need to be cleaned, tested and calibrated annually. Lightning strikes, re-paving other factors may necessitate sensor replacement.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	1.00	3.0	ELEC	0.25	1.0	0.0	SC-E-D
				0.08	0.8	0.0	ELEC
				0.02	0.7	0.0	TS-3
				0.18	0.0	4.0	SC-E-R
				0.15	0.0	3.2	ELEC
				0.03	0.0	2.6	TS-3
future	1.00	3.0	ELEC	0.25	1.0	0.0	SC-E-D
				0.03	0.8	0.0	ELEC
				0.01	0.7	0.0	TS-3
				0.23	0.0	4.0	SC-E-R
				0.11	0.0	3.2	ELEC
				0.02	0.0	2.6	TS-3

Communications

Routers, Modems, Communications: Preventative maintenance includes annual inspection. Repair maintenance includes component replacement to restore communications. Repairs will occur more frequently in the short-term due to problem maintenance components (e.g. Lantronix).

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	1.00	1.0	SC-I-PM	0.50	3.8	0.0	SC-I-D
				0.15	3.0	0.0	IS-5N
				0.03	2.7	0.0	IS-6N
				0.35	0.0	1.3	SC-I-R
				0.30	0.0	1.0	IS-5N
				0.06	0.0	0.9	IS-6N
future	1.00	1.0	SC-I-PM	0.25	3.8	0.0	SC-I-D
				0.03	3.0	0.0	IS-5N
				0.01	2.7	0.0	IS-6N
				0.23	0.0	1.3	SC-I-R
				0.11	0.0	1.0	IS-5N
				0.02	0.0	0.9	IS-6N

Local cable and wiring: The most common repair need for the field device is the cable connecting the sensors to the RPU.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	1.00	2.0	SC-E-PM	0.50	1.5	0.0	SC-E-D
				0.15	1.2	0.0	ELEC
				0.03	1.1	0.0	TS-3
				0.35	0.0	3.0	SC-E-R
				0.30	0.0	2.4	ELEC
				0.06	0.0	1.9	TS-3
future	1.00	2.0	SC-E-PM	0.50	1.5	0.0	SC-E-D
				0.05	1.2	0.0	ELEC
				0.01	1.1	0.0	TS-3
				0.45	0.0	3.0	SC-E-R
				0.22	0.0	2.4	ELEC
				0.03	0.0	1.9	TS-3

Field Processor / Controller

Remote processing unit: Needs regular re-booting and inspection. Repair maintenance will involve emergency re-starts and replacing weather-damaged components.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	6.00	1.0	SC-I-PM	1.00	2.0	0.0	SC-I-D
				0.30	1.6	0.0	IS-5N
				0.06	1.4	0.0	IS-6N
				0.70	0.0	1.0	SC-I-R
				0.59	0.0	0.8	IS-5N
				0.12	0.0	0.7	IS-6N
future	6.00	1.0	SC-I-PM	1.00	2.0	0.0	SC-I-D
				0.10	1.6	0.0	IS-5N
				0.02	1.4	0.0	IS-6N
				0.90	0.0	1.0	SC-I-R
				0.44	0.0	0.8	IS-5N
				0.06	0.0	0.7	IS-6N

Software

RPU software: Software installed at RPU to collect sensor data and send it to database. Upgrades necessary only rarely - every five years.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	0.50	4.0	SC-I-PM	0.00	0.0	0.0	
future	0.50	4.0	SC-I-PM	0.00	0.0	0.0	

Database applications: Vendor is responsible for database support. ODOT maintenance includes developing SQL queries.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	repair	job class
current	0.50	4.0	SC-I-PM	0.00	0.0	0.0	
future	0.50	4.0	SC-I-PM	0.00	0.0	0.0	

SCAN software: Developed and maintained by vendor; no maintenance necessary.

Center Sub-Systems

Regional Servers: Servers need regular re-booting. Occasional repair focuses on hardware replacement or upgrading.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	repair	job class
current	52.00	1.0	SC-I-PM	1.00	6.0	0.0	SC-I-D
				0.30	4.8	0.0	IS-5N
				0.06	4.3	0.0	IS-6N
				0.70	0.0	2.0	SC-I-R
				0.59	0.0	1.6	IS-5N
				0.12	0.0	1.4	IS-6N
future	52.00	1.0	SC-I-PM	1.00	6.0	0.0	SC-I-D
				0.10	4.8	0.0	IS-5N
				0.02	4.3	0.0	IS-6N
				0.90	0.0	2.0	SC-I-R
				0.44	0.0	1.6	IS-5N
				0.06	0.0	1.4	IS-6N

RWIS Server: Similar maintenance needs as the regional servers.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	repair	job class
current	52.00	1.0	SC-I-PM	1.00	6.0	0.0	SC-I-D
				0.30	4.8	0.0	IS-5N
				0.06	4.3	0.0	IS-6N
				0.70	0.0	2.0	SC-I-R
				0.59	0.0	1.6	IS-5N
				0.12	0.0	1.4	IS-6N
future	52.00	1.0	SC-I-PM	1.00	6.0	0.0	SC-I-D
				0.10	4.8	0.0	IS-5N
				0.02	4.3	0.0	IS-6N
				0.90	0.0	2.0	SC-I-R
				0.44	0.0	1.6	IS-5N
				0.06	0.0	1.4	IS-6N

Information Delivery

No unique information delivery components.

Summary

Field Units

current

Preventative Maintenance			Repair Maintenance		
visits per yr	hrs per visit	job class	visits per yr	hrs per visit	job class
0.00	0.0	SC-I-D	1.00	3.9	SC-I-D
0.00	0.0	SC-I-R	0.70	1.6	SC-I-R
6.00	1.5	SC-I-PM	0.00	0.0	SC-I-PM
0.00	0.0	SC-E-D	0.50	2.0	SC-E-D
0.00	0.0	SC-E-R	0.35	5.0	SC-E-R
1.00	2.0	SC-E-PM	0.00	0.0	SC-E-PM
0.00	0.0	IS-5N	0.59	2.9	IS-5N
0.00	0.0	IS-6N	0.12	2.6	IS-6N
1.00	3.0	ELEC	0.30	4.8	ELEC
0.00	0.0	TS-3	0.06	3.9	TS-3

future

Preventative Maintenance			Repair Maintenance		
visits per yr	hrs per visit	job class	visits per yr	hrs per visit	job class
0.00	0.0	SC-I-D	1.00	2.9	SC-I-D
0.00	0.0	SC-I-R	0.90	1.3	SC-I-R
6.00	1.5	SC-I-PM	0.00	0.0	SC-I-PM
0.00	0.0	SC-E-D	0.50	2.0	SC-E-D
0.00	0.0	SC-E-R	0.45	5.0	SC-E-R
1.00	2.0	SC-E-PM	0.00	0.0	SC-E-PM
0.00	0.0	IS-5N	0.44	1.6	IS-5N
0.00	0.0	IS-6N	0.06	1.6	IS-6N
1.00	3.0	ELEC	0.22	4.4	ELEC
0.00	0.0	TS-3	0.03	3.7	TS-3

Regional Server

current

Preventative Maintenance			Repair Maintenance		
visits per yr	hrs per visit	job class	visits per yr	hrs per visit	job class
0.00	0.0	SC-I-D	1.00	6.0	SC-I-D
0.00	0.0	SC-I-R	0.70	2.0	SC-I-R
52.00	1.0	SC-I-PM	0.00	0.0	SC-I-PM
0.00	0.0	IS-5N	0.59	4.0	IS-5N
0.00	0.0	IS-6N	0.12	3.6	IS-6N

future

Preventative Maintenance			Repair Maintenance		
visits per yr	hrs per visit	job class	visits per yr	hrs per visit	job class
0.00	0.0	SC-I-D	1.00	6.0	SC-I-D
0.00	0.0	SC-I-R	0.90	2.0	SC-I-R
52.00	1.0	SC-I-PM	0.00	0.0	SC-I-PM
0.00	0.0	IS-5N	0.44	2.7	IS-5N
0.00	0.0	IS-6N	0.06	2.8	IS-6N

Central Server

current

Preventative Maintenance			Repair Maintenance		
visits per yr	hrs per visit	job class	visits per yr	hrs per visit	job class
0.00	0.0	SC-I-D	1.00	6.0	SC-I-D
0.00	0.0	SC-I-R	0.70	2.0	SC-I-R
52.00	1.0	SC-I-PM	0.00	0.0	SC-I-PM
0.00	0.0	IS-5N	0.59	4.0	IS-5N
0.00	0.0	IS-6N	0.12	3.6	IS-6N

future

Preventative Maintenance			Repair Maintenance		
visits per yr	hrs per visit	job class	visits per yr	hrs per visit	job class
0.00	0.0	SC-I-D	1.00	6.0	SC-I-D
0.00	0.0	SC-I-R	0.90	2.0	SC-I-R
52.00	1.0	SC-I-PM	0.00	0.0	SC-I-PM
0.00	0.0	IS-5N	0.44	2.7	IS-5N
0.00	0.0	IS-6N	0.06	2.8	IS-6N

Travel Time

Reduce by 50 percent for preventative maintenance due to widespread device deployment.

Staffing Needs (FTE)

Support Coordinator / IS-Diag (SC-I-D) - DAS # SC-I-D

	Region					State
	1	2	3	4	5	Total
Existing	0.03	0.03	0.01	0.07	0.01	0.15
Existing + STIP	0.04	0.06	0.03	0.13	0.15	0.41
Existing + Strategic Plan	0.05	0.13	0.14	0.29	0.20	0.81

Support Coordinator / IS-Repair (SC-I-R) - DAS # SC-I-R

	Region					State
	1	2	3	4	5	Total
Existing	0.01	0.01	0.00	0.04	0.01	0.08
Existing + STIP	0.02	0.03	0.01	0.07	0.09	0.22
Existing + Strategic Plan	0.03	0.09	0.10	0.23	0.15	0.60

Support Coordinator / IS-Preventative Maintenance (SC-I-PM) - DAS # SC-I-PM

	Region					State
	1	2	3	4	5	Total
Existing	0.09	0.11	0.05	0.17	0.05	0.47
Existing + STIP	0.12	0.17	0.08	0.30	0.35	1.02
Existing + Strategic Plan	0.16	0.35	0.34	0.68	0.49	2.03

Support Coordinator / Elec-Diag (SC-E-D) - DAS # — SC-E-D

	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	0.01	0.01	0.00	0.03	0.00	0.05
Existing + STIP	0.01	0.02	0.01	0.05	0.06	0.16
Existing + Strategic Plan	0.02	0.05	0.06	0.13	0.09	0.36

Support Coordinator / Elec-Repair (SC-E-R) - DAS # — SC-E-R

	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	0.01	0.01	0.00	0.03	0.00	0.05
Existing + STIP	0.02	0.02	0.01	0.05	0.06	0.15
Existing + Strategic Plan	0.03	0.07	0.07	0.15	0.11	0.43

Support Coordinator / Elec-Preventative Maintenance (SC-E-PM) - DAS # — SC-E-PM

	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	0.01	0.01	0.00	0.03	0.00	0.05
Existing + STIP	0.02	0.02	0.01	0.05	0.06	0.15
Existing + Strategic Plan	0.03	0.06	0.06	0.12	0.08	0.34

Info Services 5 - Networks / Servers (IS-5N) - DAS #1485 — IS-5N

	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	0.01	0.01	0.00	0.04	0.01	0.08
Existing + STIP	0.02	0.03	0.01	0.07	0.08	0.22
Existing + Strategic Plan	0.02	0.05	0.05	0.11	0.08	0.31

Info Services 6 - Networks / Servers (IS-6N) - DAS #1486 — IS-6N

	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	0.00	0.00	0.00	0.01	0.00	0.01
Existing + STIP	0.00	0.01	0.00	0.01	0.02	0.04
Existing + Strategic Plan	0.00	0.01	0.01	0.02	0.01	0.04

Info Services 7 - Software (IS-7S) - DAS #1487 — IS-7S

	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.00

Electrician (ELEC) - DAS #4213						ELEC
	Region					State
	1	2	3	4	5	Total
Existing	0.02	0.02	0.01	0.05	0.01	0.11
Existing + STIP	0.03	0.04	0.02	0.10	0.12	0.31
Existing + Strategic Plan	0.05	0.10	0.11	0.21	0.15	0.62

Traffic Signal Technician 3 (TS-3) - DAS #3411						TS-3
	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.00	0.00	0.00	0.00	0.01
Existing + STIP	0.00	0.00	0.00	0.01	0.01	0.03
Existing + Strategic Plan	0.00	0.00	0.01	0.01	0.01	0.03

K.2.1.6 Travel Time Estimation

Inventory Table

Field units

	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	0	0	0	0	0	0
STIP	0	0	0	0	0	0
Existing + STIP	0	0	0	0	0	0
Strategic Plan	80	0	0	0	0	80
Existing + Strategic Plan	80	0	0	0	0	80

Server

	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	0	0	0	0	0	0
STIP	0	0	0	0	0	0
Existing + STIP	0	0	0	0	0	0
Strategic Plan	1	0	0	0	0	1
Existing + Strategic Plan	1	0	0	0	0	1

Sensors

Digital camera and infrared light source: Preventative maintenance to clean lens; repairs due to knockdowns and replacing light source. Power supply may need some maintenance as well. Preventative maintenance will be as frequent as it is for CCTV, but should take considerably less time because of the simplicity of the equipment and easy access. Repairs will take half as long as normal cameras because of "black box" technology.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	2.00	1.0	SC-E-PM	0.50	1.0	0.0	SC-E-D
				0.15	0.8	0.0	ELEC
				0.03	0.7	0.0	TS-3
				0.35	0.0	1.5	SC-E-R
				0.30	0.0	1.2	ELEC
				0.06	0.0	1.0	TS-3
future	2.00	1.0	SC-E-PM	0.50	0.5	0.0	SC-E-D
				0.05	0.4	0.0	ELEC
				0.01	0.4	0.0	TS-3
				0.45	0.0	0.8	SC-E-R
				0.22	0.0	0.6	ELEC
				0.03	0.0	0.5	TS-3

Communications

Fiber network: Connects field RPUs with TOC, where observations are processed. Maintenance needs are addressed under Communications Network device.

Modems: Each field RPU will be connected to the fiber network. Annual preventative maintenance is recommended; repair maintenance will be fairly rare.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	repair	job class
current	1.00	1.0	SC-I-PM	0.25	3.8	0.0	SC-I-D
				0.08	3.0	0.0	IS-5N
				0.02	2.7	0.0	IS-6N
				0.18	0.0	1.3	SC-I-R
				0.15	0.0	1.0	IS-5N
				0.03	0.0	0.9	IS-6N
future	1.00	1.0	SC-I-PM	0.25	3.8	0.0	SC-I-D
				0.03	3.0	0.0	IS-5N
				0.01	2.7	0.0	IS-6N
				0.23	0.0	1.3	SC-I-R
				0.11	0.0	1.0	IS-5N
				0.02	0.0	0.9	IS-6N

Field Processor/Controller

Controller: Reads vehicle actuations, activates camera and light source.

RPU: Reads plates, runs OCR software. Upgrades are not necessary that often because the RPU's operating demands will stay fairly constant.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	repair	job class
current	6.00	1.0	SC-I-PM	0.50	2.0	0.0	SC-I-D
				0.15	1.6	0.0	IS-5N
				0.03	1.4	0.0	IS-6N
				0.35	0.0	1.0	SC-I-R
				0.30	0.0	0.8	IS-5N
				0.06	0.0	0.7	IS-6N
future	6.00	1.0	SC-I-PM	0.50	2.0	0.0	SC-I-D
				0.05	1.6	0.0	IS-5N
				0.01	1.4	0.0	IS-6N
				0.45	0.0	1.0	SC-I-R
				0.22	0.0	0.8	IS-5N
				0.03	0.0	0.7	IS-6N

Software

RPU software: Optical character recognition software may requires upgrades to improve success in reading plates.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	repair	job class
current	0.50	4.0	SC-I-PM	0.00	0.0	0.0	
future	0.50	4.0	SC-I-PM	0.00	0.0	0.0	

Travel time software: Database application requires upgrades and database management (i.e. pruning).

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	0.50	4.0	SC-I-PM	0.00	0.0	0.0	
future	0.50	4.0	SC-I-PM	0.00	0.0	0.0	

Center Sub-Systems

Travel time server: Compiles readings from various field RPUs to estimate travel times. Basic server maintenance is required.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	52.00	1.0	SC-I-PM	1.00	6.0	0.0	SC-I-D
				0.30	4.8	0.0	IS-5N
				0.06	4.3	0.0	IS-6N
				0.70	0.0	2.0	SC-I-R
				0.59	0.0	1.6	IS-5N
				0.12	0.0	1.4	IS-6N
future	52.00	1.0	SC-I-PM	1.00	6.0	0.0	SC-I-D
				0.10	4.8	0.0	IS-5N
				0.02	4.3	0.0	IS-6N
				0.90	0.0	2.0	SC-I-R
				0.44	0.0	1.6	IS-5N
				0.06	0.0	1.4	IS-6N

Information Delivery

No new information delivery systems.

Summary

Field units

	Preventative Maintenance			Repair Maintenance		
	visits	hrs per	job	visits	hrs per	job
current	per yr	visit	class	per yr	visit	class
	0.00	0.0	SC-I-D	0.50	3.9	SC-I-D
	0.00	0.0	SC-I-R	0.35	1.6	SC-I-R
	6.00	1.5	SC-I-PM	0.00	0.0	SC-I-PM
	0.00	0.0	SC-E-D	0.50	1.0	SC-E-D
	0.00	0.0	SC-E-R	0.35	1.5	SC-E-R
	2.00	1.0	SC-E-PM	0.00	0.0	SC-E-PM
	0.00	0.0	IS-5N	0.30	2.9	IS-5N
	0.00	0.0	IS-6N	0.06	2.6	IS-6N
	0.00	0.0	ELEC	0.30	1.6	ELEC
	0.00	0.0	TS-3	0.06	1.3	TS-3

	Preventative Maintenance			Repair Maintenance		
	visits	hrs per	job	visits	hrs per	job
future	per yr	visit	class	per yr	visit	class
	0.00	0.0	SC-I-D	0.50	3.9	SC-I-D
	0.00	0.0	SC-I-R	0.45	1.6	SC-I-R
	6.00	1.5	SC-I-PM	0.00	0.0	SC-I-PM
	0.00	0.0	SC-E-D	0.50	0.5	SC-E-D
	0.00	0.0	SC-E-R	0.45	0.8	SC-E-R
	2.00	1.0	SC-E-PM	0.00	0.0	SC-E-PM
	0.00	0.0	IS-5N	0.22	2.0	IS-5N
	0.00	0.0	IS-6N	0.03	2.0	IS-6N
	0.00	0.0	ELEC	0.22	0.7	ELEC
	0.00	0.0	TS-3	0.03	0.6	TS-3

Server

	Preventative Maintenance			Repair Maintenance		
	visits	hrs per	job	visits	hrs per	job
current	per yr	visit	class	per yr	visit	class
	0.00	0.0	SC-I-D	1.00	6.0	SC-I-D
	0.00	0.0	SC-I-R	0.70	2.0	SC-I-R
	52.00	1.0	SC-I-PM	0.00	0.0	SC-I-PM
	0.00	0.0	IS-5N	0.59	4.0	IS-5N
	0.00	0.0	IS-6N	0.12	3.6	IS-6N

	Preventative Maintenance			Repair Maintenance		
	visits	hrs per	job	visits	hrs per	job
future	per yr	visit	class	per yr	visit	class
	0.00	0.0	SC-I-D	1.00	6.0	SC-I-D
	0.00	0.0	SC-I-R	0.90	2.0	SC-I-R
	52.00	1.0	SC-I-PM	0.00	0.0	SC-I-PM
	0.00	0.0	IS-5N	0.44	2.7	IS-5N
	0.00	0.0	IS-6N	0.06	2.8	IS-6N

Travel Time

Reduce by 75 percent for preventative maintenance because of wide device deployment.

Staffing Needs (FTE)

Support Coordinator / IS-Diag (SC-I-D) - DAS # SC-I-D

	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.17	0.00	0.00	0.00	0.00	0.17

Support Coordinator / IS-Repair (SC-I-R) - DAS #						SC-I-R
	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.10	0.00	0.00	0.00	0.00	0.10

Support Coordinator / IS-Preventative Maintenance (SC-I-PM) - DAS #						SC-I-PM
	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.62	0.00	0.00	0.00	0.00	0.62

Support Coordinator / Elec-Diag (SC-E-D) - DAS #						SC-E-D
	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.09	0.00	0.00	0.00	0.00	0.09

Support Coordinator / Elec-Repair (SC-E-R) - DAS #						SC-E-R
	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.08	0.00	0.00	0.00	0.00	0.08

Support Coordinator / Elec-Preventative Maintenance (SC-E-PM) - DAS #						SC-E-PM
	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.15	0.00	0.00	0.00	0.00	0.15

Info Services 5 - Networks / Servers (IS-5N) - DAS #1485						IS-5N
	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.05	0.00	0.00	0.00	0.00	0.05

Info Services 6 - Networks / Servers (IS-6N) - DAS #1486 — IS-6N

	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.01	0.00	0.00	0.00	0.00	0.01

Electrician (ELEC) - DAS #4213 — ELEC

	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.04	0.00	0.00	0.00	0.00	0.04

Traffic Signal Technician 3 (TS-3) - DAS #3411 — TS-3

	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.01	0.00	0.00	0.00	0.00	0.01

K.2.1.7 Automatic Vehicle Location

(includes Incident Response Vehicle system)

Inventory Table

Equipped Vehicles

	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	7	0	0	0	0	7
STIP	0	4	0	40	0	44
Existing + STIP	7	4	0	40	0	51
Strategic Plan	100	100	100	60	100	460
Existing + Strategic Plan	107	104	100	100	100	511

AVL Servers

	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	1	0	0	0	0	1
STIP	0	1	0	1	0	2
Existing + STIP	1	1	0	1	0	3
Strategic Plan	0	0	1	0	1	2
Existing + Strategic Plan	1	1	1	1	1	5

Sensors

Maintenance activity sensors: Sensors will track the extent of chemical use, plowing activity, and similar maintenance functions. Preventative maintenance includes calibration and cleaning of sensors.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	1.00	1.0	ELEC	0.20	1.0	0.0	SC-E-D
				0.06	0.8	0.0	ELEC
				0.01	0.7	0.0	TS-3
				0.14	0.0	4.0	SC-E-R
				0.12	0.0	3.2	ELEC
				0.02	0.0	2.6	TS-3
future	1.00	1.0	ELEC	0.20	1.0	0.0	SC-E-D
				0.02	0.8	0.0	ELEC
				0.00	0.7	0.0	TS-3
				0.18	0.0	4.0	SC-E-R
				0.09	0.0	3.2	ELEC
				0.01	0.0	2.6	TS-3

Communications

GPS satellites: Maintained by vendor.

In-vehicle unit: Maintained by vendor.

Low-band radio: No preventative maintenance is recommended. Repair maintenance will be fairly infrequent.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	0.00	0.0		0.25	1.0	0.0	SC-I-D
				0.08	0.8	0.0	IS-5R
				0.02	0.7	0.0	IS-6R
				0.18	0.0	3.0	SC-I-R
				0.15	0.0	2.4	IS-5R
				0.03	0.0	2.2	IS-6R
future	0.00	0.0		0.20	1.0	0.0	SC-I-D
				0.02	0.8	0.0	IS-5R
				0.00	0.7	0.0	IS-6R
				0.18	0.0	3.0	SC-I-R
				0.09	0.0	2.4	IS-5R
				0.01	0.0	2.2	IS-6R

Radio towers and facilities: Maintenance of the supporting infrastructure is covered under existing procedures.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	0.00	0.0		0.00	0.0	0.0	
future	0.00	0.0		0.00	0.0	0.0	

Field Processor/Controller

No field processors/controllers.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	0.00	0.0		0.00	0.0	0.0	
future	0.00	0.0		0.00	0.0	0.0	

Software

Tracking software at TOC: Upgrades provided by vendor, installed by ODOT. Upgrades are provided annually.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	1.00	4.0	SC-I-PM	0.00	0.0	0.0	
future	1.00	4.0	SC-I-PM	0.00	0.0	0.0	

Center Sub-Systems

AVL server: Used to track COMET vehicle locations. Requires database management (preventative) and basic server maintenance (repair) activities.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	52.00	1.0	SC-I-PM	1.00	6.0	0.0	SC-I-D
				0.30	4.8	0.0	IS-5N
				0.06	4.3	0.0	IS-6N
				0.70	0.0	2.0	SC-I-R
				0.59	0.0	1.6	IS-5N
				0.12	0.0	1.4	IS-6N
future	52.00	1.0	SC-I-PM	1.00	6.0	0.0	SC-I-D
				0.10	4.8	0.0	IS-5N
				0.02	4.3	0.0	IS-6N
				0.90	0.0	2.0	SC-I-R
				0.44	0.0	1.6	IS-5N
				0.06	0.0	1.4	IS-6N

Information Delivery

No unique information delivery devices.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	0.00	0.0		0.00	0.0	0.0	
future	0.00	0.0		0.00	0.0	0.0	

Summary

Vehicles

	Preventative Maintenance			Repair Maintenance		
current	visits per yr	hrs per visit	job class	visits per yr	hrs per visit	job class
	0.00	0.0	SC-I-D	0.25	1.0	SC-I-D
	0.00	0.0	SC-I-R	0.18	3.0	SC-I-R
	0.00	0.0	SC-E-D	0.20	1.0	SC-E-D
	0.00	0.0	SC-E-R	0.14	4.0	SC-E-R
	0.00	0.0	IS-5R	0.15	2.8	IS-5R
	0.00	0.0	IS-6R	0.03	2.5	IS-6R
	1.00	1.0	ELEC	0.12	3.6	ELEC
	0.00	0.0	TS-3	0.02	2.9	TS-3

	Preventative Maintenance			Repair Maintenance		
	visits	hrs per	job	visits	hrs per	job
future	per yr	visit	class	per yr	visit	class
	0.00	0.0	SC-I-D	0.20	1.0	SC-I-D
	0.00	0.0	SC-I-R	0.18	3.0	SC-I-R
	0.00	0.0	SC-E-D	0.20	1.0	SC-E-D
	0.00	0.0	SC-E-R	0.18	4.0	SC-E-R
	0.00	0.0	IS-5R	0.09	2.6	IS-5R
	0.00	0.0	IS-6R	0.01	2.4	IS-6R
	1.00	1.0	ELEC	0.09	3.4	ELEC
	0.00	0.0	TS-3	0.01	2.8	TS-3

AVL Servers

	Preventative Maintenance			Repair Maintenance		
	visits	hrs per	job	visits	hrs per	job
current	per yr	visit	class	per yr	visit	class
	0.00	0.0	SC-I-D	1.00	6.0	SC-I-D
	0.00	0.0	SC-I-R	0.70	2.0	SC-I-R
	52.00	1.1	SC-I-PM	0.00	0.0	SC-I-PM
	0.00	0.0	IS-5N	0.59	4.0	IS-5N
	0.00	0.0	IS-6N	0.12	3.6	IS-6N

	Preventative Maintenance			Repair Maintenance		
	visits	hrs per	job	visits	hrs per	job
future	per yr	visit	class	per yr	visit	class
	0.00	0.0	SC-I-D	1.00	6.0	SC-I-D
	0.00	0.0	SC-I-R	0.90	2.0	SC-I-R
	52.00	1.1	SC-I-PM	0.00	0.0	SC-I-PM
	0.00	0.0	IS-5N	0.44	2.7	IS-5N
	0.00	0.0	IS-6N	0.06	2.8	IS-6N

Travel Time

Reduce by 90 percent for preventative maintenance because of wide device deployment. Assume for repair maintenance that vehicles are brought into the shop whenever problems occur, so only one round-trip is necessary.

Staffing Needs (FTE)

Support Coordinator / IS-Diag (SC-I-D) - DAS #

	Region					SC-I-D State
	1	2	3	4	5	Total
Existing	0.01	0.00	0.00	0.00	0.00	0.01
Existing + STIP	0.01	0.01	0.00	0.05	0.00	0.06
Existing + Strategic Plan	0.04	0.06	0.07	0.10	0.08	0.35

Support Coordinator / IS-Repair (SC-I-R) - DAS # — SC-I-R

	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.04	0.00	0.05
Existing + Strategic Plan	0.06	0.08	0.08	0.11	0.10	0.42

Support Coordinator / IS-Preventative Maintenance (SC-I-PM) - DAS # — SC-I-PM

	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	0.03	0.00	0.00	0.00	0.00	0.03
Existing + STIP	0.03	0.03	0.00	0.03	0.00	0.10
Existing + Strategic Plan	0.03	0.03	0.03	0.03	0.03	0.17

Support Coordinator / Elec-Diag (SC-E-D) - DAS # — SC-E-D

	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.04	0.00	0.04
Existing + Strategic Plan	0.04	0.06	0.06	0.09	0.08	0.33

Support Coordinator / Elec-Repair (SC-E-R) - DAS # — SC-E-R

	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.04	0.00	0.04
Existing + Strategic Plan	0.07	0.09	0.09	0.12	0.11	0.47

Info Services 5 - Radio Technician (IS-5R) - DAS #1485 — IS-5R

	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.03	0.00	0.04
Existing + Strategic Plan	0.03	0.03	0.04	0.05	0.04	0.19

Info Services 5 - Networks / Servers (IS-5N) - DAS #1485 — IS-5N

	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.00

Info Services 6 - Radio Technician (IS-6R) - DAS #1486 — IS-6R

	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.01	0.00	0.01
Existing + Strategic Plan	0.00	0.00	0.01	0.01	0.01	0.03

Info Services 6 - Networks / Servers (IS-6N) - DAS #1486 — IS-6N

	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.00

Electrician (ELEC) - DAS #4213 — ELEC

	Region					State
	1	2	3	4	5	Total
Existing	0.01	0.00	0.00	0.00	0.00	0.01
Existing + STIP	0.01	0.01	0.00	0.07	0.00	0.08
Existing + Strategic Plan	0.11	0.12	0.13	0.15	0.14	0.66

Traffic Signal Technician 3 (TS-3) - DAS #3411 — TS-3

	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.01	0.00	0.01
Existing + Strategic Plan	0.00	0.00	0.01	0.01	0.01	0.03

K.2.2 Traffic Management

K.2.2.1 Ramp Metering

Inventory Table

	Region					State
	1	2	3	4	5	Total
Existing	64	0	0	0	0	64
STIP	26	0	0	0	0	26
Existing + STIP	90	0	0	0	0	90
Strategic Plan	60	65	35	0	0	160
Existing + Strategic Plan	150	65	35	0	0	250

Sensors

Inductive loops: Used to record traffic actuations. Maintenance covered under existing procedures.

Communications

Local cable and wiring: Maintenance covered under existing procedures.

Fiber optic network: Connects ramp meters to TMOC for Region 1 camreas. Same network as used for cameras. Maintenance considered under Communications Networks device.

Field Processor/Controller

Type 170 field controller with local firmware: Maintenance covered under existing procedures.

Controller cabinet: Maintenance covered under existing procedures.

Software

ATMS interfaces with ramp meters: Maintenance covered under ATMS.

Center Sub-Systems

No unique center sub-systems components.

Information Delivery

Traffic signal heads: Maintenance covered under existing procedures.

Staffing Needs (FTE)

No new staffing needs

K.2.2.2 Traffic Signal Preemption for Emergency Vehicles

Inventory Table

	Region					State
	1	2	3	4	5	Total
Existing	206	104	59	51	23	443
STIP	0	0	0	0	0	0
Existing + STIP	206	104	59	51	23	443
Strategic Plan	0	0	0	0	0	0
Existing + Strategic Plan	206	104	59	51	23	443

Sensors

Mast-mounted infrared sensor: Maintenance covered under existing procedures.

In-vehicle unit: Maintenance covered under existing procedures.

Communications

Local cable and wiring: Connects mast-mounted sensor to controller cabinet. Maintenance covered under existing procedures.

Field Processor/Controller

Uses existing intersection control; no additional maintenance.

Software

Additional firmware required for controller: Maintenance covered under existing procedures.

Center Sub-Systems

No center sub-system components.

Information Delivery

No new information delivery components.

Staffing Needs (FTE)

No new staffing needs

K.2.2.3 Preferential Signal Treatment for Transit Vehicles

Inventory Table

	Region 1	2	3	4	5	State Total
Existing	17	0	0	0	0	17
STIP	0	0	0	0	0	0
Existing + STIP	17	0	0	0	0	17
Strategic Plan	0	100	0	0	0	100
Existing + Strategic Plan	17	100	0	0	0	117

Sensors

Mast-mounted infrared sensor: Maintenance covered under existing procedures.

In-vehicle unit: Maintenance covered under existing procedures.

Communications

Local cable and wiring: Connects mast-mounted sensor to controller cabinet. Maintenance covered under existing procedures.

Field Processor/Controller

Uses existing intersection control; no additional maintenance.

Software

Additional firmware required for controller: Maintenance covered under existing procedures.

Center Sub-Systems

No center sub-system components.

Information Delivery

No new information delivery components.

Staffing Needs (FTE)

No new staffing needs

K.2.2.4 Advanced Traffic Management System

Inventory Table

Regional Deployment

	Region 1	2	3	4	5	State Total
Existing	1	0	0	0	0	1
STIP	0	0	0	0	0	0
Existing + STIP	1	0	0	0	0	1
Strategic Plan	0	1	1	1	1	4
Existing + Strategic Plan	1	1	1	1	1	5

Workstations

	Region 1	2	3	4	5	State Total
Existing	20	0	0	0	0	20
STIP	1	0	0	0	0	1
Existing + STIP	21	0	0	0	0	21
Strategic Plan	0	6	6	6	6	24
Existing + Strategic Plan	21	6	6	6	6	45

For regions 2-5, assume the following computers for each region: 2 operator consoles, 2 ATMS support machines, 2 computers (1 desktop, 1 laptop) for TOC manager.

Software Applications

	Region 1	2	3	4	5	State Total
Existing	0	1	0	0	0	1
STIP	0	0	0	0	0	0
Existing + STIP	0	1	0	0	0	1
Strategic Plan	0	0	0	0	0	0
Existing + Strategic Plan	0	1	0	0	0	1

Sensors

No independent sensors.

Communications

Communications into TOC: Maintenance covered under other respective devices.

Communications within TOC: Preventative maintenance includes looking for and replacing worn cabling. Repair maintenance focuses on emergency communications breakdowns within the TOC. It is assumed that such breakdowns would be infrequent.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	1.00	2.0	SC-I-PM	0.50	1.5	0.0	SC-I-D
				0.15	1.2	0.0	IS-5N
				0.03	1.1	0.0	IS-6N
				0.35	0.0	3.0	SC-I-R
				0.30	0.0	2.4	IS-5N
				0.06	0.0	1.9	IS-6N
future	1.00	2.0	SC-I-PM	0.50	1.5	0.0	SC-I-D
				0.05	1.2	0.0	IS-5N
				0.01	1.1	0.0	IS-6N
				0.45	0.0	3.0	SC-I-R
				0.22	0.0	2.4	IS-5N
				0.03	0.0	1.9	IS-6N

Field Processor/Controller

Workstations: Many computers are included in each TOC for various ATMS-related tasks. Each computer is assumed to have similar maintenance needs. Excluded from these workstations are dedicated servers, such as the AVL server, RWIS regional servers, or the camera server.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	12.00	1.0	SC-I-PM	2.00	2.0	0.0	SC-I-D
				0.60	1.6	0.0	IS-5N
				0.12	1.4	0.0	IS-6N
				1.40	0.0	1.0	SC-I-R
				1.18	0.0	0.8	IS-5N
				0.24	0.0	0.7	IS-6N
future	12.00	1.0	SC-I-PM	2.00	2.0	0.0	SC-I-D
				0.20	1.6	0.0	IS-5N
				0.04	1.4	0.0	IS-6N
				1.80	0.0	1.0	SC-I-R
				0.88	0.0	0.8	IS-5N
				0.13	0.0	0.7	IS-6N

Software

ATMS software development: It is assumed that ODOT staff will devote some time to ATMS software modifications to enhance capability or reflect additional deployments. This will require specialized support because it is a UNIX application. It is assumed that improvements developed for one region would be applicable to the other ODOT regions. It is assumed that re-writes will require an average of 8 hours per week. Emergency de-bugging will occur every couple of months as a repair need.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	52.00	8.0	IS-6S	6.00	4.0	0.0	IS-6S
				1.20	3.6	0.0	IS-7S
				4.80	0.0	2.0	IS-6S
				1.68	0.0	1.8	IS-7S
future	52.00	8.0	IS-6S	6.00	4.0	0.0	IS-6S
				1.20	3.6	0.0	IS-7S
				4.80	0.0	2.0	IS-6S
				1.68	0.0	1.8	IS-7S

ATMS software upgrades: Software changes developed need to be installed in each of the regions. This will be done annually.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	0.50	4.0	SC-I-PM	0.00	0.0	0.0	
future	0.50	4.0	SC-I-PM	0.00	0.0	0.0	

Database management: Preventative maintenance includes database pruning tasks, which may be done remotely in Salem. These may be done daily, although the amount of time expended per task is very small. Repair maintenance may include some reprogramming and upgrades.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	52.00	1.0	SC-I-PM	1.00	6.0	0.0	SC-I-D
				0.30	4.8	0.0	IS-5N
				0.06	4.3	0.0	IS-6N
				0.70	0.0	2.0	SC-I-R
				0.59	0.0	1.6	IS-5N
				0.12	0.0	1.4	IS-6N
future	52.00	1.0	SC-I-PM	1.00	6.0	0.0	SC-I-D
				0.10	4.8	0.0	IS-5N
				0.02	4.3	0.0	IS-6N
				0.90	0.0	2.0	SC-I-R
				0.44	0.0	1.6	IS-5N
				0.06	0.0	1.4	IS-6N

Center Sub-Systems

Servers: Portland has a graphical user interface server and a database/communications server, each of which is assumed to have generic server maintenance needs. It is assumed that each of the other regions would also have two servers in order to allow for expandable operations.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	52.00	2.0	SC-I-PM	2.00	6.0	0.0	SC-I-D
				0.60	4.8	0.0	IS-5N
				0.12	4.3	0.0	IS-6N
				1.40	0.0	2.0	SC-I-R
				1.18	0.0	1.6	IS-5N
				0.24	0.0	1.4	IS-6N
future	52.00	2.0	SC-I-PM	2.00	6.0	0.0	SC-I-D
				0.20	4.8	0.0	IS-5N
				0.04	4.3	0.0	IS-6N
				1.80	0.0	2.0	SC-I-R
				0.88	0.0	1.6	IS-5N
				0.13	0.0	1.4	IS-6N

Information Delivery

No unique information delivery components.

Summary

Regional Deployment

	Preventative Maintenance			Repair Maintenance		
	visits per yr	hrs per visit	job class	visits per yr	hrs per visit	job class
current	0.00	0.0	SC-I-D	2.00	9.4	SC-I-D
	0.00	0.0	SC-I-R	1.40	3.8	SC-I-R
	52.00	3.1	SC-I-PM	0.00	0.0	SC-I-PM
	0.00	0.0	IS-5N	1.18	6.8	IS-5N
	0.00	0.0	IS-6N	0.24	6.0	IS-6N

	Preventative Maintenance			Repair Maintenance		
	visits per yr	hrs per visit	job class	visits per yr	hrs per visit	job class
future	0.00	0.0	SC-I-D	2.00	9.4	SC-I-D
	0.00	0.0	SC-I-R	1.80	3.8	SC-I-R
	52.00	3.1	SC-I-PM	0.00	0.0	SC-I-PM
	0.00	0.0	IS-5N	0.88	4.7	IS-5N
	0.00	0.0	IS-6N	0.13	4.7	IS-6N

Workstations

current

Preventative Maintenance			Repair Maintenance		
visits per yr	hrs per visit	job class	visits per yr	hrs per visit	job class
0.00	0.0	SC-I-D	2.00	2.0	SC-I-D
0.00	0.0	SC-I-R	1.40	1.0	SC-I-R
12.00	1.0	SC-I-PM	0.00	0.0	SC-I-PM
0.00	0.0	IS-5N	1.18	1.6	IS-5N
0.00	0.0	IS-6N	0.24	1.4	IS-6N

future

Preventative Maintenance			Repair Maintenance		
visits per yr	hrs per visit	job class	visits per yr	hrs per visit	job class
0.00	0.0	SC-I-D	2.00	2.0	SC-I-D
0.00	0.0	SC-I-R	1.80	1.0	SC-I-R
12.00	1.0	SC-I-PM	0.00	0.0	SC-I-PM
0.00	0.0	IS-5N	0.88	1.2	IS-5N
0.00	0.0	IS-6N	0.13	1.2	IS-6N

Software Applications

current

Preventative Maintenance			Repair Maintenance		
visits per yr	hrs per visit	job class	visits per yr	hrs per visit	job class
52.00	8.0	IS-6S	6.00	5.6	IS-6S
0.00	0.0	IS-7S	1.68	4.4	IS-7S

future

Preventative Maintenance			Repair Maintenance		
visits per yr	hrs per visit	job class	visits per yr	hrs per visit	job class
52.00	8.0	IS-6S	6.00	5.6	IS-6S
0.00	0.0	IS-7S	1.68	4.4	IS-7S

Travel Time

No travel time will be necessary for maintenance, since the wide-area network can be used to work on software issues remotely.

Staffing Needs (FTE)

Support Coordinator / IS-Diag (SC-I-D) - DAS # SC-I-D

	Region					State
	1	2	3	4	5	Total
Existing	0.06	0.00	0.00	0.00	0.00	0.06
Existing + STIP	0.06	0.00	0.00	0.00	0.00	0.06
Existing + Strategic Plan	0.06	0.03	0.03	0.03	0.03	0.17

Support Coordinator / IS-Repair (SC-I-R) - DAS # — SC-I-R

	Region 1	2	3	4	5	State Total
Existing	0.02	0.00	0.00	0.00	0.00	0.02
Existing + STIP	0.02	0.00	0.00	0.00	0.00	0.02
Existing + Strategic Plan	0.03	0.01	0.01	0.01	0.01	0.07

Support Coordinator / IS-Preventative Maintenance (SC-I-PM) - DAS # — SC-I-PM

	Region 1	2	3	4	5	State Total
Existing	0.25	0.00	0.00	0.00	0.00	0.25
Existing + STIP	0.25	0.00	0.00	0.00	0.00	0.25
Existing + Strategic Plan	0.25	0.14	0.14	0.14	0.14	0.82

Info Services 5 - Networks / Servers (IS-5N) - DAS #1485 — IS-5N

	Region 1	2	3	4	5	State Total
Existing	0.03	0.00	0.00	0.00	0.00	0.03
Existing + STIP	0.03	0.00	0.00	0.00	0.00	0.03
Existing + Strategic Plan	0.02	0.01	0.01	0.01	0.01	0.04

Info Services 6 - Networks / Servers (IS-6N) - DAS #1486 — IS-6N

	Region 1	2	3	4	5	State Total
Existing	0.01	0.00	0.00	0.00	0.00	0.01
Existing + STIP	0.01	0.00	0.00	0.00	0.00	0.01
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.01

Info Services 6 - Software (IS-6S) - DAS #1486 — IS-6S

	Region 1	2	3	4	5	State Total
Existing	0.00	0.28	0.00	0.00	0.00	0.28
Existing + STIP	0.00	0.28	0.00	0.00	0.00	0.28
Existing + Strategic Plan	0.00	0.28	0.00	0.00	0.00	0.28

Info Services 7 - Software (IS-7S) - DAS #1487 — IS-7S

	Region 1	2	3	4	5	State Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.00

K.2.3 Incident Detection

K.2.3.1 Callboxes

Inventory Table

	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	0	0	4	0	0	4
STIP	0	0	0	0	0	0
Existing + STIP	0	0	4	0	0	4
Strategic Plan	0	0	0	0	0	0
Existing + Strategic Plan	0	0	4	0	0	4

Sensors

Telephone callboxes: Maintenance needs are fairly limited. Vendor recommends testing every three to four weeks to ensure the system works. Due to specialized components, repair maintenance would need to be handled by the vendor.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	12.00	0.1	SC-P	0.00	0.0	0.0	
future	12.00	0.1	SC-P	0.00	0.0	0.0	

Communications

Land-based telephone lines: No preventative maintenance is necessary. Rarely, the line will be dug into, requiring partial replacement, but this will not be ODOT responsibility.

Field Processor/Controller

No field processor/controller.

Software

No unique software application.

Center Sub-Systems

No unique center sub-system components.

Information Delivery

No unique information delivery component.

Summary

	Preventative Maintenance			Repair Maintenance		
current	visits per yr	hrs per visit	job class	visits per yr	hrs per visit	job class
	12.00	0.1	SC-P	0.00	0.0	SC-P

	Preventative Maintenance			Repair Maintenance		
	visits	hrs per	job	visits	hrs per	job
future	per yr	visit	class	per yr	visit	class
	12.00	0.1	SC-P	0.00	0.0	SC-P

Travel Time

Reduce all travel times to 0.25 hrs because of close location of TOC to callboxes.

Staffing Needs (FTE)

Support Coordinator / Program Technician (SC-P) - DAS # SC-P

	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.00	0.02	0.00	0.00	0.02
Existing + STIP	0.00	0.00	0.02	0.00	0.00	0.02
Existing + Strategic Plan	0.00	0.00	0.02	0.00	0.00	0.02

K.2.3.2 Cellular Call-In

Inventory Table

	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	0	0	0	0	0	0
STIP	0	0	0	0	0	0
Existing + STIP	0	0	0	0	0	0
Strategic Plan	0	1	0	0	0	1
Existing + Strategic Plan	0	1	0	0	0	1

Sensors

Cellular phones: Maintenance covered by phone users through contract.

Communications

Cellular tower infrastructure: Maintenance covered by phone users through contract.

Field Processor/Controller

Static signs: Maintenance covered as part of normal sign maintenance; marginal additional maintenance anticipated.

Software

No applicable software.

Center Sub-Systems

Call processing center: No new infrastructure needed for cellular call-in.

Information Delivery

No applicable center sub-system.

Staffing Needs (FTE)

No new staffing needs

K.2.3.3 Regional Incident Detection System

Inventory Table

	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	0	0	0	0	0	0
STIP	1	0	0	0	0	1
Existing + STIP	1	0	0	0	0	1
Strategic Plan	0	0	0	0	0	0
Existing + Strategic Plan	1	0	0	0	0	1

Sensors

Loop Detectors: Maintenance needs outside of this plan.
Video Detectors: Maintenance needs considered elsewhere in this plan.

Communications

Provided by fiber optics network. Maintenance covered under Communications Networks device.

Field Processor/Controller

No field processors/controllers would be used.

Software

TOC-Based Algorithm: Needs updating and refining to reduce false alarms and missed incidents.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	0.50	4.0	SC-I-PM	0.00	0.0	0.0	
future	0.50	4.0	SC-I-PM	0.00	0.0	0.0	

Center Sub-Systems

Incident detection server: A server would be devoted to polling field detectors and synthesizing information to detect incidents.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	52.00	1.0	SC-I-PM	1.00	6.0	0.0	SC-I-D
				0.30	4.8	0.0	IS-5N
				0.06	4.3	0.0	IS-6N
				0.70	0.0	2.0	SC-I-R
				0.59	0.0	1.6	IS-5N
				0.12	0.0	1.4	IS-6N
future	52.00	1.0	SC-I-PM	1.00	6.0	0.0	SC-I-D
				0.10	4.8	0.0	IS-5N
				0.02	4.3	0.0	IS-6N
				0.90	0.0	2.0	SC-I-R
				0.44	0.0	1.6	IS-5N
				0.06	0.0	1.4	IS-6N

Information Delivery

No unique information delivery system.

Summary

current

Preventative Maintenance			Repair Maintenance		
visits per yr	hrs per visit	job class	visits per yr	hrs per visit	job class
0.00	0.0	SC-I-D	1.00	6.0	SC-I-D
0.00	0.0	SC-I-R	0.70	2.0	SC-I-R
52.00	1.0	SC-I-PM	0.00	0.0	SC-I-PM
0.00	0.0	IS-5N	0.59	4.0	IS-5N
0.00	0.0	IS-6N	0.12	3.6	IS-6N

future

Preventative Maintenance			Repair Maintenance		
visits per yr	hrs per visit	job class	visits per yr	hrs per visit	job class
0.00	0.0	SC-I-D	1.00	6.0	SC-I-D
0.00	0.0	SC-I-R	0.90	2.0	SC-I-R
52.00	1.0	SC-I-PM	0.00	0.0	SC-I-PM
0.00	0.0	IS-5N	0.44	2.7	IS-5N
0.00	0.0	IS-6N	0.06	2.8	IS-6N

Travel Time

No travel time for preventative maintenance on incident detection server.

Staffing Needs (FTE)

Support Coordinator / IS-Diag (SC-I-D) - DAS # SC-I-D

	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.01	0.00	0.00	0.00	0.00	0.01
Existing + Strategic Plan	0.01	0.00	0.00	0.00	0.00	0.01

Support Coordinator / IS-Repair (SC-I-R) - DAS # SC-I-R

	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.00

Support Coordinator / IS-Preventative Maintenance (SC-I-PM) - DAS # SC-I-PM

	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.03	0.00	0.00	0.00	0.00	0.03
Existing + Strategic Plan	0.03	0.00	0.00	0.00	0.00	0.03

Info Services 5 - Networks / Servers (IS-5N) - DAS #1485 IS-5N

	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.00

Info Services 6 - Networks / Servers (IS-6N) - DAS #1486 IS-6N

	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.00

K.2.3.4 Intersection-Based Incident Detection System

Inventory Table

	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	0	0	0	0	0	0
STIP	0	1	0	1	0	2
Existing + STIP	0	1	0	1	0	2
Strategic Plan	0	0	0	0	0	0
Existing + Strategic Plan	0	1	0	1	0	2

Sensors

Loop Detectors: Maintenance needs outside of this plan.

Video Detectors: Maintenance needs considered elsewhere in this plan.

Communications

The RPU dials out to the TOC whenever an incident is detected. Maintenance is covered under field processor/controller.

Local cable and wiring: Maintenance covered under existing procedures.

Field Processor/Controller

Remote processing unit: Collects detector data, runs algorithm to detect incidents, and sends dispatch to TOC if incident is detected. Due to limited variety of applications / usage conditions, upgrades will be necessary at most every other year.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	6.00	1.0	SC-I-PM	0.50	2.0	0.0	SC-I-D
				0.15	1.6	0.0	IS-5N
				0.03	1.4	0.0	IS-6N
				0.35	0.0	1.0	SC-I-R
				0.30	0.0	0.8	IS-5N
				0.06	0.0	0.7	IS-6N
future	6.00	1.0	SC-I-PM	0.50	2.0	0.0	SC-I-D
				0.05	1.6	0.0	IS-5N
				0.01	1.4	0.0	IS-6N
				0.45	0.0	1.0	SC-I-R
				0.22	0.0	0.8	IS-5N
				0.03	0.0	0.7	IS-6N

Software

Algorithm: Needs updating and refining to reduce false alarms and missed incidents.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	0.50	4.0	SC-I-PM	0.00	0.0	0.0	
future	0.50	4.0	SC-I-PM	0.00	0.0	0.0	

Center Sub-Systems

This application can be run "in background" on existing systems; no additional maintenance

Information Delivery

No unique information delivery system.

Summary

current	Preventative Maintenance			Repair Maintenance		
	visits per yr	hrs per visit	job class	visits per yr	hrs per visit	job class
	0.00	0.0	SC-I-D	0.50	2.0	SC-I-D
	0.00	0.0	SC-I-R	0.35	1.0	SC-I-R
	6.00	1.3	SC-I-PM	0.00	0.0	SC-I-PM
	0.00	0.0	IS-5N	0.30	1.6	IS-5N
	0.00	0.0	IS-6N	0.06	1.4	IS-6N

future	Preventative Maintenance			Repair Maintenance		
	visits per yr	hrs per visit	job class	visits per yr	hrs per visit	job class
	0.00	0.0	SC-I-D	0.50	2.0	SC-I-D
	0.00	0.0	SC-I-R	0.45	1.0	SC-I-R
	6.00	1.3	SC-I-PM	0.00	0.0	SC-I-PM
	0.00	0.0	IS-5N	0.22	1.2	IS-5N
	0.00	0.0	IS-6N	0.03	1.2	IS-6N

Staffing Needs (FTE)

Support Coordinator / IS-Diag (SC-I-D) - DAS # SC-I-D

	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.01
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.01

Support Coordinator / IS-Repair (SC-I-R) - DAS # SC-I-R

	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.00

Support Coordinator / IS-Preventative Maintenance (SC-I-PM) - DAS # SC-I-PM

	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.02	0.00	0.03	0.00	0.05
Existing + Strategic Plan	0.00	0.02	0.00	0.03	0.00	0.05

Info Services 5 - Networks / Servers (IS-5N) - DAS #1485 — IS-5N

	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.00

Info Services 6 - Networks / Servers (IS-6N) - DAS #1486 — IS-6N

	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.00

K.2.4 Incident Management and Response

K.2.4.1 Computer-Aided Dispatch

Inventory Table

	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	0	5	2	2	0	9
STIP	0	0	0	0	0	0
Existing + STIP	0	5	2	2	0	9
Strategic Plan	0	0	0	0	0	0
Existing + Strategic Plan	0	5	2	2	0	9

Sensors

No applicable sensors.

Communications

Communications from central OSP to dispatch center: Responsibility of OSP.

Communications within dispatch center: Check all connections; replace cables and components as necessary. Time to repair is half of generic communications equipment.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	1.00	0.5	SC-I-PM	0.25	1.9	0.0	SC-I-D
				0.08	1.5	0.0	IS-5N
				0.02	1.4	0.0	IS-6N
				0.18	0.0	0.6	SC-I-R
				0.15	0.0	0.5	IS-5N
				0.03	0.0	0.5	IS-6N
future	1.00	0.5	SC-I-PM	0.25	1.9	0.0	SC-I-D
				0.03	1.5	0.0	IS-5N
				0.01	1.4	0.0	IS-6N
				0.23	0.0	0.6	SC-I-R
				0.11	0.0	0.5	IS-5N
				0.02	0.0	0.5	IS-6N

Field Processor/Controller

No applicable field processor/controllers.

Software

CAD software: Periodic upgrades on workstations are necessary.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	0.50	4.0	SC-I-PM	0.00	0.0	0.0	
future	0.50	4.0	SC-I-PM	0.00	0.0	0.0	

Center Sub-Systems

Operator workstations: Limited preventative maintenance is required. Repair maintenance is necessary to bring downed terminals back up.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	12.00	1.0	SC-I-PM	2.00	2.0	0.0	SC-I-D
				0.60	1.6	0.0	IS-5N
				0.12	1.4	0.0	IS-6N
				1.40	0.0	1.0	SC-I-R
				1.18	0.0	0.8	IS-5N
				0.24	0.0	0.7	IS-6N
future	12.00	1.0	SC-I-PM	2.00	2.0	0.0	SC-I-D
				0.20	1.6	0.0	IS-5N
				0.04	1.4	0.0	IS-6N
				1.80	0.0	1.0	SC-I-R
				0.88	0.0	0.8	IS-5N
				0.13	0.0	0.7	IS-6N

Information Delivery

Already covered under center sub-systems

Summary

	Preventative Maintenance			Repair Maintenance		
	visits	hrs per	job	visits	hrs per	job
current	per yr	visit	class	per yr	visit	class
	0.00	0.0	SC-I-D	2.00	2.2	SC-I-D
	0.00	0.0	SC-I-R	1.40	1.1	SC-I-R
	12.00	1.2	SC-I-PM	0.00	0.0	SC-I-PM
	0.00	0.0	IS-5N	1.18	1.8	IS-5N
	0.00	0.0	IS-6N	0.24	1.6	IS-6N

	Preventative Maintenance			Repair Maintenance		
	visits	hrs per	job	visits	hrs per	job
future	per yr	visit	class	per yr	visit	class
	0.00	0.0	SC-I-D	2.00	2.2	SC-I-D
	0.00	0.0	SC-I-R	1.80	1.1	SC-I-R
	12.00	1.2	SC-I-PM	0.00	0.0	SC-I-PM
	0.00	0.0	IS-5N	0.88	1.3	IS-5N
	0.00	0.0	IS-6N	0.13	1.3	IS-6N

Staffing Needs (FTE)

Support Coordinator / IS-Diag (SC-I-D) - DAS # SC-I-D

	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.01	0.01	0.01	0.00	0.02
Existing + STIP	0.00	0.01	0.01	0.01	0.00	0.02
Existing + Strategic Plan	0.00	0.01	0.01	0.01	0.00	0.02

Support Coordinator / IS-Repair (SC-I-R) - DAS # — SC-I-R

	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	0.00	0.00	0.00	0.00	0.00	0.01
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.01
Existing + Strategic Plan	0.00	0.01	0.00	0.00	0.00	0.01

Support Coordinator / IS-Preventative Maintenance (SC-I-PM) - DAS # — SC-I-PM

	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	0.00	0.04	0.02	0.02	0.00	0.08
Existing + STIP	0.00	0.04	0.02	0.02	0.00	0.08
Existing + Strategic Plan	0.00	0.04	0.02	0.02	0.00	0.08

Info Services 5 - Networks / Servers (IS-5N) - DAS #1485 — IS-5N

	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	0.00	0.01	0.00	0.00	0.00	0.01
Existing + STIP	0.00	0.01	0.00	0.00	0.00	0.01
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.01

Info Services 6 - Networks / Servers (IS-6N) - DAS #1486 — IS-6N

	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.00

K.2.4.2 Incident Response Vehicles

Inventory Table

	Region					State
	1	2	3	4	5	Total
Existing	7	0	0	0	0	7
STIP	0	4	0	0	0	4
Existing + STIP	7	4	0	0	0	11
Strategic Plan	0	0	0	0	0	0
Existing + Strategic Plan	7	4	0	0	0	11

Sensors

No unique sensors.

Communications

Cellular phone equipment: Infrastructure and maintenance provided by others.

CB radio: ODOT radio technicians maintain units and consoles. Maintenance addressed under dual radio systems.

Low-band (800 MHz) radio: ODOT buys units through City of Portland; City of Portland is also responsible for maintenance.

High-band (VHF) radio: ODOT radio technicians maintain units, consoles and infrastructure. Maintenance addressed under dual radio systems.

Automatic vehicle location (AVL) communications: Covered under Automatic Vehicle Location device.

Field Processor/Controller

Laptop computer: From ITS perspective, used primarily to update VMS messages beyond canned messages. Similar maintenance to generic workstation, except that no preventative maintenance activity is recommended.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	0.00	0.0		2.00	2.0	0.0	SC-I-D
				0.60	1.6	0.0	IS-5N
				0.12	1.4	0.0	IS-6N
				1.40	0.0	1.0	SC-I-R
				1.18	0.0	0.8	IS-5N
				0.24	0.0	0.7	IS-6N
future	0.00	0.0		2.00	2.0	0.0	SC-I-D
				0.20	1.6	0.0	IS-5N
				0.04	1.4	0.0	IS-6N
				1.80	0.0	1.0	SC-I-R
				0.88	0.0	0.8	IS-5N
				0.13	0.0	0.7	IS-6N

Software

AVL software: Maintenance and upgrades provided by vendor, installed by ODOT (repair). This is covered under Automatic Vehicle Location device category.

Center Sub-Systems

AVL server: Used to track COMET vehicle locations. Requires database management (preventative) and basic server maintenance (repair) activities. This is covered under Automatic Vehicle Location device category.

Information Delivery

On-board VMS: Flip-disk signs (used on the majority of existing vehicles) require regular disk cleaning and have a history of power supply problems. These signs will be phased out and replaced by signs requiring less preventative maintenance and having more reliable power. It is assumed that maintenance will require less time than permanent VMS because of easier access.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	2.00	3.0	SC-E-PM	3.00	1.0	0.0	SC-E-D
				0.90	0.8	0.0	ELEC
				0.18	0.7	0.0	TS-3
				2.10	0.0	2.0	SC-E-R
				1.77	0.0	1.6	ELEC
				0.36	0.0	1.3	TS-3
future	2.00	3.0	SC-E-PM	3.00	0.5	0.0	SC-E-D
				0.30	0.4	0.0	ELEC
				0.06	0.4	0.0	TS-3
				2.70	0.0	1.3	SC-E-R
				1.32	0.0	1.1	ELEC
				0.19	0.0	0.9	TS-3

Summary

	Preventative Maintenance			Repair Maintenance		
current	visits per yr	hrs per visit	job class	visits per yr	hrs per visit	job class
	0.00	0.0	SC-I-D	2.00	2.0	SC-I-D
	0.00	0.0	SC-I-R	1.40	1.0	SC-I-R
	0.00	0.0	SC-E-D	3.00	1.0	SC-E-D
	0.00	0.0	SC-E-R	2.10	2.0	SC-E-R
	2.00	3.0	SC-E-PM	0.00	0.0	SC-E-PM
	0.00	0.0	IS-5N	1.18	1.6	IS-5N
	0.00	0.0	IS-6N	0.24	1.4	IS-6N
	0.00	0.0	ELEC	1.77	2.0	ELEC
	0.00	0.0	TS-3	0.36	1.6	TS-3

future	Preventative Maintenance visits per yr	Preventative Maintenance hrs per visit	Preventative Maintenance job class	Repair Maintenance visits per yr	Repair Maintenance hrs per visit	Repair Maintenance job class
	0.00	0.0	SC-I-D	2.00	2.0	SC-I-D
	0.00	0.0	SC-I-R	1.80	1.0	SC-I-R
	0.00	0.0	SC-E-D	3.00	0.5	SC-E-D
	0.00	0.0	SC-E-R	2.70	1.3	SC-E-R
	2.00	3.0	SC-E-PM	0.00	0.0	SC-E-PM
	0.00	0.0	IS-5N	0.88	1.2	IS-5N
	0.00	0.0	IS-6N	0.13	1.2	IS-6N
	0.00	0.0	ELEC	1.32	1.2	ELEC
	0.00	0.0	TS-3	0.19	1.0	TS-3

Travel Time

No travel time is generally necessary because drivers can transport vehicles to wherever maintenance is performed.

Staffing Needs (FTE)

Support Coordinator / IS-Diag (SC-I-D) - DAS # SC-I-D

	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	0.02	0.00	0.00	0.00	0.00	0.02
Existing + STIP	0.02	0.01	0.00	0.00	0.00	0.03
Existing + Strategic Plan	0.02	0.01	0.00	0.00	0.00	0.03

Support Coordinator / IS-Repair (SC-I-R) - DAS # SC-I-R

	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	0.01	0.00	0.00	0.00	0.00	0.01
Existing + STIP	0.01	0.00	0.00	0.00	0.00	0.01
Existing + Strategic Plan	0.01	0.00	0.00	0.00	0.00	0.01

Support Coordinator / Elec-Diag (SC-E-D) - DAS # SC-E-D

	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	0.01	0.00	0.00	0.00	0.00	0.01
Existing + STIP	0.01	0.01	0.00	0.00	0.00	0.02
Existing + Strategic Plan	0.01	0.00	0.00	0.00	0.00	0.01

Support Coordinator / Elec-Repair (SC-E-R) - DAS # SC-E-R

	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	0.02	0.00	0.00	0.00	0.00	0.02
Existing + STIP	0.02	0.01	0.00	0.00	0.00	0.03
Existing + Strategic Plan	0.02	0.01	0.00	0.00	0.00	0.02

Support Coordinator / Elec-Preventative Maintenance (SC-E-PM) - DAS #

	Region					SC-E-PM State Total
	1	2	3	4	5	
Existing	0.03	0.00	0.00	0.00	0.00	0.03
Existing + STIP	0.03	0.01	0.00	0.00	0.00	0.04
Existing + Strategic Plan	0.03	0.01	0.00	0.00	0.00	0.04

Info Services 5 - Networks / Servers (IS-5N) - DAS #1485

	Region					IS-5N State Total
	1	2	3	4	5	
Existing	0.01	0.00	0.00	0.00	0.00	0.01
Existing + STIP	0.01	0.00	0.00	0.00	0.00	0.01
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.01

Info Services 6 - Networks / Servers (IS-6N) - DAS #1486

	Region					IS-6N State Total
	1	2	3	4	5	
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.00

Electrician (ELEC) - DAS #4213

	Region					ELEC State Total
	1	2	3	4	5	
Existing	0.02	0.00	0.00	0.00	0.00	0.02
Existing + STIP	0.02	0.01	0.00	0.00	0.00	0.02
Existing + Strategic Plan	0.01	0.00	0.00	0.00	0.00	0.01

Traffic Signal Technician 3 (TS-3) - DAS #3411

	Region					TS-3 State Total
	1	2	3	4	5	
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.00

K.2.4.3 Pre-planned Detour Routes

Inventory Table

	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	0	0	0	0	0	0
STIP	0	0	0	0	0	0
Existing + STIP	0	0	0	0	0	0
Strategic Plan	500	100	100	50	0	750
Existing + Strategic Plan	500	100	100	50	0	750

Sensors

Not applicable.

Communications

Will be necessary to enforce pre-planned detour routes; this is covered under other devices.

Field Processor/Controller

No field processor or controller present.

Software

Preventative maintenance would ensure that routes would be selected appropriately, and are coordinated appropriately with other TOC systems.

Maintenance would be done for all of a region's routes simultaneously.

Development of new detour routes or revision of existing routes would be an operational function.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	1.00	4.0	SC-I-PM	0.00	0.0	0.0	
future	1.00	4.0	SC-I-PM	0.00	0.0	0.0	

Center Sub-Systems

ATMS would be used to select detour routes; no new maintenance required.

Information Delivery

No new information delivery devices, since detour routes would likely use existing signage.

Summary

	Preventative Maintenance			Repair Maintenance		
	visits per yr	hrs per visit	job class	visits per yr	hrs per visit	job class
current	1.00	4.0	SC-I-PM	0.00	0.0	SC-I-PM

	Preventative Maintenance			Repair Maintenance		
	visits per yr	hrs per visit	job class	visits per yr	hrs per visit	job class
future	1.00	4.0	SC-I-PM	0.00	0.0	SC-I-PM

Travel Time

No travel time is necessary.

Staffing Needs (FTE)

Support Coordinator / IS-Preventative Maintenance (SC-I-PM) - DAS # SC-I-PM

	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.01

K.2.4.4 Hazardous Material Response

Inventory Table

	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	0	0	0	0	0	0
STIP	0	0	0	0	0	0
Existing + STIP	0	0	0	0	0	0
Strategic Plan	0	1	0	0	0	1
Existing + Strategic Plan	0	1	0	0	0	1

Sensors

Includes no independent sensors.

Communications

Dial-up connections would be used by HazMat carriers to access database. Maintenance for dial-up connections is same as maintenance for generic computer without performing preventative maintenance.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	1.00	1.0	SC-I-PM	0.25	3.8	0.0	SC-I-D
				0.08	3.0	0.0	IS-5N
				0.02	2.7	0.0	IS-6N
				0.18	0.0	1.3	SC-I-R
				0.15	0.0	1.0	IS-5N
				0.03	0.0	0.9	IS-6N
future	1.00	1.0	SC-I-PM	0.25	3.8	0.0	SC-I-D
				0.03	3.0	0.0	IS-5N
				0.01	2.7	0.0	IS-6N
				0.23	0.0	1.3	SC-I-R
				0.11	0.0	1.0	IS-5N
				0.02	0.0	0.9	IS-6N

Field Processor/Controller

No field processors/controllers are involved.

Software

Database application would need to be installed and updated (repair maintenance).

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	0.50	4.0	SC-I-PM	0.00	0.0	0.0	
future	0.50	4.0	SC-I-PM	0.00	0.0	0.0	

Center Sub-Systems

Server: HazMat server with database would need regular maintenance, and occasional hardware replacement.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	52.00	1.0	SC-I-PM	1.00	6.0	0.0	SC-I-D
				0.30	4.8	0.0	IS-5N
				0.06	4.3	0.0	IS-6N
				0.70	0.0	2.0	SC-I-R
				0.59	0.0	1.6	IS-5N
				0.12	0.0	1.4	IS-6N
future	52.00	1.0	SC-I-PM	1.00	6.0	0.0	SC-I-D
				0.10	4.8	0.0	IS-5N
				0.02	4.3	0.0	IS-6N
				0.90	0.0	2.0	SC-I-R
				0.44	0.0	1.6	IS-5N
				0.06	0.0	1.4	IS-6N

Information Delivery

No unique information delivery components.

Summary

	Preventative Maintenance			Repair Maintenance		
	visits	hrs per	job	visits	hrs per	job
current	per yr	visit	class	per yr	visit	class
	0.00	0.0	SC-I-D	1.00	6.9	SC-I-D
	0.00	0.0	SC-I-R	0.70	2.3	SC-I-R
	52.00	1.1	SC-I-PM	0.00	0.0	SC-I-PM
	0.00	0.0	IS-5N	0.59	4.7	IS-5N
	0.00	0.0	IS-6N	0.12	4.2	IS-6N

	Preventative Maintenance			Repair Maintenance		
	visits	hrs per	job	visits	hrs per	job
future	per yr	visit	class	per yr	visit	class
	0.00	0.0	SC-I-D	1.00	6.9	SC-I-D
	0.00	0.0	SC-I-R	0.90	2.3	SC-I-R
	52.00	1.1	SC-I-PM	0.00	0.0	SC-I-PM
	0.00	0.0	IS-5N	0.44	3.1	IS-5N
	0.00	0.0	IS-6N	0.06	3.2	IS-6N

Travel Time

No travel time is necessary.

Staffing Needs (FTE)

Support Coordinator / IS-Diag (SC-I-D) - DAS #

SC-I-D

	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.00

Support Coordinator / IS-Repair (SC-I-R) - DAS #

SC-I-R

	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.00

Support Coordinator / IS-Preventative Maintenance (SC-I-PM) - DAS #

SC-I-PM

	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.03	0.00	0.00	0.00	0.03

Info Services 5 - Networks / Servers (IS-5N) - DAS #1485

IS-5N

	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.00

Info Services 6 - Networks / Servers (IS-6N) - DAS #1486

IS-6N

	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.00

K.2.5 Pre-Trip Traveler Information

K.2.5.1 Alphanumeric Paging

Inventory Table

	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	1	0	0	0	0	1
STIP	0	0	0	0	0	0
Existing + STIP	1	0	0	0	0	1
Strategic Plan	0	0	0	0	0	0
Existing + Strategic Plan	1	0	0	0	0	1

Sensors

No unique sensors.

Communications

Paging devices: Provided and maintained by vendor.
Paging service infrastructure: Provided and maintained by vendor.

Field Processor/Controller

No unique field processors.

Software

Software provided by vendor, but must be installed by ODOT.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	0.50	4.0	SC-I-PM	0.00	0.0	0.0	
future	0.50	4.0	SC-I-PM	0.00	0.0	0.0	

Center Sub-Systems

No unique center sub-systems.

Information Delivery

Pagers: Covered under communications.

Summary

	Preventative Maintenance			Repair Maintenance		
current	visits per yr	hrs per visit	job class	visits per yr	hrs per visit	job class
	0.50	4.0	SC-I-PM	0.00	0.0	SC-I-PM

	Preventative Maintenance			Repair Maintenance		
future	visits per yr	hrs per visit	job class	visits per yr	hrs per visit	job class
	0.50	4.0	SC-I-PM	0.00	0.0	SC-I-PM

Travel Time

No travel time is necessary for this device.

Staffing Needs (FTE)

Support Coordinator / IS-Preventative Maintenance (SC-I-PM) - DAS # SC-I-PM

	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.00

K.2.5.2 Highway Travel Conditions Reporting System

Inventory Table

	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	0	0	0	0	0	0
STIP	0	1	0	0	0	1
Existing + STIP	0	1	0	0	0	1
Strategic Plan	0	0	0	0	0	0
Existing + Strategic Plan	0	1	0	0	0	1

Sensors

No unique sensors.

Communications

No unique communications system.

Field Processor/Controller

No unique field processors.

Software

HTCRS development: This is an in-house application that will need continual refinement. Debugging "repairs" are expected to occur, on average, every two months.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	52.00	10.0	IS-6S	6.00	4.0	0.0	IS-6S
				1.20	3.6	0.0	IS-7S
				4.80	0.0	2.0	IS-6S
				1.68	0.0	1.8	IS-7S
future	52.00	10.0	IS-6S	6.00	4.0	0.0	IS-6S
				1.20	3.6	0.0	IS-7S
				4.80	0.0	2.0	IS-6S
				1.68	0.0	1.8	IS-7S

Database support: Travel conditions database will need regular cleaning and pruning for more efficient operations. The database may need some re-programming from time-to-time to permit additional deployments or yield different information.

	Preventative Maintenance			Repair Maintenance			
	visits	hrs per	job	visits	hours per visit		job
	per yr	visit	class	per yr	diag.	repair	class
current	52.00	1.0	SC-I-PM	1.00	6.0	0.0	SC-I-D
				0.30	4.8	0.0	IS-5N
				0.06	4.3	0.0	IS-6N
				0.70	0.0	2.0	SC-I-R
				0.59	0.0	1.6	IS-5N
				0.12	0.0	1.4	IS-6N
future	52.00	1.0	SC-I-PM	1.00	6.0	0.0	SC-I-D
				0.10	4.8	0.0	IS-5N
				0.02	4.3	0.0	IS-6N
				0.90	0.0	2.0	SC-I-R
				0.44	0.0	1.6	IS-5N
				0.06	0.0	1.4	IS-6N

Center Sub-Systems

No unique center sub-systems.

Information Delivery

Information is output to 800-number and TripCheck Internet package; maintenance needs considered separately under those device headings.

Summary

	Preventative Maintenance			Repair Maintenance		
	visits	hrs per	job	visits	hrs per	job
current	per yr	visit	class	per yr	visit	class
	0.00	0.0	SC-I-D	1.00	6.0	SC-I-D
	0.00	0.0	SC-I-R	0.70	2.0	SC-I-R
	52.00	1.0	SC-I-PM	0.00	0.0	SC-I-PM
	0.00	0.0	IS-5N	0.59	4.0	IS-5N
	0.00	0.0	IS-6N	0.12	3.6	IS-6N
	52.00	10.0	IS-6S	6.00	5.6	IS-6S
	0.00	0.0	IS-7S	1.68	4.4	IS-7S

	Preventative Maintenance			Repair Maintenance		
	visits	hrs per	job	visits	hrs per	job
future	per yr	visit	class	per yr	visit	class
	0.00	0.0	SC-I-D	1.00	6.0	SC-I-D
	0.00	0.0	SC-I-R	0.90	2.0	SC-I-R
	52.00	1.0	SC-I-PM	0.00	0.0	SC-I-PM
	0.00	0.0	IS-5N	0.44	2.7	IS-5N
	0.00	0.0	IS-6N	0.06	2.8	IS-6N
	52.00	10.0	IS-6S	6.00	5.6	IS-6S
	0.00	0.0	IS-7S	1.68	4.4	IS-7S

Travel Time

No travel time is necessary for this device.

Staffing Needs (FTE)

Support Coordinator / IS-Diag (SC-I-D) - DAS # SC-I-D

	Region 1	2	3	4	5	State Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.00

Support Coordinator / IS-Repair (SC-I-R) - DAS # SC-I-R

	Region 1	2	3	4	5	State Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.00

Support Coordinator / IS-Preventative Maintenance (SC-I-PM) - DAS # SC-I-PM

	Region 1	2	3	4	5	State Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.03	0.00	0.00	0.00	0.03
Existing + Strategic Plan	0.00	0.03	0.00	0.00	0.00	0.03

Info Services 5 - Networks / Servers (IS-5N) - DAS #1485 IS-5N

	Region 1	2	3	4	5	State Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.00

Info Services 6 - Networks / Servers (IS-6N) - DAS #1486 IS-6N

	Region 1	2	3	4	5	State Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.00

Info Services 6 - Software (IS-6S) - DAS #1486 IS-6S

	Region 1	2	3	4	5	State Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.34	0.00	0.00	0.00	0.34
Existing + Strategic Plan	0.00	0.34	0.00	0.00	0.00	0.34

Info Services 7 - Software (IS-7S) - DAS #1487 IS-7S

	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.00

K.2.5.3 800-number Information

Inventory Table

	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	0	1	0	0	0	1
STIP	0	0	0	0	0	0
Existing + STIP	0	1	0	0	0	1
Strategic Plan	0	0	0	0	0	0
Existing + Strategic Plan	0	1	0	0	0	1

Sensors

No unique sensors.

Communications

Communications lines into the center are provided by others. For communications within the center, some preventative maintenance is recommended to identify and replace worn cabling. Repair maintenance would be necessary on rare emergencies to replace cabling.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	1.00	2.0	SC-E-PM	0.50	1.5	0.0	SC-E-D
				0.15	1.2	0.0	ELEC
				0.03	1.1	0.0	TS-3
				0.35	0.0	3.0	SC-E-R
				0.30	0.0	2.4	ELEC
				0.06	0.0	1.9	TS-3
future	1.00	2.0	SC-E-PM	0.50	1.5	0.0	SC-E-D
				0.05	1.2	0.0	ELEC
				0.01	1.1	0.0	TS-3
				0.45	0.0	3.0	SC-E-R
				0.22	0.0	2.4	ELEC
				0.03	0.0	1.9	TS-3

Field Processor/Controller

No field processors / controllers.

Software

Voice translation software: Not in place yet. When installed, this will allow data from the Highway Travel Conditions Reporting System to be translated into simulated-voice messages.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	0.50	4.0	SC-I-PM	0.00	0.0	0.0	
future	0.50	4.0	SC-I-PM	0.00	0.0	0.0	

Phone server software: This is used to take incoming calls and distribute them to each machine, and to provide the appropriate information to each caller. Weekly maintenance is necessary for upgrading and debugging.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	52.00	5.0	IS-6S	1.00	6.0	0.0	SC-I-D
				0.30	4.8	0.0	IS-6S
				0.06	4.3	0.0	IS-7S
				0.70	0.0	2.0	SC-I-R
				0.59	0.0	1.6	IS-6S
				0.12	0.0	1.4	IS-7S
future	52.00	5.0	IS-6S	1.00	6.0	0.0	SC-I-D
				0.10	4.8	0.0	IS-6S
				0.02	4.3	0.0	IS-7S
				0.90	0.0	2.0	SC-I-R
				0.44	0.0	1.6	IS-6S
				0.06	0.0	1.4	IS-7S

Center Sub-Systems

Five interconnected servers: Five servers are used to handle all the different telephone lines. Because they act in concert, they are treated as one generic server in terms of preventative maintenance and two generic servers in terms of repair maintenance.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	52.00	1.0	SC-I-PM	1.00	6.0	0.0	SC-I-D
				0.30	4.8	0.0	IS-5N
				0.06	4.3	0.0	IS-6N
				0.70	0.0	2.0	SC-I-R
				0.59	0.0	1.6	IS-5N
				0.12	0.0	1.4	IS-6N
future	52.00	1.0	SC-I-PM	1.00	6.0	0.0	SC-I-D
				0.10	4.8	0.0	IS-5N
				0.02	4.3	0.0	IS-6N
				0.90	0.0	2.0	SC-I-R
				0.44	0.0	1.6	IS-5N
				0.06	0.0	1.4	IS-6N

Information Delivery

Voice recording: Solid-state, digitally-developed messages are encoded using software; maintenance needs covered under software.

Summary

current	Preventative Maintenance			Repair Maintenance		
	visits per yr	hrs per visit	job class	visits per yr	hrs per visit	job class
	0.00	0.0	SC-I-D	1.00	12.0	SC-I-D
	0.00	0.0	SC-I-R	0.70	4.0	SC-I-R
	52.00	1.0	SC-I-PM	0.00	0.0	SC-I-PM
	0.00	0.0	SC-E-D	0.50	1.5	SC-E-D
	0.00	0.0	SC-E-R	0.35	3.0	SC-E-R
	1.00	2.0	SC-E-PM	0.00	0.0	SC-E-PM
	0.00	0.0	IS-5N	0.59	4.0	IS-5N
	0.00	0.0	IS-6N	0.12	3.6	IS-6N
	52.00	5.0	IS-6S	0.59	4.0	IS-6S
	0.00	0.0	IS-7S	0.12	3.6	IS-7S
	0.00	0.0	ELEC	0.30	3.0	ELEC
	0.00	0.0	TS-3	0.06	2.5	TS-3

future	Preventative Maintenance			Repair Maintenance		
	visits per yr	hrs per visit	job class	visits per yr	hrs per visit	job class
	0.00	0.0	SC-I-D	1.00	12.0	SC-I-D
	0.00	0.0	SC-I-R	0.90	4.0	SC-I-R
	52.00	1.0	SC-I-PM	0.00	0.0	SC-I-PM
	0.00	0.0	SC-E-D	0.50	1.5	SC-E-D
	0.00	0.0	SC-E-R	0.45	3.0	SC-E-R
	1.00	2.0	SC-E-PM	0.00	0.0	SC-E-PM
	0.00	0.0	IS-5N	0.44	2.7	IS-5N
	0.00	0.0	IS-6N	0.06	2.8	IS-6N
	52.00	5.0	IS-6S	0.44	2.7	IS-6S
	0.00	0.0	IS-7S	0.06	2.8	IS-7S
	0.00	0.0	ELEC	0.22	2.7	ELEC
	0.00	0.0	TS-3	0.03	2.3	TS-3

Travel Time

No travel time necessary; all equipment is centrally located in Salem.

Staffing Needs (FTE)

Support Coordinator / IS-Diag (SC-I-D) - DAS # SC-I-D

	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.01	0.00	0.00	0.00	0.01
Existing + STIP	0.00	0.01	0.00	0.00	0.00	0.01
Existing + Strategic Plan	0.00	0.01	0.00	0.00	0.00	0.01

Support Coordinator / IS-Repair (SC-I-R) - DAS # SC-I-R

	Region 1	2	3	4	5	State Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.00

Support Coordinator / IS-Preventative Maintenance (SC-I-PM) - DAS # SC-I-PM

	Region 1	2	3	4	5	State Total
Existing	0.00	0.03	0.00	0.00	0.00	0.03
Existing + STIP	0.00	0.03	0.00	0.00	0.00	0.03
Existing + Strategic Plan	0.00	0.03	0.00	0.00	0.00	0.03

Support Coordinator / Elec-Diag (SC-E-D) - DAS # SC-E-D

	Region 1	2	3	4	5	State Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.00

Support Coordinator / Elec-Repair (SC-E-R) - DAS # SC-E-R

	Region 1	2	3	4	5	State Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.00

Support Coordinator / Elec-Preventative Maintenance (SC-E-PM) - DAS # SC-E-PM

	Region 1	2	3	4	5	State Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.00

Info Services 5 - Networks / Servers (IS-5N) - DAS #1485 IS-5N

	Region 1	2	3	4	5	State Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.00

Info Services 6 - Networks / Servers (IS-6N) - DAS #1486

IS-6N	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.00

Info Services 6 - Software (IS-6S) - DAS #1486

IS-6S	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	0.00	0.16	0.00	0.00	0.00	0.16
Existing + STIP	0.00	0.16	0.00	0.00	0.00	0.16
Existing + Strategic Plan	0.00	0.16	0.00	0.00	0.00	0.16

Info Services 7 - Software (IS-7S) - DAS #1487

IS-7S	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.00

Electrician (ELEC) - DAS #4213

ELEC	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.00

Traffic Signal Technician 3 (TS-3) - DAS #3411

TS-3	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.00

K.2.5.4 Internet Access

Inventory Table

	Region 1	2	3	4	5	State Total
Existing	0	1	0	0	0	1
STIP	0	0	0	0	0	0
Existing + STIP	0	1	0	0	0	1
Strategic Plan	0	0	0	0	0	0
Existing + Strategic Plan	0	1	0	0	0	1

Sensors

There are no unique sensors.

Communications

No unique communications links.

Field Processor/Controller

There are no field processors / controllers.

Software

ITS application server software. This may need continual updating to reflect new devices and deployments. This is estimated to require someone working approximately half-time.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	repair	job class
current	12.00	80.0	IS-6S	0.00	0.0	0.0	
future	12.00	80.0	IS-6S	0.00	0.0	0.0	

Center Sub-Systems

ITS application server: This machine pulls data for TripCheck from various remote servers (including RWIS and cameras). The server will need regular re-booting and occasional repair activities.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	repair	job class
current	52.00	1.0	IS-6S	1.00	6.0	0.0	SC-I-D
				0.30	4.8	0.0	IS-6S
				0.06	4.3	0.0	IS-7S
				0.70	0.0	2.0	SC-I-R
				0.59	0.0	1.6	IS-6S
				0.12	0.0	1.4	IS-7S
future	52.00	1.0	IS-6S	1.00	6.0	0.0	SC-I-D
				0.10	4.8	0.0	IS-6S
				0.02	4.3	0.0	IS-7S
				0.90	0.0	2.0	SC-I-R
				0.44	0.0	1.6	IS-6S
				0.06	0.0	1.4	IS-7S

Information Delivery

There are no unique information delivery systems.

Summary

current

Preventative Maintenance			Repair Maintenance		
visits per yr	hrs per visit	job class	visits per yr	hrs per visit	job class
0.00	0.0	SC-I-D	1.00	6.0	SC-I-D
0.00	0.0	SC-I-R	0.70	2.0	SC-I-R
52.00	19.5	IS-6S	0.59	4.0	IS-6S
0.00	0.0	IS-7S	0.12	3.6	IS-7S

future

Preventative Maintenance			Repair Maintenance		
visits per yr	hrs per visit	job class	visits per yr	hrs per visit	job class
0.00	0.0	SC-I-D	1.00	6.0	SC-I-D
0.00	0.0	SC-I-R	0.90	2.0	SC-I-R
52.00	19.5	IS-6S	0.44	2.7	IS-6S
0.00	0.0	IS-7S	0.06	2.8	IS-7S

Travel Time

No travel time is necessary for maintenance.

Staffing Needs (FTE)

Support Coordinator / IS-Diag (SC-I-D) - DAS # SC-I-D

	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.00

Support Coordinator / IS-Repair (SC-I-R) - DAS # SC-I-R

	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.00

Info Services 6 - Software (IS-6S) - DAS #1486 IS-6S

	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.62	0.00	0.00	0.00	0.62
Existing + STIP	0.00	0.62	0.00	0.00	0.00	0.62
Existing + Strategic Plan	0.00	0.62	0.00	0.00	0.00	0.62

Info Services 7 - Software (IS-7S) - DAS #1487						IS-7S
	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.00

K.2.5.5 Kiosks

Inventory Table

Kiosks

	Region					State
	1	2	3	4	5	Total
Existing	0	0	0	0	0	0
STIP	0	0	0	0	0	0
Existing + STIP	0	0	0	0	0	0
Strategic Plan	117	30	30	30	30	237
Existing + Strategic Plan	117	30	30	30	30	237

Kiosk Servers

	Region					State
	1	2	3	4	5	Total
Existing	0	0	0	0	0	0
STIP	0	0	0	0	0	0
Existing + STIP	0	0	0	0	0	0
Strategic Plan	0	1	0	0	0	1
Existing + Strategic Plan	0	1	0	0	0	1

Sensors

User interface: Touch screen will need regular cleaning, and occasional replacement due to vandalism. Maintenance included as part of field processor/controller.

Communications

Network: Telephone lines used to provide regular updates of data on machine, as well as allow for real-time downloading of latest information. No applicable preventative maintenance. Repair maintenance includes replacing cables and network components such as routers and modems. It is assumed problems are more frequent at kiosks, due to unforeseen cabinet relocation.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	repair	job class
current	1.00	1.0	IS-K	0.50	3.8	0.0	IS-K
				0.15	3.0	0.0	IS-5N
				0.03	2.7	0.0	IS-6N
				0.35	0.0	1.3	IS-K
				0.30	0.0	1.0	IS-5N
				0.06	0.0	0.9	IS-6N
future	1.00	1.0	IS-K	0.50	3.8	0.0	IS-K
				0.05	3.0	0.0	IS-5N
				0.01	2.7	0.0	IS-6N
				0.45	0.0	1.3	IS-K
				0.22	0.0	1.0	IS-5N
				0.03	0.0	0.9	IS-6N

Field Processor/Controller

Local RPU: Includes Web interface, user interface. Regular cleaning and visual inspection of components is recommended for preventative maintenance. Repair needs will be replacement of components due to failure and/or vandalism, as well as occasional re-setting.

Thermal printer: Preventative maintenance includes filling paper and checking print quality. Repair maintenance includes fixing paper jams, toner, and printer replacement as necessary.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	repair	job class
current	12.00	0.2	IS-K	1.00	2.0	0.0	IS-K
				0.30	1.6	0.0	IS-5N
				0.06	1.4	0.0	IS-6N
				0.70	0.0	1.0	IS-K
				0.59	0.0	0.8	IS-5N
				0.12	0.0	0.7	IS-6N
future	12.00	0.2	IS-K	1.00	2.0	0.0	IS-K
				0.10	1.6	0.0	IS-5N
				0.02	1.4	0.0	IS-6N
				0.90	0.0	1.0	IS-K
				0.44	0.0	0.8	IS-5N
				0.06	0.0	0.7	IS-6N

Software

Local software: May need upgrades. Debugging could be done centrally with updates applied as needed.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	repair	job class
current	0.50	4.0	IS-K	0.00	0.0	0.0	
future	0.50	4.0	IS-K	0.00	0.0	0.0	

Polling software: May need upgrades.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	repair	job class
current	0.50	4.0	SC-I-PM	0.00	0.0	0.0	
future	0.50	4.0	SC-I-PM	0.00	0.0	0.0	

Center Sub-Systems

Dedicated kiosk server: Used to provide information access to kiosks and to poll kiosks to see if they are working.

	Preventative Maintenance			Repair Maintenance			
	visits	hrs per	job	visits	hours per visit		job
	per yr	visit	class	per yr	diag.	repair	class
current	52.00	1.0	SC-I-PM	1.00	6.0	0.0	SC-I-D
				0.30	4.8	0.0	IS-5N
				0.06	4.3	0.0	IS-6N
				0.70	0.0	2.0	SC-I-R
				0.59	0.0	1.6	IS-5N
				0.12	0.0	1.4	IS-6N
future	52.00	1.0	SC-I-PM	1.00	6.0	0.0	SC-I-D
				0.10	4.8	0.0	IS-5N
				0.02	4.3	0.0	IS-6N
				0.90	0.0	2.0	SC-I-R
				0.44	0.0	1.6	IS-5N
				0.06	0.0	1.4	IS-6N

Information Delivery

Display covered under field controller/processor.

Summary

Kiosks

	Preventative Maintenance			Repair Maintenance		
	visits	hrs per	job	visits	hrs per	job
current	per yr	visit	class	per yr	visit	class
	12.00	0.5	IS-K	1.00	5.0	IS-K
	0.00	0.0	IS-5N	0.59	2.9	IS-5N
	0.00	0.0	IS-6N	0.12	2.6	IS-6N

	Preventative Maintenance			Repair Maintenance		
	visits	hrs per	job	visits	hrs per	job
future	per yr	visit	class	per yr	visit	class
	12.00	0.5	IS-K	1.00	5.3	IS-K
	0.00	0.0	IS-5N	0.44	2.0	IS-5N
	0.00	0.0	IS-6N	0.06	2.0	IS-6N

Kiosk Server

	Preventative Maintenance			Repair Maintenance		
	visits	hrs per	job	visits	hrs per	job
current	per yr	visit	class	per yr	visit	class
	0.00	0.0	SC-I-D	1.00	6.0	SC-I-D
	0.00	0.0	SC-I-R	0.70	2.0	SC-I-R
	52.00	1.0	SC-I-PM	0.00	0.0	SC-I-PM
	0.00	0.0	IS-5N	0.59	4.0	IS-5N
	0.00	0.0	IS-6N	0.12	3.6	IS-6N

future	Preventative Maintenance visits per yr	Preventative Maintenance hrs per visit	Preventative Maintenance job class	Repair Maintenance visits per yr	Repair Maintenance hrs per visit	Repair Maintenance job class
	0.00	0.0	SC-I-D	1.00	6.0	SC-I-D
	0.00	0.0	SC-I-R	0.90	2.0	SC-I-R
	52.00	1.0	SC-I-PM	0.00	0.0	SC-I-PM
	0.00	0.0	IS-5N	0.44	2.7	IS-5N
	0.00	0.0	IS-6N	0.06	2.8	IS-6N

Travel Time

Reduce by 75 percent for preventative maintenance because of wide device deployment.

Staffing Needs (FTE)

Support Coordinator / IS-Diag (SC-I-D) - DAS # — SC-I-D

	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.00

Support Coordinator / IS-Repair (SC-I-R) - DAS # — SC-I-R

	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.00

Support Coordinator / IS-Preventative Maintenance (SC-I-PM) - DAS # — SC-I-PM

	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.03	0.00	0.00	0.00	0.03

Info Services - Kiosk Specialist (IS-K) - DAS #1484 — IS-K

	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	1.42	0.49	0.53	0.74	0.65	3.83

Info Services 5 - Networks / Servers (IS-5N) - DAS #1485 — IS-5N

	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.16	0.06	0.06	0.10	0.08	0.46

Info Services 6 - Networks / Servers (IS-6N) - DAS #1486 — IS-6N

	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.02	0.01	0.01	0.01	0.01	0.07

K.2.6 En-Route Traveler Information

K.2.6.1 Icy Bridge Warning CMS

Inventory Table

	Region 1	2	3	4	5	State Total
Existing	0	0	1	0	0	1
STIP	0	0	0	0	0	0
Existing + STIP	0	0	1	0	0	1
Strategic Plan	0	0	0	0	0	0
Existing + Strategic Plan	0	0	1	0	0	1

Sensors

No sensors in use.

Communications

Local cable and wiring: Repair maintenance necessary rarely.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	1.00	2.0	SC-E-PM	0.50	1.5	0.0	SC-E-D
				0.15	1.2	0.0	ELEC
				0.03	1.1	0.0	TS-3
				0.35	0.0	3.0	SC-E-R
				0.30	0.0	2.4	ELEC
				0.06	0.0	1.9	TS-3
future	1.00	2.0	SC-E-PM	0.50	1.5	0.0	SC-E-D
				0.05	1.2	0.0	ELEC
				0.01	1.1	0.0	TS-3
				0.45	0.0	3.0	SC-E-R
				0.22	0.0	2.4	ELEC
				0.03	0.0	1.9	TS-3

Field Processor/Controller

Sign motor: Activated by remote switch. Preventative maintenance includes annual test.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	1.00	1.0	SC-E-PM	0.50	1.0	0.0	SC-E-D
				0.15	0.8	0.0	ELEC
				0.03	0.7	0.0	TS-3
				0.35	0.0	3.0	SC-E-R
				0.30	0.0	2.4	ELEC
				0.06	0.0	1.9	TS-3
future	1.00	1.0	SC-E-PM	0.50	1.0	0.0	SC-E-D
				0.05	0.8	0.0	ELEC
				0.01	0.7	0.0	TS-3
				0.45	0.0	3.0	SC-E-R
				0.22	0.0	2.4	ELEC
				0.03	0.0	1.9	TS-3

Software

No applicable software.

Center Sub-Systems

No center sub-system components.

Information Delivery

Sign: Maintenance covered under field processor/controller.

Summary

	Preventative Maintenance			Repair Maintenance		
current	visits per yr	hrs per visit	job class	visits per yr	hrs per visit	job class
	0.00	0.0	SC-E-D	0.50	2.5	SC-E-D
	0.00	0.0	SC-E-R	0.35	6.0	SC-E-R
	1.00	3.0	SC-E-PM	0.00	0.0	SC-E-PM
	0.00	0.0	ELEC	0.30	5.8	ELEC
	0.00	0.0	TS-3	0.06	4.7	TS-3

	Preventative Maintenance			Repair Maintenance		
future	visits per yr	hrs per visit	job class	visits per yr	hrs per visit	job class
	0.00	0.0	SC-E-D	0.50	2.5	SC-E-D
	0.00	0.0	SC-E-R	0.45	6.0	SC-E-R
	1.00	3.0	SC-E-PM	0.00	0.0	SC-E-PM
	0.00	0.0	ELEC	0.22	5.3	ELEC
	0.00	0.0	TS-3	0.03	4.4	TS-3

Staffing Needs (FTE)

Support Coordinator / Elec-Diag (SC-E-D) - DAS # — SC-E-D

	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.00

Support Coordinator / Elec-Repair (SC-E-R) - DAS # — SC-E-R

	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.00

Support Coordinator / Elec-Preventative Maintenance (SC-E-PM) - DAS # — SC-E-PM

	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.00

Electrician (ELEC) - DAS #4213 — ELEC

	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.00

Traffic Signal Technician 3 (TS-3) - DAS #3411 — TS-3

	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.00

K.2.6.2 Tunnel Lane Closure CMS

Inventory Table

	Region 1	2	3	4	5	State Total
Existing	1	0	0	0	0	1
STIP	0	0	0	0	0	0
Existing + STIP	1	0	0	0	0	1
Strategic Plan	0	0	0	0	0	0
Existing + Strategic Plan	1	0	0	0	0	1

Sensors

No sensors in use.

Communications

Local cable and wiring: Repair maintenance necessary rarely.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	repair	job class
current	1.00	2.0	SC-E-PM	0.50	1.5	0.0	SC-E-D
				0.15	1.2	0.0	ELEC
				0.03	1.1	0.0	TS-3
				0.35	0.0	3.0	SC-E-R
				0.30	0.0	2.4	ELEC
				0.06	0.0	1.9	TS-3
future	1.00	2.0	SC-E-PM	0.50	1.5	0.0	SC-E-D
				0.05	1.2	0.0	ELEC
				0.01	1.1	0.0	TS-3
				0.45	0.0	3.0	SC-E-R
				0.22	0.0	2.4	ELEC
				0.03	0.0	1.9	TS-3

Field Processor/Controller

Sign motor: Activated by remote switch. Preventative maintenance includes annual test.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	repair	job class
current	1.00	1.0	SC-E-PM	0.50	1.0	0.0	SC-E-D
				0.15	0.8	0.0	ELEC
				0.03	0.7	0.0	TS-3
				0.35	0.0	3.0	SC-E-R
				0.30	0.0	2.4	ELEC
				0.06	0.0	1.9	TS-3
future	1.00	1.0	SC-E-PM	0.50	1.0	0.0	SC-E-D
				0.05	0.8	0.0	ELEC
				0.01	0.7	0.0	TS-3
				0.45	0.0	3.0	SC-E-R
				0.22	0.0	2.4	ELEC
				0.03	0.0	1.9	TS-3

Software

No applicable software.

Center Sub-Systems

No center sub-system components.

Information Delivery

Sign: Maintenance covered under field processor/controller.

Summary

	Preventative Maintenance			Repair Maintenance		
current	visits per yr	hrs per visit	job class	visits per yr	hrs per visit	job class
	0.00	0.0	SC-E-D	0.50	2.5	SC-E-D
	0.00	0.0	SC-E-R	0.35	6.0	SC-E-R
	1.00	3.0	SC-E-PM	0.00	0.0	SC-E-PM
	0.00	0.0	ELEC	0.30	5.8	ELEC
	0.00	0.0	TS-3	0.06	4.7	TS-3

	Preventative Maintenance			Repair Maintenance		
future	visits per yr	hrs per visit	job class	visits per yr	hrs per visit	job class
	0.00	0.0	SC-E-D	0.50	2.5	SC-E-D
	0.00	0.0	SC-E-R	0.45	6.0	SC-E-R
	1.00	3.0	SC-E-PM	0.00	0.0	SC-E-PM
	0.00	0.0	ELEC	0.22	5.3	ELEC
	0.00	0.0	TS-3	0.03	4.4	TS-3

Staffing Needs (FTE)

Support Coordinator / Elec-Diag (SC-E-D) - DAS # SC-E-D

	Region 1	2	3	4	5	State Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.00

Support Coordinator / Elec-Repair (SC-E-R) - DAS # SC-E-R

	Region 1	2	3	4	5	State Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.00

Support Coordinator / Elec-Preventative Maintenance (SC-E-PM) - DAS # SC-E-PM

	Region 1	2	3	4	5	State Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.00

Electrician (ELEC) - DAS #4213 ELEC

	Region 1	2	3	4	5	State Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.00

Traffic Signal Technician 3 (TS-3) - DAS #3411 TS-3

	Region 1	2	3	4	5	State Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.00

K.2.6.3 Radio-Controlled Snow Zone CMS

Inventory Table

	Region					State
	1	2	3	4	5	Total
Existing	0	0	0	4	0	4
STIP	0	0	0	0	0	0
Existing + STIP	0	0	0	4	0	4
Strategic Plan	0	0	0	0	0	0
Existing + Strategic Plan	0	0	0	4	0	4

Sensors

No sensors used.

Communications

Assume that radio communications is used. Annual inspections are recommended along with repair as needed.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	1.00	0.5	IS-5R	0.25	1.0	0.0	SC-I-D
				0.08	0.8	0.0	IS-5R
				0.02	0.7	0.0	IS-6R
				0.18	0.0	3.0	SC-I-R
				0.15	0.0	2.4	IS-5R
				0.03	0.0	2.2	IS-6R
future	1.00	0.5	IS-5R	0.20	1.0	0.0	SC-I-D
				0.02	0.8	0.0	IS-5R
				0.00	0.7	0.0	IS-6R
				0.18	0.0	3.0	SC-I-R
				0.09	0.0	2.4	IS-5R
				0.01	0.0	2.2	IS-6R

Field Processor/Controller

No unique field processor/controller.

Software

No applicable software.

Center Sub-Systems

No applicable center sub-systems.

Information Delivery

Static sign with rotating drum: Annual preventative maintenance is recommended to test operations. Repair maintenance may be necessary only rarely if sign fails to function when required to.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	1.00	1.0	SC-E-PM	0.50	1.0	0.0	SC-E-D
				0.15	0.8	0.0	ELEC
				0.03	0.7	0.0	TS-3
				0.35	0.0	3.0	SC-E-R
				0.30	0.0	2.4	ELEC
				0.06	0.0	1.9	TS-3
future	1.00	1.0	SC-E-PM	0.50	1.0	0.0	SC-E-D
				0.05	0.8	0.0	ELEC
				0.01	0.7	0.0	TS-3
				0.45	0.0	3.0	SC-E-R
				0.22	0.0	2.4	ELEC
				0.03	0.0	1.9	TS-3

Summary

	Preventative Maintenance			Repair Maintenance		
current	visits per yr	hrs per visit	job class	visits per yr	hrs per visit	job class
	0.00	0.0	SC-I-D	0.25	1.0	SC-I-D
	0.00	0.0	SC-I-R	0.18	3.0	SC-I-R
	0.00	0.0	SC-E-D	0.50	1.0	SC-E-D
	0.00	0.0	SC-E-R	0.35	3.0	SC-E-R
	1.00	1.0	SC-E-PM	0.00	0.0	SC-E-PM
	1.00	0.5	IS-5R	0.15	2.8	IS-5R
	0.00	0.0	IS-6R	0.03	2.5	IS-6R
	0.00	0.0	ELEC	0.30	2.8	ELEC
	0.00	0.0	TS-3	0.06	2.3	TS-3

	Preventative Maintenance			Repair Maintenance		
future	visits per yr	hrs per visit	job class	visits per yr	hrs per visit	job class
	0.00	0.0	SC-I-D	0.20	1.0	SC-I-D
	0.00	0.0	SC-I-R	0.18	3.0	SC-I-R
	0.00	0.0	SC-E-D	0.50	1.0	SC-E-D
	0.00	0.0	SC-E-R	0.45	3.0	SC-E-R
	1.00	1.0	SC-E-PM	0.00	0.0	SC-E-PM
	1.00	0.5	IS-5R	0.09	2.6	IS-5R
	0.00	0.0	IS-6R	0.01	2.4	IS-6R
	0.00	0.0	ELEC	0.22	2.6	ELEC
	0.00	0.0	TS-3	0.03	2.1	TS-3

Travel Time

Reduce by 50 percent for preventative maintenance because of concentration of devices at Mt.

Staffing Needs (FTE)

Support Coordinator / IS-Diag (SC-I-D) - DAS #

	Region					SC-I-D State
	1	2	3	4	5	Total
Existing	0.00	0.00	0.00	0.01	0.00	0.01
Existing + STIP	0.00	0.00	0.00	0.01	0.00	0.01
Existing + Strategic Plan	0.00	0.00	0.00	0.01	0.00	0.01

Support Coordinator / IS-Repair (SC-I-R) - DAS #

	Region					SC-I-R State
	1	2	3	4	5	Total
Existing	0.00	0.00	0.00	0.01	0.00	0.01
Existing + STIP	0.00	0.00	0.00	0.01	0.00	0.01
Existing + Strategic Plan	0.00	0.00	0.00	0.01	0.00	0.01

Support Coordinator / Elec-Diag (SC-E-D) - DAS #

	Region					SC-E-D State
	1	2	3	4	5	Total
Existing	0.00	0.00	0.00	0.01	0.00	0.01
Existing + STIP	0.00	0.00	0.00	0.01	0.00	0.01
Existing + Strategic Plan	0.00	0.00	0.00	0.01	0.00	0.01

Support Coordinator / Elec-Repair (SC-E-R) - DAS #

	Region					SC-E-R State
	1	2	3	4	5	Total
Existing	0.00	0.00	0.00	0.01	0.00	0.01
Existing + STIP	0.00	0.00	0.00	0.01	0.00	0.01
Existing + Strategic Plan	0.00	0.00	0.00	0.01	0.00	0.01

Support Coordinator / Elec-Preventative Maintenance (SC-E-PM) - DAS #

	Region					SC-E-PM State
	1	2	3	4	5	Total
Existing	0.00	0.00	0.00	0.01	0.00	0.01
Existing + STIP	0.00	0.00	0.00	0.01	0.00	0.01
Existing + Strategic Plan	0.00	0.00	0.00	0.01	0.00	0.01

Info Services 5 - Radio Technician (IS-5R) - DAS #1485

	Region					IS-5R State
	1	2	3	4	5	Total
Existing	0.00	0.00	0.00	0.01	0.00	0.01
Existing + STIP	0.00	0.00	0.00	0.01	0.00	0.01
Existing + Strategic Plan	0.00	0.00	0.00	0.01	0.00	0.01

Info Services 6 - Radio Technician (IS-6R) - DAS #1486 — IS-6R

	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.00

Electrician (ELEC) - DAS #4213 — ELEC

	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	0.00	0.00	0.00	0.01	0.00	0.01
Existing + STIP	0.00	0.00	0.00	0.01	0.00	0.01
Existing + Strategic Plan	0.00	0.00	0.00	0.01	0.00	0.01

Traffic Signal Technician 3 (TS-3) - DAS #3411 — TS-3

	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.00

K.2.6.4 Telephone-Activated Snow Zone CMS

Inventory Table

	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	0	0	0	0	8	8
STIP	0	0	0	0	0	0
Existing + STIP	0	0	0	0	8	8
Strategic Plan	0	0	0	0	0	0
Existing + Strategic Plan	0	0	0	0	8	8

Sensors

No sensors.

Communications

Dial-up modem: Needs occasional repair maintenance.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	1.00	1.0	SC-I-PM	0.25	3.8	0.0	SC-I-D
				0.08	3.0	0.0	IS-5N
				0.02	2.7	0.0	IS-6N
				0.18	0.0	1.3	SC-I-R
				0.15	0.0	1.0	IS-5N
				0.03	0.0	0.9	IS-6N
future	1.00	1.0	SC-I-PM	0.25	3.8	0.0	SC-I-D
				0.03	3.0	0.0	IS-5N
				0.01	2.7	0.0	IS-6N
				0.23	0.0	1.3	SC-I-R
				0.11	0.0	1.0	IS-5N
				0.02	0.0	0.9	IS-6N

Field Processor/Controller

Controller: Rotates the drum and activates beacon depending upon signal from modem. Firmware will need no reprogramming. Preventative maintenance would focus on annual testing and cleaning. Repair maintenance may involve environmental exposure.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	1.00	1.0	SC-E-PM	0.50	1.0	0.0	SC-E-D
				0.15	0.8	0.0	ELEC
				0.03	0.7	0.0	TS-3
				0.35	0.0	3.0	SC-E-R
				0.30	0.0	2.4	ELEC
				0.06	0.0	1.9	TS-3
future	1.00	1.0	SC-E-PM	0.50	1.0	0.0	SC-E-D
				0.05	0.8	0.0	ELEC
				0.01	0.7	0.0	TS-3
				0.45	0.0	3.0	SC-E-R
				0.22	0.0	2.4	ELEC
				0.03	0.0	1.9	TS-3

Software

No software application.

Center Sub-Systems

No center sub-system components.

Information Delivery

Sign: Rotating drums need to be cleaned, motors need to be tested. Maintenance for this is included under field controller/processor.

Summary

	Preventative Maintenance			Repair Maintenance		
	visits	hrs per	job	visits	hrs per	job
current	per yr	visit	class	per yr	visit	class
	0.00	0.0	SC-I-D	0.25	3.8	SC-I-D
	0.00	0.0	SC-I-R	0.18	1.3	SC-I-R
	1.00	1.0	SC-I-PM	0.00	0.0	SC-I-PM
	0.00	0.0	SC-E-D	0.50	1.0	SC-E-D
	0.00	0.0	SC-E-R	0.35	3.0	SC-E-R
	1.00	1.0	SC-E-PM	0.00	0.0	SC-E-PM
	0.00	0.0	IS-5N	0.15	2.5	IS-5N
	0.00	0.0	IS-6N	0.03	2.3	IS-6N
	0.00	0.0	ELEC	0.30	2.8	ELEC
	0.00	0.0	TS-3	0.06	2.3	TS-3

future	Preventative Maintenance visits per yr	hrs per visit	job class	Repair Maintenance visits per yr	hrs per visit	job class
	0.00	0.0	SC-I-D	0.25	3.8	SC-I-D
	0.00	0.0	SC-I-R	0.23	1.3	SC-I-R
	1.00	1.0	SC-I-PM	0.00	0.0	SC-I-PM
	0.00	0.0	SC-E-D	0.50	1.0	SC-E-D
	0.00	0.0	SC-E-R	0.45	3.0	SC-E-R
	1.00	1.0	SC-E-PM	0.00	0.0	SC-E-PM
	0.00	0.0	IS-5N	0.11	1.7	IS-5N
	0.00	0.0	IS-6N	0.02	1.7	IS-6N
	0.00	0.0	ELEC	0.22	2.6	ELEC
	0.00	0.0	TS-3	0.03	2.1	TS-3

Travel Time

Reduce by 75 percent due to concentration of signs.

Staffing Needs (FTE)

Support Coordinator / IS-Diag (SC-I-D) - DAS # SC-I-D

	Region 1	2	3	4	5	State Total
Existing	0.00	0.00	0.00	0.00	0.01	0.01
Existing + STIP	0.00	0.00	0.00	0.00	0.01	0.01
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.01	0.01

Support Coordinator / IS-Repair (SC-I-R) - DAS # SC-I-R

	Region 1	2	3	4	5	State Total
Existing	0.00	0.00	0.00	0.00	0.01	0.01
Existing + STIP	0.00	0.00	0.00	0.00	0.01	0.01
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.01	0.01

Support Coordinator / IS-Preventative Maintenance (SC-I-PM) - DAS # SC-I-PM

	Region 1	2	3	4	5	State Total
Existing	0.00	0.00	0.00	0.00	0.01	0.01
Existing + STIP	0.00	0.00	0.00	0.00	0.01	0.01
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.01	0.01

Support Coordinator / Elec-Diag (SC-E-D) - DAS # SC-E-D

	Region 1	2	3	4	5	State Total
Existing	0.00	0.00	0.00	0.00	0.02	0.02
Existing + STIP	0.00	0.00	0.00	0.00	0.02	0.02
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.02	0.02

Support Coordinator / Elec-Repair (SC-E-R) - DAS # — SC-E-R

	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	0.00	0.00	0.00	0.00	0.02	0.02
Existing + STIP	0.00	0.00	0.00	0.00	0.02	0.02
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.02	0.02

Support Coordinator / Elec-Preventative Maintenance (SC-E-PM) - DAS # — SC-E-PM

	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	0.00	0.00	0.00	0.00	0.01	0.01
Existing + STIP	0.00	0.00	0.00	0.00	0.01	0.01
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.01	0.01

Info Services 5 - Networks / Servers (IS-5N) - DAS #1485 — IS-5N

	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	0.00	0.00	0.00	0.00	0.01	0.01
Existing + STIP	0.00	0.00	0.00	0.00	0.01	0.01
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.01	0.01

Info Services 6 - Networks / Servers (IS-6N) - DAS #1486 — IS-6N

	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.00

Electrician (ELEC) - DAS #4213 — ELEC

	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	0.00	0.00	0.00	0.00	0.02	0.02
Existing + STIP	0.00	0.00	0.00	0.00	0.02	0.02
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.01	0.01

Traffic Signal Technician 3 (TS-3) - DAS #3411 — TS-3

	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	0.00	0.00	0.00	0.00	0.01	0.01
Existing + STIP	0.00	0.00	0.00	0.00	0.01	0.01
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.00

K.2.6.5 Oversize Vehicle Restriction CMS

Inventory Table

	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	0	1	0	0	0	1
STIP	0	0	0	0	0	0
Existing + STIP	0	1	0	0	0	1
Strategic Plan	0	0	0	0	0	0
Existing + Strategic Plan	0	1	0	0	0	1

Sensors

No sensors are in use.

Communications

Assume that radio communications is used. Annual inspections are recommended along with repair as needed.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	1.00	0.5	IS-5R	0.25	1.0	0.0	SC-I-D
				0.08	0.8	0.0	IS-5R
				0.02	0.7	0.0	IS-6R
				0.18	0.0	3.0	SC-I-R
				0.15	0.0	2.4	IS-5R
				0.03	0.0	2.2	IS-6R
future	1.00	0.5	IS-5R	0.20	1.0	0.0	SC-I-D
				0.02	0.8	0.0	IS-5R
				0.00	0.7	0.0	IS-6R
				0.18	0.0	3.0	SC-I-R
				0.09	0.0	2.4	IS-5R
				0.01	0.0	2.2	IS-6R

Field Processor/Controller

No field processors / controllers.

Software

No applicable software.

Center Sub-Systems

No applicable software systems.

Information Delivery

Various display mechanisms: May be neon, rotating drum, or other display type. Maintenance needs are assumed to be similar to standard flashing becaon due to mechanical simplicity. However, repairs would be necessary more frequently due to age of deployments.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	repair	job class
current	1.00	1.0	SC-E-PM	1.00	1.0	0.0	SC-E-D
				0.30	0.8	0.0	ELEC
				0.06	0.7	0.0	TS-3
				0.70	0.0	3.0	SC-E-R
				0.59	0.0	2.4	ELEC
				0.12	0.0	1.9	TS-3
future	1.00	1.0	SC-E-PM	1.00	1.0	0.0	SC-E-D
				0.10	0.8	0.0	ELEC
				0.02	0.7	0.0	TS-3
				0.90	0.0	3.0	SC-E-R
				0.44	0.0	2.4	ELEC
				0.06	0.0	1.9	TS-3

Summary

	Preventative Maintenance			Repair Maintenance		
current	visits per yr	hrs per visit	job class	visits per yr	hrs per visit	job class
	0.00	0.0	SC-I-D	0.25	1.0	SC-I-D
	0.00	0.0	SC-I-R	0.18	3.0	SC-I-R
	0.00	0.0	SC-E-D	1.00	1.0	SC-E-D
	0.00	0.0	SC-E-R	0.70	3.0	SC-E-R
	1.00	1.0	SC-E-PM	0.00	0.0	SC-E-PM
	1.00	0.5	IS-5R	0.15	2.8	IS-5R
	0.00	0.0	IS-6R	0.03	2.5	IS-6R
	0.00	0.0	ELEC	0.59	2.8	ELEC
	0.00	0.0	TS-3	0.12	2.3	TS-3

	Preventative Maintenance			Repair Maintenance		
future	visits per yr	hrs per visit	job class	visits per yr	hrs per visit	job class
	0.00	0.0	SC-I-D	0.20	1.0	SC-I-D
	0.00	0.0	SC-I-R	0.18	3.0	SC-I-R
	0.00	0.0	SC-E-D	1.00	1.0	SC-E-D
	0.00	0.0	SC-E-R	0.90	3.0	SC-E-R
	1.00	1.0	SC-E-PM	0.00	0.0	SC-E-PM
	1.00	0.5	IS-5R	0.09	2.6	IS-5R
	0.00	0.0	IS-6R	0.01	2.4	IS-6R
	0.00	0.0	ELEC	0.44	2.6	ELEC
	0.00	0.0	TS-3	0.06	2.1	TS-3

Staffing Needs (FTE)

Support Coordinator / IS-Diag (SC-I-D) - DAS # — SC-I-D

	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.00

Support Coordinator / IS-Repair (SC-I-R) - DAS # — SC-I-R

	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.00

Support Coordinator / Elec-Diag (SC-E-D) - DAS # — SC-E-D

	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.00

Support Coordinator / Elec-Repair (SC-E-R) - DAS # — SC-E-R

	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.00

Support Coordinator / Elec-Preventative Maintenance (SC-E-PM) - DAS # — SC-E-PM

	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.00

Info Services 5 - Radio Technician (IS-5R) - DAS #1485 — IS-5R

	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.00

Info Services 6 - Radio Technician (IS-6R) - DAS #1486

IS-6R	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.00

Electrician (ELEC) - DAS #4213

ELEC	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.00

Traffic Signal Technician 3 (TS-3) - DAS #3411

TS-3	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.00

K.2.6.6 Permanent Variable Message Signs

Inventory Table

Signs

	Region					State
	1	2	3	4	5	Total
Existing	12	5	2	1	5	25
STIP	4	4	0	0	5	13
Existing + STIP	16	9	2	1	10	38
Strategic Plan	16	0	0	0	8	24
Existing + Strategic Plan	32	9	2	1	18	62

Note: ODOT is assumed to have no maintenance responsibility over CSEPP signs (Region 5 only) until after STIP expires, although they can currently be used for operations. It is assumed, as a worst case scenario, that ODOT would take over maintenance for all eight CSEPP-related VMS.

Centers

	Region					State
	1	2	3	4	5	Total
Existing	1	1	1	1	1	5
STIP	0	0	0	0	0	0
Existing + STIP	1	1	1	1	1	5
Strategic Plan	0	0	0	0	0	0
Existing + Strategic Plan	1	1	1	1	1	5

Sensors

No applicable sensors.

Communications

Routers, Modems, Communications: Preventative maintenance includes annual inspection. Repair maintenance includes component replacement to restore communications.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	1.00	1.0	SC-I-PM	0.25	3.8	0.0	SC-I-D
				0.08	3.0	0.0	IS-5N
				0.02	2.7	0.0	IS-6N
				0.18	0.0	1.3	SC-I-R
				0.15	0.0	1.0	IS-5N
				0.03	0.0	0.9	IS-6N
future	1.00	1.0	SC-I-PM	0.25	3.8	0.0	SC-I-D
				0.03	3.0	0.0	IS-5N
				0.01	2.7	0.0	IS-6N
				0.23	0.0	1.3	SC-I-R
				0.11	0.0	1.0	IS-5N
				0.02	0.0	0.9	IS-6N

Field Processor/Controller

Field processor is designed to display information. Maintenance needs are covered under information display.

Software

Software is used to translate and transmit messages from TOC console to the sign display. Software upgrades are rarely necessary, except for NTCIP compliance. Assume an average of three manufacturers per region, and each software package would be updated every ten years. Software is fairly unsophisticated, and would take half as long to install as other software packages.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	0.50	4.0	SC-I-PM	0.00	0.0	0.0	
future	0.50	4.0	SC-I-PM	0.00	0.0	0.0	

Center Sub-Systems

No center sub-systems.

Information Delivery

Sign: Preventative maintenance includes cleaning, checking display modules, inspection, etc. Repair maintenance is assumed to be easier in the future because of improved self-diagnostic capabilities. Repair frequency is expected to decrease in the future as lower-maintenance technologies are implemented on a greater scale.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	2.00	5.0	ELEC	3.00	1.0	0.0	SC-E-D
				0.90	0.8	0.0	ELEC
				0.18	0.7	0.0	TS-3
				2.10	0.0	3.0	SC-E-R
				1.77	0.0	2.4	ELEC
				0.36	0.0	1.9	TS-3
future	2.00	5.0	ELEC	1.00	0.5	0.0	SC-E-D
				0.10	0.4	0.0	ELEC
				0.02	0.4	0.0	TS-3
				2.70	0.0	2.0	SC-E-R
				1.32	0.0	1.6	ELEC
				0.19	0.0	1.3	TS-3

Summary

Field Units

current

Preventative Maintenance			Repair Maintenance		
visits per yr	hrs per visit	job class	visits per yr	hrs per visit	job class
0.00	0.0	SC-I-D	0.25	3.8	SC-I-D
0.00	0.0	SC-I-R	0.18	1.3	SC-I-R
1.00	1.0	SC-I-PM	0.00	0.0	SC-I-PM
0.00	0.0	SC-E-D	3.00	1.0	SC-E-D
0.00	0.0	SC-E-R	2.10	3.0	SC-E-R
0.00	0.0	IS-5N	0.15	2.5	IS-5N
0.00	0.0	IS-6N	0.03	2.3	IS-6N
2.00	5.0	ELEC	1.77	2.8	ELEC
0.00	0.0	TS-3	0.36	2.3	TS-3

future

Preventative Maintenance			Repair Maintenance		
visits per yr	hrs per visit	job class	visits per yr	hrs per visit	job class
0.00	0.0	SC-I-D	0.25	3.8	SC-I-D
0.00	0.0	SC-I-R	0.23	1.3	SC-I-R
1.00	1.0	SC-I-PM	0.00	0.0	SC-I-PM
0.00	0.0	SC-E-D	1.00	0.5	SC-E-D
0.00	0.0	SC-E-R	2.70	2.0	SC-E-R
0.00	0.0	IS-5N	0.11	1.7	IS-5N
0.00	0.0	IS-6N	0.02	1.7	IS-6N
2.00	5.0	ELEC	1.32	1.6	ELEC
0.00	0.0	TS-3	0.19	1.3	TS-3

Operation Centers

current

Preventative Maintenance			Repair Maintenance		
visits per yr	hrs per visit	job class	visits per yr	hrs per visit	job class
0.50	4.0	SC-I-PM	0.00	0.0	SC-I-PM

future

Preventative Maintenance			Repair Maintenance		
visits per yr	hrs per visit	job class	visits per yr	hrs per visit	job class
0.50	4.0	SC-I-PM	0.00	0.0	SC-I-PM

Travel Time

Reduced by 50 percent for preventative maintenance in Regions 1, 2 and 5 due to widespread device deployment.

Staffing Needs (FTE)

Support Coordinator / IS-Diag (SC-I-D) - DAS #

SC-I-D	Region 1	2	3	4	5	State Total
Existing	0.01	0.01	0.00	0.00	0.01	0.03
Existing + STIP	0.02	0.01	0.00	0.00	0.02	0.05
Existing + Strategic Plan	0.03	0.01	0.00	0.00	0.03	0.08

Support Coordinator / IS-Repair (SC-I-R) - DAS #

SC-I-R	Region 1	2	3	4	5	State Total
Existing	0.01	0.00	0.00	0.00	0.01	0.02
Existing + STIP	0.01	0.01	0.00	0.00	0.01	0.03
Existing + Strategic Plan	0.02	0.01	0.00	0.00	0.02	0.05

Support Coordinator / IS-Preventative Maintenance (SC-I-PM) - DAS #

SC-I-PM	Region 1	2	3	4	5	State Total
Existing	0.02	0.01	0.01	0.01	0.01	0.05
Existing + STIP	0.02	0.02	0.01	0.01	0.02	0.07
Existing + Strategic Plan	0.04	0.02	0.01	0.01	0.04	0.11

Support Coordinator / Elec-Diag (SC-E-D) - DAS #

SC-E-D	Region 1	2	3	4	5	State Total
Existing	0.09	0.06	0.03	0.02	0.09	0.28
Existing + STIP	0.12	0.10	0.03	0.02	0.17	0.44
Existing + Strategic Plan	0.07	0.03	0.01	0.01	0.10	0.21

Support Coordinator / Elec-Repair (SC-E-R) - DAS #

SC-E-R	Region 1	2	3	4	5	State Total
Existing	0.09	0.05	0.02	0.02	0.07	0.26
Existing + STIP	0.12	0.10	0.02	0.02	0.15	0.40
Existing + Strategic Plan	0.27	0.11	0.03	0.02	0.31	0.73

Info Services 5 - Networks / Servers (IS-5N) - DAS #1485

IS-5N	Region 1	2	3	4	5	State Total
Existing	0.01	0.00	0.00	0.00	0.00	0.02
Existing + STIP	0.01	0.01	0.00	0.00	0.01	0.03
Existing + Strategic Plan	0.01	0.00	0.00	0.00	0.01	0.03

Info Services 6 - Networks / Servers (IS-6N) - DAS #1486 — IS-6N

	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.01
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.00

Electrician (ELEC) - DAS #4213 — ELEC

	Region					State
	1	2	3	4	5	Total
Existing	0.16	0.09	0.04	0.03	0.11	0.43
Existing + STIP	0.22	0.15	0.04	0.03	0.22	0.66
Existing + Strategic Plan	0.36	0.12	0.03	0.02	0.32	0.85

Traffic Signal Technician 3 (TS-3) - DAS #3411 — TS-3

	Region					State
	1	2	3	4	5	Total
Existing	0.01	0.01	0.01	0.00	0.02	0.05
Existing + STIP	0.02	0.01	0.01	0.00	0.04	0.08
Existing + Strategic Plan	0.02	0.01	0.00	0.00	0.04	0.06

K.2.6.7 Portable Variable Message Signs

Inventory Table

Signs

	Region					State
	1	2	3	4	5	Total
Existing	1	19	0	3	0	23
STIP	0	0	0	2	0	2
Existing + STIP	1	19	0	5	0	25
Strategic Plan	60	80	100	97	100	437
Existing + Strategic Plan	61	99	100	102	100	462

Centers

	Region					State
	1	2	3	4	5	Total
Existing	1	1	0	1	0	3
STIP	0	0	0	0	0	0
Existing + STIP	1	1	0	1	0	3
Strategic Plan	0	0	1	0	1	2
Existing + Strategic Plan	1	1	1	1	1	5

Sensors

No unique sensors.

Communications

Cellular modems: No unique PM for communications is recommended because problems should be evident during weekly operational tests and periodic checks by electricians. Repair maintenance is expected to be more frequent than other communications systems based on ODOT experience with the effects of transport on cellular modems, although it is expected to take less time. Repair should be less frequent in the future.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	0.00	0.0		2.00	3.8	0.0	SC-I-D
				0.60	3.0	0.0	IS-5N
				0.12	2.7	0.0	IS-6N
				1.40	0.0	1.3	SC-I-R
				1.18	0.0	1.0	IS-5N
				0.24	0.0	0.9	IS-6N
future	0.00	0.0		1.00	3.8	0.0	SC-I-D
				0.10	3.0	0.0	IS-5N
				0.02	2.7	0.0	IS-6N
				0.90	0.0	1.3	SC-I-R
				0.44	0.0	1.0	IS-5N
				0.06	0.0	0.9	IS-6N

Field Processor/Controller

Weekly operational tests are recommended to ensure sign is ready to be dispatched immediately. This may reveal repair needs which can be addressed quickly. These may done remotely.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	repair	job class
current	52.00	0.3	SC-P	0.00	0.0	0.0	
future	52.00	0.3	SC-P	0.00	0.0	0.0	

Software

Software to program messages onto signs: May need to be upgraded on a rare occasion. Upgrades should occur rarely - i.e. at same frequency as permanent VMS.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	repair	job class
current	0.50	4.0	SC-I-PM	0.00	0.0	0.0	
future	0.50	4.0	SC-I-PM	0.00	0.0	0.0	

Center Sub-Systems

No unique center sub-systems.

Information Delivery

Sign display: Preventative maintenance recommended to check for corrosion, leakage, etc. Repair maintenance may include replacement of some boards. PM will be more frequent but less time-consuming than PM for overhead VMS due to greater environmental exposure but easier access. Repair maintenance will be less frequent than overhead VMS. Repair maintenance in the future will be less frequent still due to better protection against vibration.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	repair	job class
current	4.00	1.3	SC-E-PM	2.00	1.0	0.0	SC-E-D
				0.60	0.8	0.0	ELEC
				0.12	0.7	0.0	TS-3
				1.40	1.0	0.0	SC-E-R
				1.18	0.8	0.0	ELEC
				0.24	0.7	0.0	TS-3
future	4.00	1.3	SC-E-PM	1.00	0.5	0.0	SC-E-D
				0.10	0.4	0.0	ELEC
				0.02	0.4	0.0	TS-3
				0.90	0.5	0.0	SC-E-R
				0.44	0.4	0.0	ELEC
				0.06	0.4	0.0	TS-3

Summary

Field units

current

Preventative Maintenance			Repair Maintenance		
visits per yr	hrs per visit	job class	visits per yr	hrs per visit	job class
0.00	0.0	SC-I-D	2.00	3.8	SC-I-D
0.00	0.0	SC-I-R	1.40	1.3	SC-I-R
0.00	0.0	SC-E-D	2.00	1.0	SC-E-D
0.00	0.0	SC-E-R	1.40	1.0	SC-E-R
4.00	1.3	SC-E-PM	0.00	0.0	SC-E-PM
52.00	0.3	SC-P	0.00	0.0	SC-P
0.00	0.0	IS-5N	1.18	2.5	IS-5N
0.00	0.0	IS-6N	0.24	2.3	IS-6N
0.00	0.0	ELEC	1.18	1.2	ELEC
0.00	0.0	TS-3	0.24	1.1	TS-3

future

Preventative Maintenance			Repair Maintenance		
visits per yr	hrs per visit	job class	visits per yr	hrs per visit	job class
0.00	0.0	SC-I-D	1.00	3.8	SC-I-D
0.00	0.0	SC-I-R	0.90	1.3	SC-I-R
0.00	0.0	SC-E-D	1.00	0.5	SC-E-D
0.00	0.0	SC-E-R	0.90	0.5	SC-E-R
4.00	1.3	SC-E-PM	0.00	0.0	SC-E-PM
52.00	0.3	SC-P	0.00	0.0	SC-P
0.00	0.0	IS-5N	0.44	1.7	IS-5N
0.00	0.0	IS-6N	0.06	1.7	IS-6N
0.00	0.0	ELEC	0.44	0.5	ELEC
0.00	0.0	TS-3	0.06	0.5	TS-3

Centers

current

Preventative Maintenance			Repair Maintenance		
visits per yr	hrs per visit	job class	visits per yr	hrs per visit	job class
0.50	4.0	SC-I-PM	0.00	0.0	SC-I-PM

future

Preventative Maintenance			Repair Maintenance		
visits per yr	hrs per visit	job class	visits per yr	hrs per visit	job class
0.50	4.0	SC-I-PM	0.00	0.0	SC-I-PM

Travel Time

No travel time for preventative maintenance; it is assumed that operational tests can be done without additional travel time, and that preventative maintenance would be performed when maintenance staff are performing other functions in the area.

Staffing Needs (FTE)

Support Coordinator / IS-Diag (SC-I-D) - DAS # SC-I-D

	Region 1	2	3	4	5	State Total
Existing	0.01	0.21	0.00	0.05	0.00	0.27
Existing + STIP	0.01	0.21	0.00	0.08	0.00	0.30
Existing + Strategic Plan	0.25	0.55	0.60	0.85	0.74	2.98

Support Coordinator / IS-Repair (SC-I-R) - DAS # SC-I-R

	Region 1	2	3	4	5	State Total
Existing	0.00	0.11	0.00	0.03	0.00	0.14
Existing + STIP	0.00	0.11	0.00	0.05	0.00	0.16
Existing + Strategic Plan	0.14	0.36	0.40	0.62	0.53	2.05

Support Coordinator / IS-Preventative Maintenance (SC-I-PM) - DAS # SC-I-PM

	Region 1	2	3	4	5	State Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.01

Support Coordinator / Elec-Diag (SC-E-D) - DAS # SC-E-D

	Region 1	2	3	4	5	State Total
Existing	0.00	0.15	0.00	0.04	0.00	0.19
Existing + STIP	0.00	0.15	0.00	0.07	0.00	0.22
Existing + Strategic Plan	0.13	0.35	0.40	0.64	0.54	2.06

Support Coordinator / Elec-Repair (SC-E-R) - DAS # SC-E-R

	Region 1	2	3	4	5	State Total
Existing	0.00	0.10	0.00	0.03	0.00	0.13
Existing + STIP	0.00	0.10	0.00	0.05	0.00	0.15
Existing + Strategic Plan	0.12	0.31	0.36	0.58	0.48	1.85

Support Coordinator / Elec-Preventative Maintenance (SC-E-PM) - DAS # SC-E-PM

	Region 1	2	3	4	5	State Total
Existing	0.00	0.06	0.00	0.01	0.00	0.07
Existing + STIP	0.00	0.06	0.00	0.02	0.00	0.08
Existing + Strategic Plan	0.19	0.30	0.31	0.31	0.31	1.42

Support Coordinator / Program Technician (SC-P) - DAS # — SC-P

	Region					State
	1	2	3	4	5	Total
Existing	0.01	0.18	0.00	0.03	0.00	0.22
Existing + STIP	0.01	0.18	0.00	0.05	0.00	0.24
Existing + Strategic Plan	0.58	0.95	0.96	0.98	0.96	4.43

Info Services 5 - Networks / Servers (IS-5N) - DAS #1485 — IS-5N

	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.11	0.00	0.03	0.00	0.14
Existing + STIP	0.00	0.11	0.00	0.04	0.00	0.16
Existing + Strategic Plan	0.08	0.19	0.21	0.32	0.27	1.05

Info Services 6 - Networks / Servers (IS-6N) - DAS #1486 — IS-6N

	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.02	0.00	0.01	0.00	0.03
Existing + STIP	0.00	0.02	0.00	0.01	0.00	0.03
Existing + Strategic Plan	0.01	0.03	0.03	0.05	0.04	0.15

Electrician (ELEC) - DAS #4213 — ELEC

	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.09	0.00	0.02	0.00	0.12
Existing + STIP	0.00	0.09	0.00	0.04	0.00	0.13
Existing + Strategic Plan	0.06	0.15	0.18	0.28	0.24	0.91

Traffic Signal Technician 3 (TS-3) - DAS #3411 — TS-3

	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.01	0.00	0.01	0.00	0.02
Existing + STIP	0.00	0.01	0.00	0.01	0.00	0.02
Existing + Strategic Plan	0.01	0.02	0.04	0.04	0.06	0.17

K.2.6.8 Highway Advisory Radio

Inventory Table

	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	0	0	1	0	0	1
STIP	0	0	0	0	0	0
Existing + STIP	0	0	1	0	0	1
Strategic Plan	0	0	0	0	0	0
Existing + Strategic Plan	0	0	1	0	0	1

Sensors

No applicable sensors.

Communications

Radio transmitter: Annual maintenance check reviews power level.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	1.00	0.5	IS-5R	0.25	1.0	0.0	SC-I-D
				0.08	0.8	0.0	IS-5R
				0.02	0.7	0.0	IS-6R
				0.18	0.0	3.0	SC-I-R
				0.15	0.0	2.4	IS-5R
				0.03	0.0	2.2	IS-6R
future	1.00	0.5	IS-5R	0.20	1.0	0.0	SC-I-D
				0.02	0.8	0.0	IS-5R
				0.00	0.7	0.0	IS-6R
				0.18	0.0	3.0	SC-I-R
				0.09	0.0	2.4	IS-5R
				0.01	0.0	2.2	IS-6R

Field Processor/Controller

Recorder / player unit: Maintenance needs assumed to be similar to communications equipment (i.e. modems)

	Preventative Maintenance			Repair Maintenance			
	visits	hrs per	job	visits	hours per visit		job
	per yr	visit	class	per yr	diag.	repair	class
current	1.00	1.0	SC-I-PM	0.25	3.8	0.0	SC-I-D
				0.08	3.0	0.0	IS-5N
				0.02	2.7	0.0	IS-6N
				0.18	0.0	1.3	SC-I-R
				0.15	0.0	1.0	IS-5N
				0.03	0.0	0.9	IS-6N
future	1.00	1.0	SC-I-PM	0.25	3.8	0.0	SC-I-D
				0.03	3.0	0.0	IS-5N
				0.01	2.7	0.0	IS-6N
				0.23	0.0	1.3	SC-I-R
				0.11	0.0	1.0	IS-5N
				0.02	0.0	0.9	IS-6N

Software

No software.

Center Sub-Systems

No applicable center sub-systems.

Information Delivery

Static sign: Maintenance covered by existing procedures.

Flashing beacons: Annual testing and bulb replacement.

	Preventative Maintenance			Repair Maintenance			
	visits	hrs per	job	visits	hours per visit		job
	per yr	visit	class	per yr	diag.	repair	class
current	1.00	1.0	SC-E-PM	0.50	1.0	0.0	SC-E-D
				0.15	0.8	0.0	ELEC
				0.03	0.7	0.0	TS-3
				0.35	0.0	3.0	SC-E-R
				0.30	0.0	2.4	ELEC
				0.06	0.0	1.9	TS-3
future	1.00	1.0	SC-E-PM	0.50	1.0	0.0	SC-E-D
				0.05	0.8	0.0	ELEC
				0.01	0.7	0.0	TS-3
				0.45	0.0	3.0	SC-E-R
				0.22	0.0	2.4	ELEC
				0.03	0.0	1.9	TS-3

Summary

current	Preventative Maintenance			Repair Maintenance		
	visits per yr	hrs per visit	job class	visits per yr	hrs per visit	job class
	0.00	0.0	SC-I-D	0.25	4.8	SC-I-D
	0.00	0.0	SC-I-R	0.18	4.3	SC-I-R
	1.00	1.0	SC-I-PM	0.00	0.0	SC-I-PM
	0.00	0.0	SC-E-D	0.50	1.0	SC-E-D
	0.00	0.0	SC-E-R	0.35	3.0	SC-E-R
	1.00	1.0	SC-E-PM	0.00	0.0	SC-E-PM
	1.00	0.5	IS-5R	0.15	2.8	IS-5R
	0.00	0.0	IS-5N	0.15	2.5	IS-5N
	0.00	0.0	IS-6R	0.03	2.5	IS-6R
	0.00	0.0	IS-6N	0.03	2.3	IS-6N
	0.00	0.0	ELEC	0.30	2.8	ELEC
	0.00	0.0	TS-3	0.06	2.3	TS-3

future	Preventative Maintenance			Repair Maintenance		
	visits per yr	hrs per visit	job class	visits per yr	hrs per visit	job class
	0.00	0.0	SC-I-D	0.25	4.6	SC-I-D
	0.00	0.0	SC-I-R	0.23	3.7	SC-I-R
	1.00	1.0	SC-I-PM	0.00	0.0	SC-I-PM
	0.00	0.0	SC-E-D	0.50	1.0	SC-E-D
	0.00	0.0	SC-E-R	0.45	3.0	SC-E-R
	1.00	1.0	SC-E-PM	0.00	0.0	SC-E-PM
	1.00	0.5	IS-5R	0.09	2.6	IS-5R
	0.00	0.0	IS-5N	0.11	1.7	IS-5N
	0.00	0.0	IS-6R	0.01	2.4	IS-6R
	0.00	0.0	IS-6N	0.02	1.7	IS-6N
	0.00	0.0	ELEC	0.22	2.6	ELEC
	0.00	0.0	TS-3	0.03	2.1	TS-3

Travel Time

All travel times are 1.5 hrs.

Staffing Needs (FTE)

Support Coordinator / IS-Diag (SC-I-D) - DAS # SC-I-D

	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.00

Support Coordinator / IS-Repair (SC-I-R) - DAS #

SC-I-R

	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.00

Support Coordinator / IS-Preventative Maintenance (SC-I-PM) - DAS #

SC-I-PM

	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.00

Support Coordinator / Elec-Diag (SC-E-D) - DAS #

SC-E-D

	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.00

Support Coordinator / Elec-Repair (SC-E-R) - DAS #

SC-E-R

	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.00

Support Coordinator / Elec-Preventative Maintenance (SC-E-PM) - DAS #

SC-E-PM

	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.00

Info Services 5 - Radio Technician (IS-5R) - DAS #1485

IS-5R

	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.00

Info Services 5 - Networks / Servers (IS-5N) - DAS #1485 — IS-5N

	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.00

Info Services 6 - Radio Technician (IS-6R) - DAS #1486 — IS-6R

	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.00

Info Services 6 - Networks / Servers (IS-6N) - DAS #1486 — IS-6N

	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.00

Electrician (ELEC) - DAS #4213 — ELEC

	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.00

Traffic Signal Technician 3 (TS-3) - DAS #3411 — TS-3

	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.00

K.2.6.9 Icy Bridge Detectors

Inventory Table

	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	1	0	0	0	0	1
STIP	0	0	0	0	0	0
Existing + STIP	1	0	0	0	0	1
Strategic Plan	4	4	4	4	4	20
Existing + Strategic Plan	5	4	4	4	4	21

Sensors

Air temperature and relative humidity sensors: Humidity sensor needs to be cleaned and wetted annually.

Precipitation sensors: Lenses need to be cleaned annually.

Pavement surface sensors: Sensor needs to be wiped off so it will accurately show dry vs. wet pavement.

All sensors need to be cleaned, tested and calibrated annually. Lightning strikes, re-paving other factors may necessitate sensor replacement.

Will take approximately 3/4 of time as full RWIS.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	1.00	2.3	ELEC	0.19	1.0	0.0	SC-E-D
				0.06	0.8	0.0	ELEC
				0.01	0.7	0.0	TS-3
				0.13	0.0	4.0	SC-E-R
				0.11	0.0	3.2	ELEC
				0.02	0.0	2.6	TS-3
future	1.00	2.3	ELEC	0.19	1.0	0.0	SC-E-D
				0.02	0.8	0.0	ELEC
				0.00	0.7	0.0	TS-3
				0.17	0.0	4.0	SC-E-R
				0.08	0.0	3.2	ELEC
				0.01	0.0	2.6	TS-3

Communications

Routers, Modems, Communications: Preventative maintenance includes annual inspection. Repair maintenance includes component replacement to restore communications.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	1.00	1.0	SC-I-PM	0.25	3.8	0.0	SC-I-D
				0.08	3.0	0.0	IS-5N
				0.02	2.7	0.0	IS-6N
				0.18	0.0	1.3	SC-I-R
				0.15	0.0	1.0	IS-5N
				0.03	0.0	0.9	IS-6N
future	1.00	1.0	SC-I-PM	0.25	3.8	0.0	SC-I-D
				0.03	3.0	0.0	IS-5N
				0.01	2.7	0.0	IS-6N
				0.23	0.0	1.3	SC-I-R
				0.11	0.0	1.0	IS-5N
				0.02	0.0	0.9	IS-6N

Field Processor/Controller

RPU: Maintenance needs are half of RWIS RPU because of seasonal usage. Preventative maintenance should take half as long as typical RPUs due to fewer diagnostic needs.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	3.00	0.5	SC-I-PM	0.50	2.0	0.0	SC-I-D
				0.15	1.6	0.0	IS-5N
				0.03	1.4	0.0	IS-6N
				0.35	0.0	1.0	SC-I-R
				0.30	0.0	0.8	IS-5N
				0.06	0.0	0.7	IS-6N
future	3.00	0.5	SC-I-PM	0.50	2.0	0.0	SC-I-D
				0.05	1.6	0.0	IS-5N
				0.01	1.4	0.0	IS-6N
				0.45	0.0	1.0	SC-I-R
				0.22	0.0	0.8	IS-5N
				0.03	0.0	0.7	IS-6N

Software

Local software: Used to collect sensor data and transmit data to regional server.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	0.50	4.0	SC-I-PM	0.00	0.0	0.0	
future	0.50	4.0	SC-I-PM	0.00	0.0	0.0	

Database applications: Assume that this system could use existing RWIS database. No additional maintenance would be required.

Center Sub-Systems

Regional servers: Assume that this would utilize existing RWIS servers. No additional maintenance would be required.

Information Delivery

Static sign with flashing beacon: Annual preventative maintenance includes testing, bulb replacement. Assumed to be identical to HAR flashing beacon.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	1.00	1.0	SC-E-PM	0.50	1.0	0.0	SC-E-D
				0.15	0.8	0.0	ELEC
				0.03	0.7	0.0	TS-3
				0.35	0.0	3.0	SC-E-R
				0.30	0.0	2.4	ELEC
				0.06	0.0	1.9	TS-3
future	1.00	1.0	SC-E-PM	0.50	1.0	0.0	SC-E-D
				0.05	0.8	0.0	ELEC
				0.01	0.7	0.0	TS-3
				0.45	0.0	3.0	SC-E-R
				0.22	0.0	2.4	ELEC
				0.03	0.0	1.9	TS-3

Summary

	Preventative Maintenance			Repair Maintenance		
current	visits per yr	hrs per visit	job class	visits per yr	hrs per visit	job class
	0.00	0.0	SC-I-D	0.50	3.9	SC-I-D
	0.00	0.0	SC-I-R	0.35	1.6	SC-I-R
	3.00	1.5	SC-I-PM	0.00	0.0	SC-I-PM
	0.00	0.0	SC-E-D	0.50	1.4	SC-E-D
	0.00	0.0	SC-E-R	0.35	4.5	SC-E-R
	1.00	1.0	SC-E-PM	0.00	0.0	SC-E-PM
	0.00	0.0	IS-5N	0.30	2.9	IS-5N
	0.00	0.0	IS-6N	0.06	2.6	IS-6N
	1.00	2.3	ELEC	0.30	4.2	ELEC
	0.00	0.0	TS-3	0.06	3.4	TS-3

future	Preventative Maintenance visits per yr	Preventative Maintenance hrs per visit	Preventative Maintenance job class	Repair Maintenance visits per yr	Repair Maintenance hrs per visit	Repair Maintenance job class
	0.00	0.0	SC-I-D	0.50	3.9	SC-I-D
	0.00	0.0	SC-I-R	0.45	1.6	SC-I-R
	3.00	1.5	SC-I-PM	0.00	0.0	SC-I-PM
	0.00	0.0	SC-E-D	0.50	1.4	SC-E-D
	0.00	0.0	SC-E-R	0.45	4.5	SC-E-R
	1.00	1.0	SC-E-PM	0.00	0.0	SC-E-PM
	0.00	0.0	IS-5N	0.22	2.0	IS-5N
	0.00	0.0	IS-6N	0.03	2.0	IS-6N
	1.00	2.3	ELEC	0.22	3.9	ELEC
	0.00	0.0	TS-3	0.03	3.2	TS-3

Staffing Needs (FTE)

Support Coordinator / IS-Diag (SC-I-D) - DAS # SC-I-D

	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.01	0.01	0.01	0.02	0.01	0.07

Support Coordinator / IS-Repair (SC-I-R) - DAS # SC-I-R

	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.01	0.01	0.01	0.01	0.01	0.05

Support Coordinator / IS-Preventative Maintenance (SC-I-PM) - DAS # SC-I-PM

	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.01	0.00	0.00	0.00	0.00	0.01
Existing + Strategic Plan	0.03	0.04	0.04	0.06	0.05	0.22

Support Coordinator / Elec-Diag (SC-E-D) - DAS # SC-E-D

	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.01	0.01	0.01	0.01	0.01	0.05

Support Coordinator / Elec-Repair (SC-E-R) - DAS # SC-E-R

	Region 1	2	3	4	5	State Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.01	0.01	0.01	0.02	0.01	0.06

Support Coordinator / Elec-Preventative Maintenance (SC-E-PM) - DAS # SC-E-PM

	Region 1	2	3	4	5	State Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.01	0.01	0.01	0.02	0.02	0.07

Info Services 5 - Networks / Servers (IS-5N) - DAS #1485 IS-5N

	Region 1	2	3	4	5	State Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.00	0.00	0.01	0.01	0.02

Info Services 6 - Networks / Servers (IS-6N) - DAS #1486 IS-6N

	Region 1	2	3	4	5	State Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.00

Electrician (ELEC) - DAS #4213 ELEC

	Region 1	2	3	4	5	State Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.02	0.02	0.02	0.03	0.03	0.11

Traffic Signal Technician 3 (TS-3) - DAS #3411 TS-3

	Region 1	2	3	4	5	State Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.00

K.2.6.10 Oversize Load Detector

Inventory Table

	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	0	0	0	0	0	0
STIP	0	0	0	5	0	5
Existing + STIP	0	0	0	5	0	5
Strategic Plan	0	0	0	0	0	0
Existing + Strategic Plan	0	0	0	5	0	5

Sensors

Wind sensors: Replace bearings annually.

Pavement surface sensors: Sensor needs to be wiped off so it will accurately show dry vs. wet pavement.

All sensors need to be cleaned, tested and calibrated annually. Lightning strikes, re-paving other factors may necessitate sensor replacement.

Will take approximately 1/2 time of full RWIS.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	1.00	1.5	ELEC	0.25	1.0	0.0	SC-E-D
				0.08	0.8	0.0	ELEC
				0.02	0.7	0.0	TS-3
				0.18	0.0	4.0	SC-E-R
				0.15	0.0	3.2	ELEC
				0.03	0.0	2.6	TS-3
future	1.00	1.5	ELEC	0.25	1.0	0.0	SC-E-D
				0.03	0.8	0.0	ELEC
				0.01	0.7	0.0	TS-3
				0.23	0.0	4.0	SC-E-R
				0.11	0.0	3.2	ELEC
				0.02	0.0	2.6	TS-3

Communications

Routers, Modems, Communications: Preventative maintenance includes annual inspection. Repair maintenance includes component replacement to restore communications.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	1.00	1.0	SC-I-PM	0.25	3.8	0.0	SC-I-D
				0.08	3.0	0.0	IS-5N
				0.02	2.7	0.0	IS-6N
				0.18	0.0	1.3	SC-I-R
				0.15	0.0	1.0	IS-5N
				0.03	0.0	0.9	IS-6N
future	1.00	1.0	SC-I-PM	0.25	3.8	0.0	SC-I-D
				0.03	3.0	0.0	IS-5N
				0.01	2.7	0.0	IS-6N
				0.23	0.0	1.3	SC-I-R
				0.11	0.0	1.0	IS-5N
				0.02	0.0	0.9	IS-6N

Field Processor/Controller

RPU: Needs preventative maintenance and repairs typical for a field RPU. Repair maintenance will be necessary half as often as other RPUs due to use of single-application without need for hardware upgrades. Preventative Maintenance will require less time due to fewer diagnostic needs.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	6.00	0.5	SC-I-PM	0.50	2.0	0.0	SC-I-D
				0.15	1.6	0.0	IS-5N
				0.03	1.4	0.0	IS-6N
				0.35	0.0	1.0	SC-I-R
				0.30	0.0	0.8	IS-5N
				0.06	0.0	0.7	IS-6N
future	6.00	0.5	SC-I-PM	0.50	2.0	0.0	SC-I-D
				0.05	1.6	0.0	IS-5N
				0.01	1.4	0.0	IS-6N
				0.45	0.0	1.0	SC-I-R
				0.22	0.0	0.8	IS-5N
				0.03	0.0	0.7	IS-6N

Software

Local software: Used to collect sensor data and transmit data to regional server.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	0.50	4.0	SC-I-PM	0.00	0.0	0.0	
future	0.50	4.0	SC-I-PM	0.00	0.0	0.0	

Database applications: Assume that this system could use existing RWIS database. No additional maintenance would be required.

Center Sub-Systems

Regional servers: Assume that this would utilize existing RWIS servers. No additional maintenance would be required.

Information Delivery

Static sign with flashing beacon: Annual preventative maintenance includes testing, bulb replacement. Assumed to be identical to HAR flashing beacon.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	1.00	1.0	SC-E-PM	0.50	1.0	0.0	SC-E-D
				0.15	0.8	0.0	ELEC
				0.03	0.7	0.0	TS-3
				0.35	0.0	3.0	SC-E-R
				0.30	0.0	2.4	ELEC
				0.06	0.0	1.9	TS-3
future	1.00	1.0	SC-E-PM	0.50	1.0	0.0	SC-E-D
				0.05	0.8	0.0	ELEC
				0.01	0.7	0.0	TS-3
				0.45	0.0	3.0	SC-E-R
				0.22	0.0	2.4	ELEC
				0.03	0.0	1.9	TS-3

Summary

	Preventative Maintenance			Repair Maintenance		
current	visits per yr	hrs per visit	job class	visits per yr	hrs per visit	job class
	0.00	0.0	SC-I-D	0.50	3.9	SC-I-D
	0.00	0.0	SC-I-R	0.35	1.6	SC-I-R
	6.00	1.0	SC-I-PM	0.00	0.0	SC-I-PM
	0.00	0.0	SC-E-D	0.50	1.5	SC-E-D
	0.00	0.0	SC-E-R	0.35	5.0	SC-E-R
	1.00	1.0	SC-E-PM	0.00	0.0	SC-E-PM
	0.00	0.0	IS-5N	0.30	2.9	IS-5N
	0.00	0.0	IS-6N	0.06	2.6	IS-6N
	1.00	1.5	ELEC	0.30	4.6	ELEC
	0.00	0.0	TS-3	0.06	3.7	TS-3

future	Preventative Maintenance visits per yr	hrs per visit	job class	Repair Maintenance visits per yr	hrs per visit	job class
	0.00	0.0	SC-I-D	0.50	3.9	SC-I-D
	0.00	0.0	SC-I-R	0.45	1.6	SC-I-R
	6.00	1.0	SC-I-PM	0.00	0.0	SC-I-PM
	0.00	0.0	SC-E-D	0.50	1.5	SC-E-D
	0.00	0.0	SC-E-R	0.45	5.0	SC-E-R
	1.00	1.0	SC-E-PM	0.00	0.0	SC-E-PM
	0.00	0.0	IS-5N	0.22	2.0	IS-5N
	0.00	0.0	IS-6N	0.03	2.0	IS-6N
	1.00	1.5	ELEC	0.22	4.3	ELEC
	0.00	0.0	TS-3	0.03	3.5	TS-3

Travel Time

Reduce travel time for preventative maintenance by 50 percent due to expected concentration of devices.

Staffing Needs (FTE)

Support Coordinator / IS-Diag (SC-I-D) - DAS # SC-I-D

	Region 1	2	3	4	5	State Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.02	0.00	0.02
Existing + Strategic Plan	0.00	0.00	0.00	0.02	0.00	0.02

Support Coordinator / IS-Repair (SC-I-R) - DAS # SC-I-R

	Region 1	2	3	4	5	State Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.01	0.00	0.01
Existing + Strategic Plan	0.00	0.00	0.00	0.02	0.00	0.02

Support Coordinator / IS-Preventative Maintenance (SC-I-PM) - DAS # SC-I-PM

	Region 1	2	3	4	5	State Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.08	0.00	0.08
Existing + Strategic Plan	0.00	0.00	0.00	0.08	0.00	0.08

Support Coordinator / Elec-Diag (SC-E-D) - DAS # SC-E-D

	Region 1	2	3	4	5	State Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.02	0.00	0.02
Existing + Strategic Plan	0.00	0.00	0.00	0.02	0.00	0.02

Support Coordinator / Elec-Repair (SC-E-R) - DAS # — SC-E-R

	Region 1	2	3	4	5	State Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.02	0.00	0.02
Existing + Strategic Plan	0.00	0.00	0.00	0.02	0.00	0.02

Support Coordinator / Elec-Preventative Maintenance (SC-E-PM) - DAS # — SC-E-PM

	Region 1	2	3	4	5	State Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.01	0.00	0.01
Existing + Strategic Plan	0.00	0.00	0.00	0.01	0.00	0.01

Info Services 5 - Networks / Servers (IS-5N) - DAS #1485 — IS-5N

	Region 1	2	3	4	5	State Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.01	0.00	0.01
Existing + Strategic Plan	0.00	0.00	0.00	0.01	0.00	0.01

Info Services 6 - Networks / Servers (IS-6N) - DAS #1486 — IS-6N

	Region 1	2	3	4	5	State Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.00

Electrician (ELEC) - DAS #4213 — ELEC

	Region 1	2	3	4	5	State Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.03	0.00	0.03
Existing + Strategic Plan	0.00	0.00	0.00	0.02	0.00	0.02

Traffic Signal Technician 3 (TS-3) - DAS #3411 — TS-3

	Region 1	2	3	4	5	State Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.00

K.2.6.11 Variable Speed Limit Systems

Inventory Table

	Region 1	2	3	4	5	State Total
Existing	0	0	0	0	0	0
STIP	0	0	0	0	0	0
Existing + STIP	0	0	0	0	0	0
Strategic Plan	2	3	5	5	5	20
Existing + Strategic Plan	2	3	5	5	5	20

Sensors

Wind sensors: Replace bearings annually.

Visibility sensors: Clean annually.

Precipitation sensors: Lenses need to be cleaned annually.

Pavement surface sensors: Sensor needs to be wiped off so it will accurately show dry vs. wet pavement.

All sensors need to be cleaned, tested and calibrated annually. Lightning strikes, re-paving other factors may necessitate sensor replacement.

Preventative maintenance is expected to require 1/2 time of RWIS.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	repair	job class
current	1.00	1.5	ELEC	0.25	1.0	0.0	SC-E-D
				0.08	0.8	0.0	ELEC
				0.02	0.7	0.0	TS-3
				0.18	0.0	4.0	SC-E-R
				0.15	0.0	3.2	ELEC
				0.03	0.0	2.6	TS-3
future	1.00	1.5	ELEC	0.25	1.0	0.0	SC-E-D
				0.03	0.8	0.0	ELEC
				0.01	0.7	0.0	TS-3
				0.23	0.0	4.0	SC-E-R
				0.11	0.0	3.2	ELEC
				0.02	0.0	2.6	TS-3

Communications

Routers, Modems, Communications: Preventative maintenance includes annual inspection. Repair maintenance includes component replacement to restore communications.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	1.00	1.0	SC-I-PM	0.25	3.8	0.0	SC-I-D
				0.08	3.0	0.0	IS-5N
				0.02	2.7	0.0	IS-6N
				0.18	0.0	1.3	SC-I-R
				0.15	0.0	1.0	IS-5N
				0.03	0.0	0.9	IS-6N
future	1.00	1.0	SC-I-PM	0.25	3.8	0.0	SC-I-D
				0.03	3.0	0.0	IS-5N
				0.01	2.7	0.0	IS-6N
				0.23	0.0	1.3	SC-I-R
				0.11	0.0	1.0	IS-5N
				0.02	0.0	0.9	IS-6N

Field Processor/Controller

RPU: Preventative maintenance includes regular re-booting. It will take less time than other field RPUs due to fewer diagnostic tests. Repair maintenance includes replacement of weathered or damaged components. Upgrades will be seldom necessary.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	6.00	0.5	SC-I-PM	0.50	2.0	0.0	SC-I-D
				0.15	1.6	0.0	IS-5N
				0.03	1.4	0.0	IS-6N
				0.35	0.0	1.0	SC-I-R
				0.30	0.0	0.8	IS-5N
				0.06	0.0	0.7	IS-6N
future	6.00	0.5	SC-I-PM	0.50	2.0	0.0	SC-I-D
				0.05	1.6	0.0	IS-5N
				0.01	1.4	0.0	IS-6N
				0.45	0.0	1.0	SC-I-R
				0.22	0.0	0.8	IS-5N
				0.03	0.0	0.7	IS-6N

Software

Local software: Used to collect sensor data and transmit data to regional server.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	0.50	4.0	SC-I-PM	0.00	0.0	0.0	
future	0.50	4.0	SC-I-PM	0.00	0.0	0.0	

Database applications: Assume that this system could use existing RWIS database. No additional maintenance would be required.

Center Sub-Systems

Regional servers: Assume that this would utilize existing RWIS servers. No additional maintenance would be required.

Information Delivery

Static sign with flashing beacon: Annual preventative maintenance includes testing, bulb replacement. Assumed to be identical to HAR flashing beacon.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	1.00	1.0	SC-E-PM	0.50	1.0	0.0	SC-E-D
				0.15	0.8	0.0	ELEC
				0.03	0.7	0.0	TS-3
				0.35	0.0	3.0	SC-E-R
				0.30	0.0	2.4	ELEC
				0.06	0.0	1.9	TS-3
future	1.00	1.0	SC-E-PM	0.50	1.0	0.0	SC-E-D
				0.05	0.8	0.0	ELEC
				0.01	0.7	0.0	TS-3
				0.45	0.0	3.0	SC-E-R
				0.22	0.0	2.4	ELEC
				0.03	0.0	1.9	TS-3

Summary

	Preventative Maintenance			Repair Maintenance		
current	visits per yr	hrs per visit	job class	visits per yr	hrs per visit	job class
	0.00	0.0	SC-I-D	0.50	3.9	SC-I-D
	0.00	0.0	SC-I-R	0.35	1.6	SC-I-R
	6.00	1.0	SC-I-PM	0.00	0.0	SC-I-PM
	0.00	0.0	SC-E-D	0.50	1.5	SC-E-D
	0.00	0.0	SC-E-R	0.35	5.0	SC-E-R
	1.00	1.0	SC-E-PM	0.00	0.0	SC-E-PM
	0.00	0.0	IS-5N	0.30	2.9	IS-5N
	0.00	0.0	IS-6N	0.06	2.6	IS-6N
	1.00	1.5	ELEC	0.30	4.6	ELEC
	0.00	0.0	TS-3	0.06	3.7	TS-3

future	Preventative Maintenance visits per yr	Preventative Maintenance hrs per visit	Preventative Maintenance job class	Repair Maintenance visits per yr	Repair Maintenance hrs per visit	Repair Maintenance job class
	0.00	0.0	SC-I-D	0.50	3.9	SC-I-D
	0.00	0.0	SC-I-R	0.45	1.6	SC-I-R
	6.00	1.0	SC-I-PM	0.00	0.0	SC-I-PM
	0.00	0.0	SC-E-D	0.50	1.5	SC-E-D
	0.00	0.0	SC-E-R	0.45	5.0	SC-E-R
	1.00	1.0	SC-E-PM	0.00	0.0	SC-E-PM
	0.00	0.0	IS-5N	0.22	2.0	IS-5N
	0.00	0.0	IS-6N	0.03	2.0	IS-6N
	1.00	1.5	ELEC	0.22	4.3	ELEC
	0.00	0.0	TS-3	0.03	3.5	TS-3

Staffing Needs (FTE)

Support Coordinator / IS-Diag (SC-I-D) - DAS # SC-I-D

	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.01	0.02	0.02	0.02	0.07

Support Coordinator / IS-Repair (SC-I-R) - DAS # SC-I-R

	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.01	0.01	0.02	0.01	0.05

Support Coordinator / IS-Preventative Maintenance (SC-I-PM) - DAS # SC-I-PM

	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.02	0.05	0.09	0.14	0.12	0.42

Support Coordinator / Elec-Diag (SC-E-D) - DAS # SC-E-D

	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.01	0.01	0.02	0.01	0.05

Support Coordinator / Elec-Repair (SC-E-R) - DAS # SC-E-R

	Region 1	2	3	4	5	State Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.01	0.02	0.02	0.02	0.07

Support Coordinator / Elec-Preventative Maintenance (SC-E-PM) - DAS # SC-E-PM

	Region 1	2	3	4	5	State Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.01	0.02	0.02	0.02	0.07

Info Services 5 - Networks / Servers (IS-5N) - DAS #1485 IS-5N

	Region 1	2	3	4	5	State Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.00	0.01	0.01	0.01	0.02

Info Services 6 - Networks / Servers (IS-6N) - DAS #1486 IS-6N

	Region 1	2	3	4	5	State Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.00

Electrician (ELEC) - DAS #4213 ELEC

	Region 1	2	3	4	5	State Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.01	0.01	0.02	0.03	0.03	0.11

Traffic Signal Technician 3 (TS-3) - DAS #3411 TS-3

	Region 1	2	3	4	5	State Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.01

K.2.6.12 Queue Detection System

Inventory Table

	Region 1	2	3	4	5	State Total
Existing	0	1	0	0	0	1
STIP	0	0	0	0	0	0
Existing + STIP	0	1	0	0	0	1
Strategic Plan	0	0	0	0	0	0
Existing + Strategic Plan	0	1	0	0	0	1

Sensors

Inductive Loops: Maintenance covered under existing procedures.

Communications

Local cable and wiring: Cable replacement may be necessary rarely.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	repair	job class
current	1.00	2.0	SC-E-PM	0.50	1.5	0.0	SC-E-D
				0.15	1.2	0.0	ELEC
				0.03	1.1	0.0	TS-3
				0.35	0.0	3.0	SC-E-R
				0.30	0.0	2.4	ELEC
				0.06	0.0	1.9	TS-3
future	1.00	2.0	SC-E-PM	0.50	1.5	0.0	SC-E-D
				0.05	1.2	0.0	ELEC
				0.01	1.1	0.0	TS-3
				0.45	0.0	3.0	SC-E-R
				0.22	0.0	2.4	ELEC
				0.03	0.0	1.9	TS-3

Field Processor/Controller

Timer: Annual preventative maintenance should ensure the timer is functioning properly. Repair may be necessary occasionally. It is assumed that due to the simplicity of the device that no escalation would be necessary beyond the electrician.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	repair	job class
current	1.00	0.2	ELEC	0.50	0.2	0.0	SC-E-D
				0.15	0.2	0.0	ELEC
				0.35	0.0	2.0	SC-E-R
				0.33	0.0	1.6	ELEC
future	1.00	0.2	ELEC	0.50	0.2	0.0	SC-E-D
				0.05	0.2	0.0	ELEC
				0.45	0.0	2.0	SC-E-R
				0.23	0.0	1.6	ELEC

Software

No software is used.

Center Sub-Systems

No center sub-system components.

Information Delivery

Static sign: Maintenance covered by existing procedures.

Flashing beacons: Annual testing and bulb replacement.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	1.00	1.0	SC-E-PM	0.50	1.0	0.0	SC-E-D
				0.15	0.8	0.0	ELEC
				0.03	0.7	0.0	TS-3
				0.35	0.0	3.0	SC-E-R
				0.30	0.0	2.4	ELEC
				0.06	0.0	1.9	TS-3
future	1.00	1.0	SC-E-PM	0.50	1.0	0.0	SC-E-D
				0.05	0.8	0.0	ELEC
				0.01	0.7	0.0	TS-3
				0.45	0.0	3.0	SC-E-R
				0.22	0.0	2.4	ELEC
				0.03	0.0	1.9	TS-3

Summary

current

Preventative Maintenance			Repair Maintenance		
visits per yr	hrs per visit	job class	visits per yr	hrs per visit	job class
0.00	0.0	SC-E-D	0.50	2.7	SC-E-D
0.00	0.0	SC-E-R	0.35	8.0	SC-E-R
1.00	3.0	SC-E-PM	0.00	0.0	SC-E-PM
1.00	0.2	ELEC	0.33	7.0	ELEC
0.00	0.0	TS-3	0.06	4.7	TS-3

future

Preventative Maintenance			Repair Maintenance		
visits per yr	hrs per visit	job class	visits per yr	hrs per visit	job class
0.00	0.0	SC-E-D	0.50	2.7	SC-E-D
0.00	0.0	SC-E-R	0.45	8.0	SC-E-R
1.00	3.0	SC-E-PM	0.00	0.0	SC-E-PM
1.00	0.2	ELEC	0.23	6.7	ELEC
0.00	0.0	TS-3	0.03	4.4	TS-3

Staffing Needs (FTE)

Support Coordinator / Elec-Diag (SC-E-D) - DAS # SC-E-D

	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.00

Support Coordinator / Elec-Repair (SC-E-R) - DAS # SC-E-R

	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.00

Support Coordinator / Elec-Preventative Maintenance (SC-E-PM) - DAS # SC-E-PM

	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.00

Electrician (ELEC) - DAS #4213 ELEC

	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.00

Traffic Signal Technician 3 (TS-3) - DAS #3411 TS-3

	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.00

K.2.7 Commercial Vehicle Operations

K.2.7.1 Weigh-in-Motion Systems

Inventory Table

	Region 1	2	3	4	5	State Total
Existing	0	2	4	0	5	11
STIP	5	1	0	4	0	10
Existing + STIP	5	3	4	4	5	21
Strategic Plan	0	0	0	0	0	0
Existing + Strategic Plan	5	3	4	4	5	21

Sensors

Various sensors: Sensors associated with WIM include axle sensors, automatic vehicle identification (AVI), automatic vehicle classification (AVC), and loop detectors. Preventative maintenance includes visual inspection and calibration. Repair maintenance includes sensor replacement. Maintenance activities are anticipated to occur twice as often as other sensor systems due to importance of calibration and sensor complexity.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	2.00	5.0	ELEC	2.00	1.0	0.0	SC-E-D
				0.60	0.8	0.0	ELEC
				0.12	0.7	0.0	TS-3
				1.40	0.0	4.0	SC-E-R
				1.18	0.0	3.2	ELEC
				0.24	0.0	2.6	TS-3
future	2.00	5.0	ELEC	2.00	1.0	0.0	SC-E-D
				0.20	0.8	0.0	ELEC
				0.04	0.7	0.0	TS-3
				1.80	0.0	4.0	SC-E-R
				0.88	0.0	3.2	ELEC
				0.13	0.0	2.6	TS-3

Communications

Routers, Modems, Communications: Preventative maintenance includes annual inspection. Repair maintenance includes component replacement to restore communications.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	1.00	1.0	SC-I-PM	0.25	3.8	0.0	SC-I-D
				0.08	3.0	0.0	IS-5N
				0.02	2.7	0.0	IS-6N
				0.18	0.0	1.3	SC-I-R
				0.15	0.0	1.0	IS-5N
				0.03	0.0	0.9	IS-6N
future	1.00	1.0	SC-I-PM	0.25	3.8	0.0	SC-I-D
				0.03	3.0	0.0	IS-5N
				0.01	2.7	0.0	IS-6N
				0.23	0.0	1.3	SC-I-R
				0.11	0.0	1.0	IS-5N
				0.02	0.0	0.9	IS-6N

Local cable and wiring: There are significant landline connections between the various sensors and the scalehouse. This wiring need to be regularly inspected.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	1.00	2.0	SC-E-PM	0.50	1.5	0.0	SC-E-D
				0.15	1.2	0.0	ELEC
				0.03	1.1	0.0	TS-3
				0.35	0.0	3.0	SC-E-R
				0.30	0.0	2.4	ELEC
				0.06	0.0	1.9	TS-3
future	1.00	2.0	SC-E-PM	0.50	1.5	0.0	SC-E-D
				0.05	1.2	0.0	ELEC
				0.01	1.1	0.0	TS-3
				0.45	0.0	3.0	SC-E-R
				0.22	0.0	2.4	ELEC
				0.03	0.0	1.9	TS-3

Field Processor/Controller

Supervisory computer: Computer preceded WIM; maintenance is covered under existing procedures.

Software

Supervisory Computer Software: Some software is owned by ODOT; some is jointly managed between ODOT and vendor. Assume upgrades are applied four times per year to each machine.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	0.50	4.0	SC-I-PM	0.00	0.0	0.0	
future	0.50	4.0	SC-I-PM	0.00	0.0	0.0	

Motor Carrier Database: Existed before weigh-in-motion systems; no maintenance necessary.

Center Sub-Systems

Motor Carrier Server: Existed before weigh-in-motion system; maintenance covered under existing procedures.

Information Delivery

Red-light/Green-light: System reports to transponder-equipped vehicles whether they need to pull into the weigh station. Maintenance needs are similar to flashing beacons.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	1.00	1.0	SC-E-PM	0.50	1.0	0.0	SC-E-D
				0.15	0.8	0.0	ELEC
				0.03	0.7	0.0	TS-3
				0.35	0.0	3.0	SC-E-R
				0.30	0.0	2.4	ELEC
				0.06	0.0	1.9	TS-3
future	1.00	1.0	SC-E-PM	0.50	1.0	0.0	SC-E-D
				0.05	0.8	0.0	ELEC
				0.01	0.7	0.0	TS-3
				0.45	0.0	3.0	SC-E-R
				0.22	0.0	2.4	ELEC
				0.03	0.0	1.9	TS-3

Summary

	Preventative Maintenance			Repair Maintenance		
current	visits per yr	hrs per visit	job class	visits per yr	hrs per visit	job class
	0.00	0.0	SC-I-D	0.25	3.8	SC-I-D
	0.00	0.0	SC-I-R	0.18	1.3	SC-I-R
	1.00	3.0	SC-I-PM	0.00	0.0	SC-I-PM
	0.00	0.0	SC-E-D	2.00	1.6	SC-E-D
	0.00	0.0	SC-E-R	1.40	5.5	SC-E-R
	1.00	3.0	SC-E-PM	0.00	0.0	SC-E-PM
	0.00	0.0	IS-5N	0.15	2.5	IS-5N
	0.00	0.0	IS-6N	0.03	2.3	IS-6N
	2.00	5.0	ELEC	1.18	5.1	ELEC
	0.00	0.0	TS-3	0.24	4.1	TS-3

future	Preventative Maintenance visits per yr	Preventative Maintenance hrs per visit	Preventative Maintenance job class	Repair Maintenance visits per yr	Repair Maintenance hrs per visit	Repair Maintenance job class
	0.00	0.0	SC-I-D	0.25	3.8	SC-I-D
	0.00	0.0	SC-I-R	0.23	1.3	SC-I-R
	1.00	3.0	SC-I-PM	0.00	0.0	SC-I-PM
	0.00	0.0	SC-E-D	2.00	1.6	SC-E-D
	0.00	0.0	SC-E-R	1.80	5.5	SC-E-R
	1.00	3.0	SC-E-PM	0.00	0.0	SC-E-PM
	0.00	0.0	IS-5N	0.11	1.7	IS-5N
	0.00	0.0	IS-6N	0.02	1.7	IS-6N
	2.00	5.0	ELEC	0.88	4.7	ELEC
	0.00	0.0	TS-3	0.13	3.9	TS-3

Travel Time

Reduce by 50 percent for preventative maintenance because of wide device deployment.

Staffing Needs (FTE)

Support Coordinator / IS-Diag (SC-I-D) - DAS # SC-I-D

	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	0.00	0.00	0.01	0.00	0.01	0.02
Existing + STIP	0.01	0.00	0.01	0.01	0.01	0.03
Existing + Strategic Plan	0.01	0.00	0.01	0.01	0.01	0.03

Support Coordinator / IS-Repair (SC-I-R) - DAS # SC-I-R

	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	0.00	0.00	0.00	0.00	0.01	0.01
Existing + STIP	0.00	0.00	0.00	0.00	0.01	0.02
Existing + Strategic Plan	0.00	0.00	0.00	0.01	0.01	0.02

Support Coordinator / IS-Preventative Maintenance (SC-I-PM) - DAS # SC-I-PM

	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	0.00	0.01	0.01	0.00	0.02	0.04
Existing + STIP	0.01	0.01	0.01	0.02	0.02	0.07
Existing + Strategic Plan	0.01	0.01	0.01	0.02	0.02	0.07

Support Coordinator / Elec-Diag (SC-E-D) - DAS # SC-E-D

	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	0.00	0.02	0.04	0.00	0.06	0.12
Existing + STIP	0.03	0.03	0.04	0.06	0.06	0.21
Existing + Strategic Plan	0.03	0.03	0.04	0.06	0.06	0.21

Support Coordinator / Elec-Repair (SC-E-R) - DAS # — SC-E-R

	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.02	0.04	0.00	0.06	0.12
Existing + STIP	0.04	0.03	0.04	0.05	0.06	0.22
Existing + Strategic Plan	0.05	0.04	0.05	0.07	0.08	0.28

Support Coordinator / Elec-Preventative Maintenance (SC-E-PM) - DAS # — SC-E-PM

	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.01	0.01	0.00	0.02	0.04
Existing + STIP	0.01	0.01	0.01	0.02	0.02	0.07
Existing + Strategic Plan	0.01	0.01	0.01	0.02	0.02	0.07

Info Services 5 - Networks / Servers (IS-5N) - DAS #1485 — IS-5N

	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.00	0.00	0.00	0.00	0.01
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.02
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.01

Info Services 6 - Networks / Servers (IS-6N) - DAS #1486 — IS-6N

	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.00

Electrician (ELEC) - DAS #4213 — ELEC

	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.03	0.07	0.00	0.10	0.19
Existing + STIP	0.07	0.05	0.07	0.08	0.10	0.36
Existing + Strategic Plan	0.06	0.04	0.06	0.07	0.08	0.31

Traffic Signal Technician 3 (TS-3) - DAS #3411 — TS-3

	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.00	0.01	0.00	0.01	0.03
Existing + STIP	0.01	0.00	0.01	0.01	0.01	0.04
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.01	0.02

K.2.7.2 Downhill Speed Advisory System

Inventory Table

	Region					State
	1	2	3	4	5	Total
Existing	0	0	0	0	1	1
STIP	0	0	1	0	0	1
Existing + STIP	0	0	1	0	1	2
Strategic Plan	0	4	7	7	6	24
Existing + Strategic Plan	0	4	8	7	7	26

Sensors

Various sensors: Same sensors as WIM, including axle sensors, automatic vehicle identification (AVI), automatic vehicle classification (AVC), and loop detectors. Preventative maintenance includes visual inspection and calibration. Repair maintenance includes sensor replacement. Maintenance activities are anticipated to occur twice as often as other sensor systems due to importance of calibration and sensor complexity.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	2.00	5.0	ELEC	2.00	1.0	0.0	SC-E-D
				0.60	0.8	0.0	ELEC
				0.12	0.7	0.0	TS-3
				1.40	0.0	4.0	SC-E-R
				1.18	0.0	3.2	ELEC
				0.24	0.0	2.6	TS-3
future	2.00	5.0	ELEC	2.00	1.0	0.0	SC-E-D
				0.20	0.8	0.0	ELEC
				0.04	0.7	0.0	TS-3
				1.80	0.0	4.0	SC-E-R
				0.88	0.0	3.2	ELEC
				0.13	0.0	2.6	TS-3

Communications

Routers, Modems, Communications: Preventative maintenance includes annual inspection. Repair maintenance includes component replacement to restore communications.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	1.00	1.0	SC-I-PM	0.25	3.8	0.0	SC-I-D
				0.08	3.0	0.0	IS-5N
				0.02	2.7	0.0	IS-6N
				0.18	0.0	1.3	SC-I-R
				0.15	0.0	1.0	IS-5N
				0.03	0.0	0.9	IS-6N
future	1.00	1.0	SC-I-PM	0.25	3.8	0.0	SC-I-D
				0.03	3.0	0.0	IS-5N
				0.01	2.7	0.0	IS-6N
				0.23	0.0	1.3	SC-I-R
				0.11	0.0	1.0	IS-5N
				0.02	0.0	0.9	IS-6N

Local cable and wiring: There are significant landline connections between the various sensors and the scalehouse. This wiring need to be regularly inspected.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	1.00	2.0	SC-E-PM	0.50	1.5	0.0	SC-E-D
				0.15	1.2	0.0	ELEC
				0.03	1.1	0.0	TS-3
				0.35	0.0	3.0	SC-E-R
				0.30	0.0	2.4	ELEC
				0.06	0.0	1.9	TS-3
future	1.00	2.0	SC-E-PM	0.50	1.5	0.0	SC-E-D
				0.05	1.2	0.0	ELEC
				0.01	1.1	0.0	TS-3
				0.45	0.0	3.0	SC-E-R
				0.22	0.0	2.4	ELEC
				0.03	0.0	1.9	TS-3

Field Processor/Controller

RPU: Used to process vehicle data, calculate vehicle speed, develop message for VMS and transmit message to VMS. Assume that this will require similar maintenance as a generic field RPU.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	6.00	0.5	SC-I-PM	1.00	2.0	0.0	SC-I-D
				0.30	1.6	0.0	IS-5N
				0.06	1.4	0.0	IS-6N
				0.70	0.0	1.0	SC-I-R
				0.59	0.0	0.8	IS-5N
				0.12	0.0	0.7	IS-6N
future	6.00	0.5	SC-I-PM	1.00	2.0	0.0	SC-I-D
				0.10	1.6	0.0	IS-5N
				0.02	1.4	0.0	IS-6N
				0.90	0.0	1.0	SC-I-R
				0.44	0.0	0.8	IS-5N
				0.06	0.0	0.7	IS-6N

Software

Software at RPU may need upgrading or debugging on an occasional basis.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	0.50	4.0	SC-I-PM	0.00	0.0	0.0	
future	0.50	4.0	SC-I-PM	0.00	0.0	0.0	

Center Sub-Systems

No unique sub-systems.

Information Delivery

Sign: Preventative maintenance includes cleaning, checking display modules, inspection, etc. Repair maintenance is assumed to be easier in the future because of improved self-diagnostic capabilities.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	2.00	5.0	SC-E-PM	3.00	1.0	0.0	SC-E-D
				0.90	0.8	0.0	ELEC
				0.18	0.7	0.0	TS-3
				2.10	0.0	3.0	SC-E-R
				1.77	0.0	2.4	ELEC
				0.36	0.0	1.9	TS-3
future	2.00	5.0	SC-E-PM	3.00	0.5	0.0	SC-E-D
				0.30	0.4	0.0	ELEC
				0.06	0.4	0.0	TS-3
				2.70	0.0	2.0	SC-E-R
				1.32	0.0	1.6	ELEC
				0.19	0.0	1.3	TS-3

Summary

current	Preventative Maintenance			Repair Maintenance		
	visits per yr	hrs per visit	job class	visits per yr	hrs per visit	job class
	0.00	0.0	SC-I-D	1.00	2.9	SC-I-D
	0.00	0.0	SC-I-R	0.70	1.3	SC-I-R
	6.00	1.0	SC-I-PM	0.00	0.0	SC-I-PM
	0.00	0.0	SC-E-D	3.00	1.9	SC-E-D
	0.00	0.0	SC-E-R	2.10	6.2	SC-E-R
	2.00	6.0	SC-E-PM	0.00	0.0	SC-E-PM
	0.00	0.0	IS-5N	0.59	2.2	IS-5N
	0.00	0.0	IS-6N	0.12	2.0	IS-6N
	2.00	5.0	ELEC	1.77	5.7	ELEC
	0.00	0.0	TS-3	0.36	4.7	TS-3

future	Preventative Maintenance			Repair Maintenance		
	visits per yr	hrs per visit	job class	visits per yr	hrs per visit	job class
	0.00	0.0	SC-I-D	1.00	2.9	SC-I-D
	0.00	0.0	SC-I-R	0.90	1.3	SC-I-R
	6.00	1.0	SC-I-PM	0.00	0.0	SC-I-PM
	0.00	0.0	SC-E-D	3.00	1.4	SC-E-D
	0.00	0.0	SC-E-R	2.70	5.2	SC-E-R
	2.00	6.0	SC-E-PM	0.00	0.0	SC-E-PM
	0.00	0.0	IS-5N	0.44	1.6	IS-5N
	0.00	0.0	IS-6N	0.06	1.6	IS-6N
	2.00	5.0	ELEC	1.32	4.4	ELEC
	0.00	0.0	TS-3	0.19	3.6	TS-3

Staffing Needs (FTE)

Support Coordinator / IS-Diag (SC-I-D) - DAS # SC-I-D

	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.00	0.00	0.00	0.01	0.01
Existing + STIP	0.00	0.00	0.01	0.00	0.01	0.01
Existing + Strategic Plan	0.00	0.02	0.04	0.05	0.05	0.17

Support Coordinator / IS-Repair (SC-I-R) - DAS # SC-I-R

	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.01
Existing + Strategic Plan	0.00	0.01	0.03	0.04	0.04	0.13

Support Coordinator / IS-Preventative Maintenance (SC-I-PM) - DAS # SC-I-PM

	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.00	0.00	0.00	0.02	0.02
Existing + STIP	0.00	0.00	0.02	0.00	0.02	0.04
Existing + Strategic Plan	0.00	0.07	0.15	0.19	0.17	0.58

Support Coordinator / Elec-Diag (SC-E-D) - DAS # SC-E-D

	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.00	0.00	0.00	0.02	0.02
Existing + STIP	0.00	0.00	0.01	0.00	0.02	0.03
Existing + Strategic Plan	0.00	0.05	0.11	0.14	0.12	0.43

Support Coordinator / Elec-Repair (SC-E-R) - DAS # SC-E-R

	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.00	0.00	0.00	0.02	0.02
Existing + STIP	0.00	0.00	0.02	0.00	0.02	0.03
Existing + Strategic Plan	0.00	0.07	0.15	0.17	0.16	0.55

Support Coordinator / Elec-Preventative Maintenance (SC-E-PM) - DAS # SC-E-PM

	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.00	0.00	0.00	0.01	0.01
Existing + STIP	0.00	0.00	0.01	0.00	0.01	0.03
Existing + Strategic Plan	0.00	0.05	0.10	0.11	0.10	0.35

Info Services 5 - Networks / Servers (IS-5N) - DAS #1485 IS-5N

	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.01
Existing + Strategic Plan	0.00	0.01	0.02	0.02	0.02	0.06

Info Services 6 - Networks / Servers (IS-6N) - DAS #1486 IS-6N

	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.01

Electrician (ELEC) - DAS #4213

	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.00	0.00	0.00	0.03	0.03
Existing + STIP	0.00	0.00	0.02	0.00	0.03	0.05
Existing + Strategic Plan	0.00	0.07	0.16	0.18	0.16	0.57

Traffic Signal Technician 3 (TS-3) - DAS #3411

	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.01
Existing + Strategic Plan	0.00	0.00	0.01	0.01	0.02	0.04

K.2.8 Communications Systems

K.2.8.1 Fiber Optic Networks

Inventory Table

	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	0	0	0	0	0	0
STIP	80	0	0	0	0	80
Existing + STIP	80	0	0	0	0	80
Strategic Plan	0	0	0	0	0	0
Existing + Strategic Plan	80	0	0	0	0	80

Sensors

No applicable sensors.

Communications

Fiber-optics communications: A dedicated fiber optics network in Region 1 is used to connect CCTV, ramp meters, travel time estimation RPUs and video detectors to TMOC.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	0.50	2.0	IS-F	0.50	0.3	0.0	IS-F
				0.50	0.0	1.3	IS-F
future	0.50	2.0	IS-F	0.50	0.3	0.0	IS-F
				0.50	0.0	1.3	IS-F

Field Processor/Controller

No applicable field processors/controllers.

Software

No special software is required.

Center Sub-Systems

No applicable center sub-systems.

Information Delivery

No unique information delivery systems.

Summary

	Preventative Maintenance			Repair Maintenance		
current	visits per yr	hrs per visit	job class	visits per yr	hrs per visit	job class
	0.50	2.0	IS-F	0.50	1.7	IS-F

	Preventative Maintenance			Repair Maintenance		
	visits per yr	hrs per visit	job class	visits per yr	hrs per visit	job class
future	0.50	2.0	IS-F	0.50	1.7	IS-F

Travel Time

Reduce by 50 percent for preventative maintenance because of concentrated location of fiber network.

Staffing Needs (FTE)

Info Services - Fiber Optic Technician (IS-F) - DAS # IS-F

	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.19	0.00	0.00	0.00	0.00	0.19
Existing + Strategic Plan	0.19	0.00	0.00	0.00	0.00	0.19

K.2.8.2 Radio Communications

Inventory Table

Radio Consoles

	Region 1	2	3	4	5	State Total
Existing	4	5	2	2	0	13
STIP	0	0	0	0	0	0
Existing + STIP	4	5	2	2	0	13
Strategic Plan	0	0	0	0	2	2
Existing + Strategic Plan	4	5	2	2	2	15

In-Vehicle Units

	Region 1	2	3	4	5	State Total
Existing	7	0	0	0	0	7
STIP	0	4	0	40	0	44
Existing + STIP	7	4	0	40	0	51
Strategic Plan	100	100	100	60	100	460
Existing + Strategic Plan	107	104	100	100	100	511

Sensors

No applicable sensors.

Communications

Radio consoles: Requires twice as much servicing time as radio units for preventative maintenance. Repair maintenance is expected to occur twice as frequently as radio units due to higher cost of device of replacement, and the corresponding resistance to "replace over repair".

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	1.00	1.0	IS-5R	0.50	1.0	0.0	SC-I-D
				0.15	0.8	0.0	IS-5R
				0.03	0.7	0.0	IS-6R
				0.35	0.0	3.0	SC-I-R
				0.30	0.0	2.4	IS-5R
				0.06	0.0	2.2	IS-6R
future	1.00	1.0	IS-5R	0.40	1.0	0.0	SC-I-D
				0.04	0.8	0.0	IS-5R
				0.01	0.7	0.0	IS-6R
				0.36	0.0	3.0	SC-I-R
				0.18	0.0	2.4	IS-5R
				0.03	0.0	2.2	IS-6R

Radio units: Require annual inspection and testing. Repairs are seldom recommended due to relative cost of repair compared to unit replacement.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	1.00	0.5	IS-5R	0.25	1.0	0.0	SC-I-D
				0.08	0.8	0.0	IS-5R
				0.02	0.7	0.0	IS-6R
				0.18	0.0	3.0	SC-I-R
				0.15	0.0	2.4	IS-5R
				0.03	0.0	2.2	IS-6R
future	1.00	0.5	IS-5R	0.20	1.0	0.0	SC-I-D
				0.02	0.8	0.0	IS-5R
				0.00	0.7	0.0	IS-6R
				0.18	0.0	3.0	SC-I-R
				0.09	0.0	2.4	IS-5R
				0.01	0.0	2.2	IS-6R

Radio towers: Maintenance covered under existing procedures.

Field Processor/Controller

No applicable field processor/controllers.

Software

No applicable software.

Center Sub-Systems

No center sub-systems.

Information Delivery

No applicable information delivery systems.

Summary

Radio consoles

	Preventative Maintenance			Repair Maintenance		
	visits per yr	hrs per visit	job class	visits per yr	hrs per visit	job class
current	0.00	0.0	SC-I-D	0.50	1.0	SC-I-D
	0.00	0.0	SC-I-R	0.35	3.0	SC-I-R
	1.00	1.0	IS-5R	0.30	2.8	IS-5R
	0.00	0.0	IS-6R	0.06	2.5	IS-6R

	Preventative Maintenance			Repair Maintenance		
	visits per yr	hrs per visit	job class	visits per yr	hrs per visit	job class
future	0.00	0.0	SC-I-D	0.40	1.0	SC-I-D
	0.00	0.0	SC-I-R	0.36	3.0	SC-I-R
	1.00	1.0	IS-5R	0.18	2.6	IS-5R
	0.00	0.0	IS-6R	0.03	2.4	IS-6R

Radio units

current	Preventative Maintenance			Repair Maintenance		
	visits per yr	hrs per visit	job class	visits per yr	hrs per visit	job class
	0.00	0.0	SC-I-D	0.25	1.0	SC-I-D
	0.00	0.0	SC-I-R	0.18	3.0	SC-I-R
	1.00	0.5	IS-5R	0.15	2.8	IS-5R
	0.00	0.0	IS-6R	0.03	2.5	IS-6R

future	Preventative Maintenance			Repair Maintenance		
	visits per yr	hrs per visit	job class	visits per yr	hrs per visit	job class
	0.00	0.0	SC-I-D	0.20	1.0	SC-I-D
	0.00	0.0	SC-I-R	0.18	3.0	SC-I-R
	1.00	0.5	IS-5R	0.09	2.6	IS-5R
	0.00	0.0	IS-6R	0.01	2.4	IS-6R

Travel Time

Reduce by 50 percent for preventative maintenance because of concentrated deployment in TOCs.
No travel time for in-vehicle units because vehicles can travel to technicians as needed.

Staffing Needs (FTE)

Support Coordinator / IS-Diag (SC-I-D) - DAS #

	Region					SC-I-D State
	1	2	3	4	5	Total
Existing	0.01	0.01	0.00	0.01	0.00	0.03
Existing + STIP	0.01	0.01	0.00	0.01	0.00	0.03
Existing + Strategic Plan	0.02	0.02	0.02	0.02	0.02	0.09

Support Coordinator / IS-Repair (SC-I-R) - DAS #

	Region					SC-I-R State
	1	2	3	4	5	Total
Existing	0.01	0.01	0.00	0.01	0.00	0.03
Existing + STIP	0.01	0.01	0.00	0.02	0.00	0.04
Existing + Strategic Plan	0.04	0.04	0.04	0.04	0.04	0.20

Info Services 5 - Radio Technician (IS-5R) - DAS #1485

	Region					IS-5R State
	1	2	3	4	5	Total
Existing	0.01	0.02	0.01	0.01	0.00	0.05
Existing + STIP	0.01	0.02	0.01	0.03	0.00	0.07
Existing + Strategic Plan	0.06	0.06	0.05	0.05	0.05	0.27

Info Services 6 - Radio Technician (IS-6R) - DAS #1486						IS-6R
	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.01
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.01

K.2.9 Maintenance Coordination

Inventory Table

	Region 1	2	3	4	5	State Total
Existing	0	0	0	0	0	0
STIP	1	1	1	1	1	5
Existing + STIP	1	1	1	1	1	5
Strategic Plan	0	0	0	0	0	0
Existing + Strategic Plan	1	1	1	1	1	5

Maintenance Coordination

It is assumed coordination time (for logging, hand-offs, etc.) will require a small percentage (5 percent) of field/travel time spent in device repairs and diagnostics. For vendor-based activities, half as much time would be required for coordination.

Coordination Time

	Region 1	2	3	4	5	State Total
Existing	0.09	0.15	0.02	0.06	0.05	0.37
Existing + STIP	0.13	0.20	0.04	0.14	0.13	0.63
Existing + Strategic Plan	0.45	0.45	0.40	0.57	0.52	2.39

Sensors

No sensors.

Communications

No unique communications infrastructure.

Field Processor/Controller

No field processor/controllers.

Software

Tracking software: Needs upgrades, database management.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	0.50	4.0	SC-I-PM	0.00	0.0	0.0	
future	0.50	4.0	SC-I-PM	0.00	0.0	0.0	

Center Sub-Systems

Assume lap-top computer is made available for each support coordinator. These computers will have generic maintenance needs.

	Preventative Maintenance			Repair Maintenance			
	visits per yr	hrs per visit	job class	visits per yr	hours per visit diag.	hours per visit repair	job class
current	12.00	1.0	SC-I-PM	2.00	2.0	0.0	SC-I-D
				0.60	1.6	0.0	IS-5N
				0.12	1.4	0.0	IS-6N
				1.40	0.0	1.0	SC-I-R
				1.18	0.0	0.8	IS-5N
				0.24	0.0	0.7	IS-6N
future	12.00	1.0	SC-I-PM	2.00	2.0	0.0	SC-I-D
				0.20	1.6	0.0	IS-5N
				0.04	1.4	0.0	IS-6N
				1.80	0.0	1.0	SC-I-R
				0.88	0.0	0.8	IS-5N
				0.13	0.0	0.7	IS-6N

Information Delivery

No new information delivery components.

Summary

	Preventative Maintenance			Repair Maintenance		
	visits	hrs per	job	visits	hrs per	job
current	per yr	visit	class	per yr	visit	class
	0.00	0.0	SC-I-D	2.00	2.0	SC-I-D
	0.00	0.0	SC-I-R	1.40	1.0	SC-I-R
	12.00	1.2	SC-I-PM	0.00	0.0	SC-I-PM
	0.00	0.0	IS-5N	1.18	1.6	IS-5N
	0.00	0.0	IS-6N	0.24	1.4	IS-6N

	Preventative Maintenance			Repair Maintenance		
	visits	hrs per	job	visits	hrs per	job
future	per yr	visit	class	per yr	visit	class
	0.00	0.0	SC-I-D	2.00	2.0	SC-I-D
	0.00	0.0	SC-I-R	1.80	1.0	SC-I-R
	12.00	1.2	SC-I-PM	0.00	0.0	SC-I-PM
	0.00	0.0	IS-5N	0.88	1.2	IS-5N
	0.00	0.0	IS-6N	0.13	1.2	IS-6N

Travel Time

Coordination time requires no travel.

Staffing Needs (FTE)

Support Coordinator / IS-Diag (SC-I-D) - DAS #

SC-I-D

	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.01
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.01

Support Coordinator / IS-Repair (SC-I-R) - DAS #

SC-I-R

	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.01

Support Coordinator / IS-Preventative Maintenance (SC-I-PM) - DAS #

SC-I-PM

	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.01	0.01	0.01	0.01	0.01	0.04
Existing + Strategic Plan	0.01	0.01	0.01	0.01	0.01	0.04

Info Services 5 - Networks / Servers (IS-5N) - DAS #1485

IS-5N

	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.01
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.00

Info Services 6 - Networks / Servers (IS-6N) - DAS #1486

IS-6N

	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	0.00	0.00	0.00	0.00	0.00	0.00

K.3 Resource Needs Estimates by Staff Classification

Support Coordinator / Coordination (SC-C) - DAS #

	Region					State
	1	2	3	4	5	Total
Existing	0.09	0.15	0.02	0.06	0.05	0.37
Existing + STIP	0.13	0.20	0.04	0.14	0.13	0.63
Existing + Strategic Plan	0.45	0.45	0.40	0.57	0.52	2.39

Support Coordinator / IS-Diag (SC-I-D) - DAS #

	Region					State
	1	2	3	4	5	Total
Existing	0.19	0.29	0.03	0.17	0.05	0.74
Existing + STIP	0.23	0.36	0.06	0.36	0.24	1.24
Existing + Strategic Plan	0.81	0.95	0.99	1.50	1.27	5.53

Support Coordinator / IS-Repair (SC-I-R) - DAS #

	Region					State
	1	2	3	4	5	Total
Existing	0.08	0.15	0.02	0.09	0.03	0.36
Existing + STIP	0.10	0.18	0.03	0.23	0.13	0.66
Existing + Strategic Plan	0.52	0.68	0.73	1.17	0.97	4.07

Support Coordinator / IS-Preventative Maintenance (SC-I-PM) - DAS #

	Region					State
	1	2	3	4	5	Total
Existing	0.47	0.22	0.09	0.22	0.12	1.12
Existing + STIP	0.58	0.38	0.15	0.53	0.47	2.11
Existing + Strategic Plan	1.41	0.99	0.93	1.51	1.16	5.99

Support Coordinator / Elec-Diag (SC-E-D) - DAS #

	Region					State
	1	2	3	4	5	Total
Existing	0.18	0.25	0.07	0.14	0.19	0.84
Existing + STIP	0.26	0.33	0.09	0.32	0.39	1.40
Existing + Strategic Plan	0.62	0.68	0.79	1.27	1.13	4.49

Support Coordinator / Elec-Repair (SC-E-R) - DAS #

	Region					State
	1	2	3	4	5	Total
Existing	0.18	0.20	0.07	0.11	0.18	0.74
Existing + STIP	0.27	0.28	0.09	0.27	0.34	1.26
Existing + Strategic Plan	0.88	0.81	0.86	1.30	1.37	5.23

Support Coordinator / Elec-Preventative Maintenance (SC-E-PM) - DAS #

	Region					State
	1	2	3	4	5	Total
Existing	0.08	0.09	0.02	0.07	0.05	0.31
Existing + STIP	0.11	0.12	0.04	0.14	0.14	0.54
Existing + Strategic Plan	0.52	0.52	0.57	0.71	0.62	2.95

Support Coordinator / Program Technician (SC-P) - DAS #

	Region					State
	1	2	3	4	5	Total
Existing	0.01	0.18	0.02	0.03	0.00	0.24
Existing + STIP	0.01	0.18	0.02	0.05	0.00	0.26
Existing + Strategic Plan	0.59	0.95	0.98	0.98	0.96	4.45

Info Services - Kiosk Specialist (IS-K) - DAS #1484

	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.00	0.00	0.00	0.00	0.00	0.00
Existing + Strategic Plan	1.42	0.49	0.53	0.74	0.65	3.83

Info Services 5 - Radio Technician (IS-5R) - DAS #1485

	Region					State
	1	2	3	4	5	Total
Existing	0.02	0.02	0.01	0.02	0.00	0.07
Existing + STIP	0.02	0.02	0.01	0.08	0.00	0.13
Existing + Strategic Plan	0.08	0.10	0.09	0.11	0.10	0.48

Info Services 5 - Networks / Servers (IS-5N) - DAS #1485

	Region					State
	1	2	3	4	5	Total
Existing	0.08	0.14	0.01	0.08	0.03	0.34
Existing + STIP	0.10	0.17	0.03	0.16	0.13	0.58
Existing + Strategic Plan	0.39	0.35	0.38	0.61	0.51	2.24

Info Services 6 - Radio Technician (IS-6R) - DAS #1486

	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.00	0.00	0.00	0.00	0.01
Existing + STIP	0.00	0.00	0.00	0.01	0.00	0.02
Existing + Strategic Plan	0.01	0.01	0.01	0.01	0.01	0.04

Info Services 6 - Networks / Servers (IS-6N) - DAS #1486

	Region					State
	1	2	3	4	5	Total
Existing	0.02	0.03	0.00	0.02	0.01	0.07
Existing + STIP	0.02	0.03	0.01	0.03	0.03	0.11
Existing + Strategic Plan	0.06	0.05	0.06	0.09	0.08	0.33

Info Services 6 - Software (IS-6S) - DAS #1486

	Region					State
	1	2	3	4	5	Total
Existing	0.00	1.06	0.00	0.00	0.00	1.06
Existing + STIP	0.00	1.40	0.00	0.00	0.00	1.40
Existing + Strategic Plan	0.00	1.40	0.00	0.00	0.00	1.40

Info Services 7 - Software (IS-7S) - DAS #1487

	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.01	0.00	0.00	0.00	0.01
Existing + STIP	0.00	0.01	0.00	0.00	0.00	0.01
Existing + Strategic Plan	0.00	0.01	0.00	0.00	0.00	0.01

Info Services - Fiber Optic Technician (IS-F) - DAS #

	Region					State
	1	2	3	4	5	Total
Existing	0.00	0.00	0.00	0.00	0.00	0.00
Existing + STIP	0.19	0.00	0.00	0.00	0.00	0.19
Existing + Strategic Plan	0.19	0.00	0.00	0.00	0.00	0.19

Electrician (ELEC) - DAS #4213

	Region					State
	1	2	3	4	5	Total
Existing	0.46	0.29	0.12	0.21	0.26	1.35
Existing + STIP	0.63	0.44	0.16	0.51	0.64	2.38
Existing + Strategic Plan	1.47	0.93	0.95	1.34	1.38	6.07

Traffic Signal Technician 3 (TS-3) - DAS #3411

	Region					State
	1	2	3	4	5	Total
Existing	0.03	0.03	0.02	0.02	0.05	0.14
Existing + STIP	0.04	0.04	0.02	0.05	0.09	0.23
Existing + Strategic Plan	0.06	0.04	0.09	0.09	0.16	0.44

Total

	Region					State
	1	2	3	4	5	Total
Existing	1.89	3.10	0.51	1.24	1.01	7.74
Existing + STIP	2.68	4.14	0.75	2.86	2.73	13.15
Existing + Strategic Plan	9.46	9.40	8.34	12.02	10.87	50.11

K.4 Resource Needs Estimates by Skill Set

Coordination

	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	0.10	0.33	0.04	0.09	0.05	0.61
Existing + STIP	0.14	0.38	0.05	0.18	0.13	0.88
Existing + Strategic Plan	1.04	1.40	1.37	1.55	1.48	6.83

Electrical / Electronics - Diagnostics

	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	0.26	0.31	0.10	0.18	0.25	1.09
Existing + STIP	0.36	0.41	0.12	0.41	0.51	1.82
Existing + Strategic Plan	0.73	0.76	0.87	1.38	1.26	4.99

Electrical / Electronics - Repair

	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	0.38	0.33	0.13	0.20	0.31	1.34
Existing + STIP	0.52	0.47	0.17	0.49	0.64	2.28
Existing + Strategic Plan	1.48	1.19	1.29	1.88	2.02	7.86

Electrical / Electronics - Preventative Maintenance

	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	0.30	0.23	0.08	0.17	0.17	0.94
Existing + STIP	0.42	0.33	0.12	0.39	0.45	1.71
Existing + Strategic Plan	1.34	1.04	1.10	1.46	1.39	6.33

Information Services - Diagnostics

	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	0.24	0.38	0.04	0.21	0.07	0.93
Existing + STIP	0.34	0.48	0.07	0.45	0.30	1.64
Existing + Strategic Plan	1.40	1.23	1.26	1.89	1.60	7.38

Information Services - Repair

	Region 1	Region 2	Region 3	Region 4	Region 5	State Total
Existing	0.14	0.26	0.03	0.16	0.05	0.64
Existing + STIP	0.26	0.33	0.05	0.39	0.22	1.25
Existing + Strategic Plan	1.27	1.15	1.22	1.93	1.60	7.18

Information Services - Preventative Maintenance

	Region					State
	1	2	3	4	5	Total
Existing	0.48	1.26	0.09	0.24	0.12	2.19
Existing + STIP	0.64	1.75	0.16	0.55	0.47	3.57
Existing + Strategic Plan	2.21	2.63	1.23	1.93	1.53	9.54

Total

	Region					State
	1	2	3	4	5	Total
Existing	1.89	3.10	0.51	1.24	1.01	7.74
Existing + STIP	2.68	4.14	0.75	2.86	2.73	13.15
Existing + Strategic Plan	9.46	9.40	8.34	12.02	10.87	50.11

APPENDIX L TRAINING ALTERNATIVES

This appendix describes five types of training that ODOT may apply in order to close gaps in in-house ITS maintenance capabilities.

L.1 Contractual Training

ODOT is increasingly requiring vendor-supplied training – for both operations and maintenance – as a component in procurement contracts. A continued emphasis on this training, especially as legacy systems are replaced by newer technologies, will allow ODOT staff to eventually become proficient in all device maintenance. This type of training would be especially applicable to field components themselves, such as controllers, sensors and displays, as well as in-vehicle components. This training would also be helpful for devices that use customized software interfaces or unfamiliar operating systems (such as UNIX).

The principal benefit of obtaining training by contract is that it takes advantage of the vendor's temporary presence in the state to minimize costs. The vendor will already be in the field in order to complete the punchlist for getting released from the contract. Consequently, providing training at that time would reduce or eliminate the need for vendor travel costs. Contractual training has an additional advantage of reducing the problems associated with device start-up. There may be significant maintenance issues during a device's initial operations period, such as unanticipated problems in interfacing with communications or power systems. With initial vendor-supplied training, ODOT staff may be able to diagnose many simple problems so that the vendor or contractor does not need to be summoned on an expensive repair visit.

There are two principal drawbacks in relying exclusively on contractual training. First, until legacy devices are replaced, there will always be parts of the ITS infrastructure which ODOT will not be able to efficiently and effectively maintain. Second, normal turnover of ODOT maintenance staff will mean that knowledge gained through contractual training will gradually tend to leave the organization. Eventually, unless other training efforts are used, there will be a single expert on maintaining a given device technology, which will create a single point-of-failure condition. Stakeholders have cited this as a current major maintenance concern.

L.2 Remedial Training

An alternative to using contractual training is the use of remedial training. A vendor or product supplier would provide remedial training, with the requirement that the vendor provide training at a central location within the state. This training should cover basic device operations, preventative maintenance, basic diagnostic procedures, and typical repair maintenance tasks.

Remedial training would be used primarily as a gap-filling measure due to many factors, such as trained personnel leaving the organization, inadequate training provided in the initial procurement contract, lack of cross-training within ODOT, or significant unforeseen maintenance issues unique to Oregon (such as water damage). Remedial training would involve a significant vendor cost, not only for the vendor's time in providing training but also for lodging and travel costs. Moreover, the training benefit to ODOT would likely be limited to the specific device without spillover benefits to maintaining other devices. For example, remedial training provided by one VMS manufacturer may provide some additional insight on how other VMS by other manufacturers may be maintained, but it may provide little aid in maintenance of RWIS.

As an alternative to contractual training, remedial training has the benefit of potentially yielding some savings in deployment cost. The magnitude of these savings will likely be slight. Moreover, most transportation agencies are increasingly incorporating training components into procurement, so vendors may increasingly base device cost estimates on such an expectation.

L.3 Development Training

Professional development or continuing education classes may offer opportunities for ODOT staff to improve their maintenance capabilities as well. It is unlikely that classes will provide education on specific field devices or technologies, but they may provide theoretical information about electronics that may applicable to many technologies. Development training would likely have greater potential benefit for computer or communications-related components, where ITS support requires a less-specific skill set.

Development training has the benefit of potentially providing ODOT staff with skills that would be applicable over a broad range of ITS devices and technologies, including devices that ODOT has not deployed yet. If development training is paid for by ODOT, it also provides an additional benefit for staff that may assist in employee recruitment and retention.

The biggest drawback for development training is that it may have limited applicability to field components, because it is difficult to learn topics such as electronics theory in a short course. Moreover, this type of training may require promotions and salary increases for maintenance staff that ODOT may be unable to sustain. Consequently, ODOT may end up investing significant time and resources in training its staff to help them, in essence, leave the organization.

L.4 Training Through Other Agencies

Instead of ODOT soliciting remedial training for its own staff, ODOT may seek opportunities to utilize training provided by vendors to other agencies, such as county and municipal departments of transportation, or departments of transportation in adjacent states. This would require sharing information with other agencies about when and where training is occurring. This could reduce the cost of training for ODOT significantly, but would be available or applicable only depending upon when other agencies deploy new technologies, and the manufacturers they utilize for this technology.

L.5 Internal Training

Another important training component to consider is internal training, where ODOT technicians obtain training on device maintenance from fellow technicians who have had either significant field experience with a specific device or who have obtained development training. This type of training could certainly be used in conjunction with other training methods as a way of effectively disseminating knowledge and skills across the organization.

The advantages of using internal training are many. This conserves the resources needed to send employees away to classes and training seminars. This allows for technicians to understand maintenance issues that are more specific to Oregon than may be appropriate in other parts of the country. It builds camaraderie among technicians. It will help to ensure that no technicians are "left behind" by having an obsolete skill set.

There are two primary drawbacks in using internal training. First, internal training will be valueless unless ODOT has technicians who are able to adequately understand and explain maintenance of a given device. Therefore, field experience and the ability to understand some of the theory behind the device's function would be invaluable. Second, internal training requires maintenance technicians to have time in their schedules to participate in training initiatives. The resource needs estimates produced in Chapter 6 assume that each employee involved in ITS maintenance would have an average of two weeks of paid training per year. In conversations with ODOT stakeholders, it does not appear that ODOT is currently providing this level of training consistently and continuously across the organization. The shortfall does not appear to be due to a lack of interest, but rather to a lack of time and competing priorities.

APPENDIX M CONTRACTING ACTIVITIES

This appendix describes in detail five different types of maintenance activities to which contractors may be assigned.

M.1 Preventative Maintenance

ODOT's experience, based on discussions with stakeholders, is that preventative maintenance of field devices tends to get neglected when staffing resources are constrained. Preventative maintenance activities are either never undertaken, or are performed when someone is "in the area." Using a contract for preventative maintenance activities ensures that this maintenance, critical for maintaining device longevity, is not neglected. ODOT may then devote resources to repair maintenance. One agency that has followed this idea is the North Carolina Department of Transportation in the Winston-Salem area, which has over 20 each of CCTV cameras and variable message signs (70).

Contracting for preventative maintenance has a few advantages. First, preventative maintenance tasks typically require a lesser skill base than response maintenance activities. Consequently, there may be a greater number of firms that could compete for a maintenance contract, even in rural areas. Second, providing for preventative maintenance through a contract ensures that this critical task is performed adequately and appropriately.

Contracting for preventative maintenance has some disadvantages as well. It may be difficult in some cases to ensure contractor compliance through quality control. In addition, if the contractor is not obligated to perform response maintenance as well, they may be less likely to make preemptive, non-contracted repairs in an effort to delay or avoid future device breakdowns. Without a significant number of devices, it may be difficult to make it cost-effective for a contractor to perform the work. Consequently, it may be more challenging to get a contractor for regions of the state with fewer devices deployed.

M.2 Repair Maintenance

As opposed to using contractors for preventative or routine maintenance activities, ODOT may use contract maintenance for repair maintenance. ODOT would follow a preventative maintenance program as recommended by device vendors, and then dispatch the repair contractor only when the device is malfunctioning. In contacts with various transportation agencies, no agency was identified that is exclusively contracting all repair maintenance activities.

The principal advantage of relying on contractors for repair maintenance is that it would help ODOT by providing assurance that devices will be restored to operation within a specified period of time, regardless of other time commitments currently experienced by maintenance staff. In some cases, repair maintenance may need special equipment that would be too expensive for ODOT to acquire given its infrequency of use. A contractor may be able to perform these services more cost-effectively if they are able to depreciate the equipment cost on other, non-ODOT maintenance activities.

In terms of disadvantages, the benefit of having assured response time can come with a significant cost. For systems that are critical to operations on a 24-hour-a-day, 7-day-a-week basis, there may be a significant price premium on repairs performed during evening or weekend hours. In addition, contractors often tend to not perceive ownership in the system, and may be reluctant to perform repair maintenance with the immediacy requested by ODOT.

M.3 Low-Level Maintenance

One variation of contracting repair maintenance is for an agency to contract low-level or low-difficulty repair maintenance tasks, while performing more challenging repairs with existing staff. In contacts with various agencies around the country, no agency was identified as currently pursuing this type of contract maintenance strategy.

The advantage of contracting simpler maintenance tasks, like contracting preventative maintenance activities, is that it would increase the pool of potential contractors. By using contractors for simpler tasks, ODOT staff would need to gain increased knowledge and skills to perform high-level maintenance. This allows ODOT staff to continue to enhance their skills, improving employee recruitment and retention. On the other hand, low-level maintenance needs will often be able to be more quickly addressed by ODOT staff than a contractor, so responsiveness may suffer. By contracting only some repair maintenance activities, repair visits may require two trips – one by the contractor and one by ODOT technicians – to restore operations; this increases repair cost and downtime.

M.4 High-Level Maintenance

As opposed to the prior alternative, an agency may elect to contract out for high-level maintenance. The agency will take a repair through several levels of diagnosis, but at some point – if the repair has not been resolved – will dispatch the contractor. That point could be determined either by the absence of appropriate equipment or skills.

Many agencies – including ODOT, the Colorado Department of Transportation (125), the City of Bellevue [WA] (126) and the Maine Turnpike Authority (127) – use vendors for high-level maintenance by default when their in-house expertise is limited. Therefore, this alternative is consistent with the organizational philosophy of many transportation agencies, which may be perceived as beneficial. Moreover, because high-level maintenance activities are infrequent, agencies may use contract this maintenance to help reduce their training and staff salary costs.

One primary disadvantage of applying this approach on a statewide basis is that it may be difficult to obtain high-level maintenance expertise in rural regions. Contractors may either not elect to bid on work in such regions, or they may charge a premium for services in urban areas to subsidize service to rural areas. This approach also has the potential of hindering the career development path of maintenance technicians. This may increase the difficulty of employee recruitment and retention.

M.5 Select Devices

If an agency deploys an ITS device for which they have no current skill base, it may make sense to use contract maintenance for that device, although the agency may maintain other devices in-house. ODOT has used this approach with the Motor Carrier Transportation Division, for which preventative and repair maintenance on weigh-in-motion systems are contracted. The New Jersey Turnpike has used this approach for fiber optic maintenance, although it continues to perform all other ITS maintenance in-house (68). In some cases, an agency may decide to use maintenance contracts for individual ITS elements, without respect to the technical skill required for device maintenance, such as in the Wisconsin Department of Transportation's metropolitan Milwaukee district (49). Contracts could be developed as extended warranties following deployment of different types of devices.

This approach has the advantage of being readily compatible with procurement schedules. It also would encourage ODOT to contract out maintenance on those items where either their technical expertise and equipment is not fully developed yet – such as fiber optic networks – or where it would be especially cost-effective to do so – such as kiosks. A disadvantage in using contracting for select devices, especially as an extension of warranty service provided through procurement, is that it can put the agency at the mercy of the vendor for continued maintenance. This approach would not encourage ODOT to ever develop maintenance expertise on these devices, increasing the likelihood that ODOT could get involved in unbalanced contracts. This type of approach would also not work for deployments with a limited number of devices.

APPENDIX N DETAILED BUDGET

N.1 Maintenance Budget by Device

In the following tables, maintenance coordination staffing time is allocated to each appropriate device.

N.1.1 Existing Deployment

Closed-Circuit Television (CCTV)

		Region					State
		1	2	3	4	5	
Staffing	Salary Cost	26,644	4,089	894	12,434	1,100	45,161
	Fringe (70%)	18,651	2,862	626	8,704	770	31,613
Spare Parts		14,700	1,750	350	3,550	350	20,700
Replacement		124,725	15,750	3,150	31,575	3,150	178,350
Device Total		184,720	24,451	5,020	56,263	5,370	275,824

Video Detectors

		Region					State
		1	2	3	4	5	
Staffing	Salary Cost	-	1,595	-	-	-	1,595
	Fringe (70%)	-	1,117	-	-	-	1,117
Spare Parts		-	1,000	-	-	-	1,000
Replacement		-	9,000	-	-	-	9,000
Device Total		-	12,712	-	-	-	12,712

Road and Weather Information System (RWIS)

		Region					State
		1	2	3	4	5	
Staffing	Salary Cost	9,209	10,004	3,534	21,221	3,937	47,905
	Fringe (70%)	6,446	7,003	2,474	14,855	2,756	33,534
Spare Parts		1,250	900	250	1,650	250	4,300
Replacement		10,875	7,350	1,875	14,475	1,875	36,450
Device Total		27,780	25,257	8,133	52,201	8,818	122,189

Automatic Vehicle Location (AVL)

		Region					State
		1	2	3	4	5	
Staffing	Salary Cost	2,738	-	-	-	-	2,738
	Fringe (70%)	1,917	-	-	-	-	1,917
Spare Parts		60	-	-	-	-	60
Replacement		390	-	-	-	-	390
Device Total		5,105	-	-	-	-	5,105

Advanced Traffic Management System

		Region 1	Region 2	Region 3	Region 4	Region 5	State
Staffing	Salary Cost	16,216	15,997	-	-	-	32,213
	Fringe (70%)	11,351	11,198	-	-	-	22,549
Replacement		825	-	-	-	-	825
Device Total		28,392	27,195	-	-	-	55,587

Callboxes

		Region 1	Region 2	Region 3	Region 4	Region 5	State
Staffing	Salary Cost	-	-	759	-	-	759
	Fringe (70%)	-	-	531	-	-	531
Replacement		-	-	2,700	-	-	2,700
Device Total		-	-	3,990	-	-	3,990

Computer-Aided Dispatch

		Region 1	Region 2	Region 3	Region 4	Region 5	State
Staffing	Salary Cost	-	3,183	1,273	1,273	-	5,729
	Fringe (70%)	-	2,228	891	891	-	4,010
Replacement		-	188	75	75	-	338
Device Total		-	5,599	2,239	2,239	-	10,077

Incident Response Vehicles

		Region 1	Region 2	Region 3	Region 4	Region 5	State
Staffing	Salary Cost	4,916	-	-	-	-	4,916
	Fringe (70%)	3,441	-	-	-	-	3,441
Spare Parts		1,050	-	-	-	-	1,050
Replacement		18,900	-	-	-	-	18,900
Device Total		28,307	-	-	-	-	28,307

Alphanumeric Paging

		Region 1	Region 2	Region 3	Region 4	Region 5	State
Staffing	Salary Cost	68	-	-	-	-	68
	Fringe (70%)	48	-	-	-	-	48
Device Total		116	-	-	-	-	116

800-number Information

		Region 1	2	3	4	5	State
Staffing	Salary Cost	-	11,278	-	-	-	11,278
	Fringe (70%)	-	7,895	-	-	-	7,895
Replacement		-	75	-	-	-	75
Device Total		-	19,248	-	-	-	19,248

Internet Access

		Region 1	2	3	4	5	State
Staffing	Salary Cost	-	35,669	-	-	-	35,669
	Fringe (70%)	-	24,968	-	-	-	24,968
Replacement		-	75	-	-	-	75
Device Total		-	60,712	-	-	-	60,712

Icy Bridge Warning CMS

		Region 1	2	3	4	5	State
Staffing	Salary Cost	-	-	548	-	-	548
	Fringe (70%)	-	-	384	-	-	384
Spare Parts		-	-	50	-	-	50
Replacement		-	-	450	-	-	450
Device Total		-	-	1,432	-	-	1,432

Tunnel Lane Closure CMS

		Region 1	2	3	4	5	State
Staffing	Salary Cost	386	-	-	-	-	386
	Fringe (70%)	270	-	-	-	-	270
Spare Parts		50	-	-	-	-	50
Replacement		450	-	-	-	-	450
Device Total		1,156	-	-	-	-	1,156

Radio-Controlled Snow Zone CMS

		Region 1	2	3	4	5	State
Staffing	Salary Cost	-	-	-	3,376	-	3,376
	Fringe (70%)	-	-	-	2,363	-	2,363
Spare Parts		-	-	-	200	-	200
Replacement		-	-	-	1,800	-	1,800
Device Total		-	-	-	7,739	-	7,739

Telephone-Activated Snow Zone CMS

		Region					State
		1	2	3	4	5	
Staffing	Salary Cost	-	-	-	-	5,430	5,430
	Fringe (70%)	-	-	-	-	3,801	3,801
Spare Parts		-	-	-	-	400	400
Replacement		-	-	-	-	3,600	3,600
Device Total		-	-	-	-	13,231	13,231

Oversize Vehicle Restriction CMS

		Region					State
		1	2	3	4	5	
Staffing	Salary Cost	-	870	-	-	-	870
	Fringe (70%)	-	609	-	-	-	609
Spare Parts		-	50	-	-	-	50
Replacement		-	450	-	-	-	450
Device Total		-	1,979	-	-	-	1,979

Permanent Variable Message Signs

		Region					State
		1	2	3	4	5	
Staffing	Salary Cost	18,502	10,448	5,039	3,552	14,627	52,168
	Fringe (70%)	12,951	7,314	3,527	2,486	10,239	36,517
Spare Parts		7,500	3,125	1,250	625	3,125	15,625
Replacement		135,000	56,250	22,500	11,250	56,250	281,250
Device Total		173,953	77,137	32,316	17,913	84,241	385,560

Portable Variable Message Signs

		Region					State
		1	2	3	4	5	
Staffing	Salary Cost	1,942	47,416	-	11,271	-	60,629
	Fringe (70%)	1,359	33,191	-	7,890	-	42,440
Spare Parts		150	2,850	-	450	-	3,450
Replacement		2,700	51,300	-	8,100	-	62,100
Device Total		6,151	134,757	-	27,711	-	168,619

Highway Advisory Radio (HAR)

		Region					State
		1	2	3	4	5	
Staffing	Salary Cost	-	-	741	-	-	741
	Fringe (70%)	-	-	519	-	-	519
Spare Parts		-	-	500	-	-	500
Replacement		-	-	4,750	-	-	4,750
Device Total		-	-	6,510	-	-	6,510

Icy Bridge Detectors

		Region 1	2	3	4	5	State
Staffing	Salary Cost	588	-	-	-	-	588
	Fringe (70%)	412	-	-	-	-	412
Spare Parts		250	-	-	-	-	250
Replacement		2,000	-	-	-	-	2,000
Device Total		3,250	-	-	-	-	3,250

Queue Detection System

		Region 1	2	3	4	5	State
Staffing	Salary Cost	-	653	-	-	-	653
	Fringe (70%)	-	457	-	-	-	457
Spare Parts		-	50	-	-	-	50
Replacement		-	225	-	-	-	225
Device Total		-	1,385	-	-	-	1,385

Weigh-in-Motion (WIM) Stations

		Region 1	2	3	4	5	State
Staffing	Salary Cost	-	72	144	-	180	396
	Fringe (70%)	-	50	101	-	126	277
Spare Parts		-	522	1,044	-	1,305	2,871
Replacement		-	4,698	9,396	-	11,745	25,839
Vendor Costs		-	6,484	12,967	-	16,209	35,660
Device Total		-	11,826	23,652	-	29,565	65,043

Downhill Speed Advisory Systems

		Region 1	2	3	4	5	State
Staffing	Salary Cost	-	-	-	-	2,781	2,781
	Fringe (70%)	-	-	-	-	1,947	1,947
Spare Parts		-	-	-	-	411	411
Replacement		-	-	-	-	3,699	3,699
Vendor Costs		-	-	-	-	4,545	4,545
Device Total		-	-	-	-	13,383	13,383

Radio Communications

		Region					State
		1	2	3	4	5	
Staffing	Salary Cost	1,353	1,736	763	1,106	-	4,958
	Fringe (70%)	947	1,215	534	774	-	3,470
Spare Parts		335	375	150	150	-	1,010
Replacement		3,015	3,375	1,350	1,350	-	9,090
Device Total		5,650	6,701	2,797	3,380	-	18,528

All Devices

		Region					State
		1	2	3	4	5	
Staffing	Salary Cost	82,562	143,010	13,695	54,233	28,055	321,555
	Fringe (70%)	57,793	100,107	9,587	37,963	19,639	225,089
Spare Parts		25,345	10,622	3,594	6,625	5,841	52,027
Replacement		298,880	148,736	46,246	68,625	80,319	642,806
Vendor Costs		-	6,484	12,967	-	20,754	40,205
Device Total		464,580	408,959	86,089	167,446	154,608	1,281,682

N.1.2 STIP Deployment

Closed-Circuit Television (CCTV)

		Region 1	Region 2	Region 3	Region 4	Region 5	State
Staffing	Salary Cost	30,987	5,725	894	18,543	19,802	75,951
	Fringe (70%)	21,691	4,008	626	12,980	13,861	53,166
Spare Parts		17,150	2,450	350	5,300	6,300	31,550
Replacement		146,775	22,050	3,150	47,325	56,700	276,000
Test Equipment		1,060	1,060	1,060	1,060	1,060	5,300
Device Total		217,663	35,293	6,080	85,208	97,723	441,967

Video Detection Systems

		Region 1	Region 2	Region 3	Region 4	Region 5	State
Staffing	Salary Cost	-	1,994	-	566	-	2,560
	Fringe (70%)	-	1,396	-	396	-	1,792
Spare Parts		-	1,250	-	250	-	1,500
Replacement		-	11,250	-	2,250	-	13,500
Device Total		-	15,890	-	3,462	-	19,352

Road and Weather Information System (RWIS)

		Region 1	Region 2	Region 3	Region 4	Region 5	State
Staffing	Salary Cost	12,935	18,184	8,866	38,253	45,365	123,603
	Fringe (70%)	9,055	12,729	6,206	26,777	31,756	86,523
Spare Parts		1,850	1,900	850	3,050	4,050	11,700
Replacement		16,275	16,350	7,275	27,075	36,075	103,050
Device Total		40,115	49,163	23,197	95,155	117,246	324,876

Automatic Vehicle Location (AVL)

		Region 1	Region 2	Region 3	Region 4	Region 5	State
Staffing	Salary Cost	3,001	2,691	-	14,710	-	20,402
	Fringe (70%)	2,101	1,884	-	10,297	-	14,282
Spare Parts		60	45	-	225	-	330
Replacement		390	255	-	1,875	-	2,520
Device Total		5,552	4,875	-	27,107	-	37,534

Advanced Traffic Management System

		Region 1	Region 2	Region 3	Region 4	Region 5	State
Staffing	Salary Cost	16,762	15,997	-	-	-	32,759
	Fringe (70%)	11,733	11,198	-	-	-	22,931
Replacement		863	-	-	-	-	863
Device Total		29,358	27,195	-	-	-	56,553

Mayday Callboxes

		Region 1	Region 2	Region 3	Region 4	Region 5	State
Staffing	Salary Cost	-	-	759	-	-	759
	Fringe (70%)	-	-	531	-	-	531
Replacement		-	-	2,700	-	-	2,700
Device Total		-	-	3,990	-	-	3,990

Urban Automatic Incident Detection System

		Region 1	Region 2	Region 3	Region 4	Region 5	State
Staffing	Salary Cost	1,965	-	-	-	-	1,965
	Fringe (70%)	1,376	-	-	-	-	1,376
Replacement		75	-	-	-	-	75
Device Total		3,416	-	-	-	-	3,416

Intersection-Based Incident Detection System

		Region 1	Region 2	Region 3	Region 4	Region 5	State
Staffing	Salary Cost	-	1,024	-	1,668	-	2,692
	Fringe (70%)	-	717	-	1,168	-	1,885
Replacement		-	75	-	75	-	150
Device Total		-	1,816	-	2,911	-	4,727

Computer-Aided Dispatch

		Region 1	Region 2	Region 3	Region 4	Region 5	State
Staffing	Salary Cost	-	3,183	1,273	1,273	-	5,729
	Fringe (70%)	-	2,228	891	891	-	4,010
Replacement		-	188	75	75	-	338
Device Total		-	5,599	2,239	2,239	-	10,077

Incident Response Vehicles

		Region 1	Region 2	Region 3	Region 4	Region 5	State
Staffing	Salary Cost	4,916	2,809	-	-	-	7,725
	Fringe (70%)	3,441	1,966	-	-	-	5,407
Spare Parts		1,050	600	-	-	-	1,650
Replacement		18,900	10,800	-	-	-	29,700
Device Total		28,307	16,175	-	-	-	44,482

Alpha-Numeric Paging

		Region 1	Region 2	Region 3	Region 4	Region 5	State
Staffing	Salary Cost	68	-	-	-	-	68
	Fringe (70%)	48	-	-	-	-	48
Device Total		116	-	-	-	-	116

Highway Travel Conditions Reporting System

		Region 1	Region 2	Region 3	Region 4	Region 5	State
Staffing	Salary Cost	-	21,334	-	-	-	21,334
	Fringe (70%)	-	14,934	-	-	-	14,934
Device Total		-	36,268	-	-	-	36,268

800-number information

		Region 1	Region 2	Region 3	Region 4	Region 5	State
Staffing	Salary Cost	-	11,278	-	-	-	11,278
	Fringe (70%)	-	7,895	-	-	-	7,895
Replacement		-	75	-	-	-	75
Device Total		-	19,248	-	-	-	19,248

Internet access

		Region 1	Region 2	Region 3	Region 4	Region 5	State
Staffing	Salary Cost	-	35,669	-	-	-	35,669
	Fringe (70%)	-	24,968	-	-	-	24,968
Replacement		-	75	-	-	-	75
Device Total		-	60,712	-	-	-	60,712

Icy Bridge Warning System (Low-Tech)

		Region 1	Region 2	Region 3	Region 4	Region 5	State
Staffing	Salary Cost	-	-	548	-	-	548
	Fringe (70%)	-	-	384	-	-	384
Spare Parts		-	-	50	-	-	50
Replacement		-	-	450	-	-	450
Device Total		-	-	1,432	-	-	1,432

Tunnel lane closure advisory

		Region 1	Region 2	Region 3	Region 4	Region 5	State
Staffing	Salary Cost	386	-	-	-	-	386
	Fringe (70%)	270	-	-	-	-	270
Spare Parts		50	-	-	-	-	50
Replacement		450	-	-	-	-	450
Device Total		1,156	-	-	-	-	1,156

Snow Zone Advisory

		Region 1	Region 2	Region 3	Region 4	Region 5	State
Staffing	Salary Cost	-	-	-	3,376	-	3,376
	Fringe (70%)	-	-	-	2,363	-	2,363
Spare Parts		-	-	-	200	-	200
Replacement		-	-	-	1,800	-	1,800
Device Total		-	-	-	7,739	-	7,739

Snow Zone Changeable Message Sign

		Region 1	Region 2	Region 3	Region 4	Region 5	State
Staffing	Salary Cost	-	-	-	-	5,430	5,430
	Fringe (70%)	-	-	-	-	3,801	3,801
Spare Parts		-	-	-	-	400	400
Replacement		-	-	-	-	3,600	3,600
Device Total		-	-	-	-	13,231	13,231

Oversize Vehicle Closure CMS

		Region 1	Region 2	Region 3	Region 4	Region 5	State
Staffing	Salary Cost	-	870	-	-	-	870
	Fringe (70%)	-	609	-	-	-	609
Spare Parts		-	50	-	-	-	50
Replacement		-	450	-	-	-	450
Device Total		-	1,979	-	-	-	1,979

Permanent Variable Message Signs (VMS)

		Region 1	Region 2	Region 3	Region 4	Region 5	State
Staffing	Salary Cost	24,651	18,764	5,039	3,552	29,200	81,206
	Fringe (70%)	17,256	13,135	3,527	2,486	20,440	56,844
Spare Parts		10,000	5,625	1,250	625	6,250	23,750
Replacement		180,000	101,250	22,500	11,250	112,500	427,500
Device Total		231,907	138,774	32,316	17,913	168,390	589,300

Portable Variable Message Signs (VMS)

		Region 1	Region 2	Region 3	Region 4	Region 5	State
Staffing	Salary Cost	1,942	47,416	-	18,748	-	68,106
	Fringe (70%)	1,359	33,191	-	13,124	-	47,674
Spare Parts		150	2,850	-	750	-	3,750
Replacement		2,700	51,300	-	13,500	-	67,500
Device Total		6,151	134,757	-	46,122	-	187,030

Highway Advisory Radio (HAR)

		Region 1	Region 2	Region 3	Region 4	Region 5	State
Staffing	Salary Cost	-	-	741	-	-	741
	Fringe (70%)	-	-	519	-	-	519
Spare Parts		-	-	500	-	-	500
Replacement		-	-	4,750	-	-	4,750
Device Total		-	-	6,510	-	-	6,510

Icy Bridge Detectors

		Region 1	Region 2	Region 3	Region 4	Region 5	State
Staffing	Salary Cost	902	-	-	-	-	902
	Fringe (70%)	631	-	-	-	-	631
Spare Parts		250	-	-	-	-	250
Replacement		2,000	-	-	-	-	2,000
Device Total		3,783	-	-	-	-	3,783

Oversize load detectors

		Region 1	Region 2	Region 3	Region 4	Region 5	State
Staffing	Salary Cost	-	-	-	9,156	-	9,156
	Fringe (70%)	-	-	-	6,409	-	6,409
Spare Parts		-	-	-	1,250	-	1,250
Replacement		-	-	-	10,000	-	10,000
Device Total		-	-	-	26,815	-	26,815

Queue Detection System

		Region 1	Region 2	Region 3	Region 4	Region 5	State
Staffing	Salary Cost	-	653	-	-	-	653
	Fringe (70%)	-	457	-	-	-	457
Spare Parts		-	50	-	-	-	50
Replacement		-	225	-	-	-	225
Device Total		-	1,385	-	-	-	1,385

Weigh-in-Motion (WIM) Stations

		Region 1	Region 2	Region 3	Region 4	Region 5	State
Staffing	Salary Cost	180	108	144	144	180	756
	Fringe (70%)	126	76	101	101	126	530
Spare Parts		1,305	783	1,044	1,044	1,305	5,481
Replacement		11,745	7,047	9,396	9,396	11,745	49,329
Vendor Costs		16,209	9,726	12,967	12,967	16,209	68,078
Device Total		29,565	17,740	23,652	23,652	29,565	124,174

Downhill Speed Advisory Systems

		Region 1	Region 2	Region 3	Region 4	Region 5	State
Staffing	Salary Cost	-	-	2,208	-	2,781	4,989
	Fringe (70%)	-	-	1,546	-	1,947	3,493
Spare Parts		-	-	411	-	411	822
Replacement		-	-	3,699	-	3,699	7,398
Vendor Costs		-	-	4,545	-	4,545	9,090
Device Total		-	-	12,409	-	13,383	25,792

Fiber optic networks

		Region 1	Region 2	Region 3	Region 4	Region 5	State
Staffing	Salary Cost	198	-	-	-	-	198
	Fringe (70%)	139	-	-	-	-	139
Spare Parts		400	-	-	-	-	400
Replacement		7,600	-	-	-	-	7,600
Vendor Costs		24,319	-	-	-	-	24,319
Device Total		32,656	-	-	-	-	32,656

Radio Communications

		Region 1	Region 2	Region 3	Region 4	Region 5	State
Staffing	Salary Cost	1,353	1,951	763	3,250	-	7,317
	Fringe (70%)	947	1,366	534	2,275	-	5,122
Spare Parts		335	395	150	350	-	1,230
Replacement		3,015	3,555	1,350	3,150	-	11,070
Device Total		5,650	7,267	2,797	9,025	-	24,739

Maintenance Coordination

		Region					State
		1	2	3	4	5	
Staffing	Salary Cost	600	600	600	600	600	3,000
	Fringe (70%)	420	420	420	420	420	2,100
Replacement		38	38	38	38	38	190
Test Equipment		8,000	8,000	8,000	8,000	8,000	40,000
Device Total		9,058	9,058	9,058	9,058	9,058	45,290

All Devices

		Region					State
		1	2	3	4	5	
Staffing	Salary Cost	100,846	190,250	21,835	113,839	103,358	530,128
	Fringe (70%)	70,593	133,177	15,285	79,687	72,351	371,093
Spare Parts		32,600	15,998	4,605	13,044	18,716	84,963
Replacement		390,826	224,983	55,383	127,809	224,357	1,023,358
Test Equipment		9,060	9,060	9,060	9,060	9,060	45,300
Vendor Costs		40,528	9,726	17,512	12,967	20,754	101,487
Device Total		644,453	583,194	123,680	356,406	448,596	2,156,329

N.1.3 Strategic Plan Deployment

Closed-Circuit Television (CCTV)

		Region					State
		1	2	3	4	5	
Staffing	Salary Cost	30,698	15,778	16,120	23,263	15,802	101,661
	Fringe (70%)	21,489	11,045	11,284	16,284	11,061	71,163
Spare Parts		42,700	15,750	14,350	14,050	10,850	97,700
Replacement		376,725	141,750	129,150	126,075	97,650	871,350
Vendor Costs		66,901	25,299	23,050	22,488	17,428	155,166
Device Total		538,513	209,622	193,954	202,160	152,791	1,297,040

Video Detectors

		Region					State
		1	2	3	4	5	
Staffing	Salary Cost	19,567	1,609	-	487	-	21,663
	Fringe (70%)	13,697	1,126	-	341	-	15,164
Spare Parts		25,000	1,250	-	250	-	26,500
Replacement		225,000	11,250	-	2,250	-	238,500
Device Total		283,264	15,235	-	3,328	-	301,827

Road and Weather Information System (RWIS)

		Region					State
		1	2	3	4	5	
Staffing	Salary Cost	3,030	5,875	4,291	6,310	5,121	24,627
	Fringe (70%)	2,121	4,113	3,004	4,417	3,585	17,240
Spare Parts		2,850	4,900	4,850	7,450	5,850	25,900
Replacement		25,275	43,350	43,275	66,675	52,275	230,850
Vendor Costs		32,017	54,886	54,886	84,616	66,320	292,725
Device Total		65,293	113,124	110,306	169,468	133,151	591,342

Travel Time Estimation

		Region					State
		1	2	3	4	5	
Staffing	Salary Cost	1,462	-	-	-	-	1,462
	Fringe (70%)	1,023	-	-	-	-	1,023
Spare Parts		6,025	-	-	-	-	6,025
Replacement		54,075	-	-	-	-	54,075
Vendor Costs		127,528	-	-	-	-	127,528
Device Total		190,113	-	-	-	-	190,113

Automatic Vehicle Location (AVL)

		Region					State
		1	2	3	4	5	
Staffing	Salary Cost	7,984	9,936	10,304	13,712	12,349	54,285
	Fringe (70%)	5,589	6,955	7,213	9,598	8,644	37,999
Spare Parts		560	545	525	525	525	2,680
Replacement		4,890	4,755	4,575	4,575	4,575	23,370
Vendor Costs		21,355	20,756	19,958	19,958	19,958	101,985
Device Total		40,378	42,947	42,575	48,368	46,051	220,319

Advanced Traffic Management System

		Region					State
		1	2	3	4	5	
Staffing	Salary Cost	16,126	24,306	8,310	8,310	8,310	65,362
	Fringe (70%)	11,288	17,014	5,817	5,817	5,817	45,753
Replacement		863	300	300	300	300	2,063
Device Total		28,277	41,620	14,427	14,427	14,427	113,178

Callboxes

		Region					State
		1	2	3	4	5	
Staffing	Salary Cost	-	-	759	-	-	759
	Fringe (70%)	-	-	531	-	-	531
Replacement		-	-	2,700	-	-	2,700
Device Total		-	-	3,990	-	-	3,990

Regional Incident Detection System

		Region					State
		1	2	3	4	5	
Staffing	Salary Cost	1,924	-	-	-	-	1,924
	Fringe (70%)	1,347	-	-	-	-	1,347
Replacement		75	-	-	-	-	75
Device Total		3,346	-	-	-	-	3,346

Intersection-Based Incident Detection System

		Region					State
		1	2	3	4	5	
Staffing	Salary Cost	-	1,014	-	1,655	-	2,669
	Fringe (70%)	-	710	-	1,159	-	1,869
Replacement		-	75	-	75	-	150
Device Total		-	1,799	-	2,889	-	4,688

Computer-Aided Dispatch

		Region 1	Region 2	Region 3	Region 4	Region 5	State
Staffing	Salary Cost	-	3,044	1,218	1,218	-	5,480
	Fringe (70%)	-	2,131	853	853	-	3,837
Replacement		-	188	75	75	-	338
Device Total		-	5,363	2,146	2,146	-	9,655

Incident Response Vehicles

		Region 1	Region 2	Region 3	Region 4	Region 5	State
Staffing	Salary Cost	3,838	2,193	-	-	-	6,031
	Fringe (70%)	2,687	1,535	-	-	-	4,222
Spare Parts		1,050	600	-	-	-	1,650
Replacement		18,900	10,800	-	-	-	29,700
Device Total		26,475	15,128	-	-	-	41,603

Pre-Planned Detour Routes

		Region 1	Region 2	Region 3	Region 4	Region 5	State
Staffing	Salary Cost	108	108	108	108	-	432
	Fringe (70%)	76	76	76	76	-	304
Device Total		184	184	184	184	-	736

Hazardous Material Response

		Region 1	Region 2	Region 3	Region 4	Region 5	State
Staffing	Salary Cost	-	1,787	-	-	-	1,787
	Fringe (70%)	-	1,251	-	-	-	1,251
Replacement		-	75	-	-	-	75
Device Total		-	3,113	-	-	-	3,113

Alphanumeric Paging

		Region 1	Region 2	Region 3	Region 4	Region 5	State
Staffing	Salary Cost	68	-	-	-	-	68
	Fringe (70%)	48	-	-	-	-	48
Device Total		116	-	-	-	-	116

Highway Travel Conditions Reporting System

		Region 1	Region 2	Region 3	Region 4	Region 5	State
Staffing	Salary Cost	-	21,297	-	-	-	21,297
	Fringe (70%)	-	14,908	-	-	-	14,908
Device Total		-	36,205	-	-	-	36,205

800-number Information

		Region 1	Region 2	Region 3	Region 4	Region 5	State
Staffing	Salary Cost	-	11,197	-	-	-	11,197
	Fringe (70%)	-	7,838	-	-	-	7,838
Replacement		-	75	-	-	-	75
Device Total		-	19,110	-	-	-	19,110

Internet Access

		Region 1	Region 2	Region 3	Region 4	Region 5	State
Staffing	Salary Cost	-	35,628	-	-	-	35,628
	Fringe (70%)	-	24,940	-	-	-	24,940
Replacement		-	75	-	-	-	75
Device Total		-	60,643	-	-	-	60,643

Kiosks

		Region 1	Region 2	Region 3	Region 4	Region 5	State
Staffing	Salary Cost	1,680	543	431	431	431	3,516
	Fringe (70%)	1,176	380	302	302	302	2,462
Spare Parts		17,550	4,550	4,500	4,500	4,500	35,600
Replacement		150,429	38,646	38,571	38,571	38,571	304,788
Vendor Costs		111,727	38,365	28,648	28,648	28,648	236,036
Device Total		282,562	82,484	72,452	72,452	72,452	582,402

Icy Bridge Warning CMS

		Region 1	Region 2	Region 3	Region 4	Region 5	State
Staffing	Salary Cost	-	-	538	-	-	538
	Fringe (70%)	-	-	377	-	-	377
Spare Parts		-	-	50	-	-	50
Replacement		-	-	450	-	-	450
Device Total		-	-	1,415	-	-	1,415

Tunnel Lane Closure CMS

		Region					State
		1	2	3	4	5	
Staffing	Salary Cost	381	-	-	-	-	381
	Fringe (70%)	267	-	-	-	-	267
Spare Parts		50	-	-	-	-	50
Replacement		450	-	-	-	-	450
Device Total		1,148	-	-	-	-	1,148

Radio-Controlled Snow Zone CMS

		Region					State
		1	2	3	4	5	
Staffing	Salary Cost	-	-	-	3,172	-	3,172
	Fringe (70%)	-	-	-	2,220	-	2,220
Spare Parts		-	-	-	200	-	200
Replacement		-	-	-	1,800	-	1,800
Device Total		-	-	-	7,392	-	7,392

Telephone-Activated Snow Zone CMS

		Region					State
		1	2	3	4	5	
Staffing	Salary Cost	-	-	-	-	5,275	5,275
	Fringe (70%)	-	-	-	-	3,693	3,693
Spare Parts		-	-	-	-	400	400
Replacement		-	-	-	-	3,600	3,600
Device Total		-	-	-	-	12,968	12,968

Oversize Vehicle Restriction CMS

		Region					State
		1	2	3	4	5	
Staffing	Salary Cost	-	837	-	-	-	837
	Fringe (70%)	-	586	-	-	-	586
Spare Parts		-	50	-	-	-	50
Replacement		-	450	-	-	-	450
Device Total		-	1,923	-	-	-	1,923

Permanent Variable Message Signs

		Region					State
		1	2	3	4	5	
Staffing	Salary Cost	24,544	10,113	2,554	1,870	29,883	68,964
	Fringe (70%)	17,181	7,079	1,788	1,309	20,918	48,275
Spare Parts		20,000	5,625	1,250	625	11,250	38,750
Replacement		360,000	101,250	22,500	11,250	202,500	697,500
Vendor Costs		27,265	7,788	2,216	1,192	15,409	53,870
Device Total		448,990	131,855	30,308	16,246	279,960	907,359

Portable Variable Message Signs

		Region					State
		1	2	3	4	5	
Staffing	Salary Cost	1,652	2,680	2,708	2,762	2,708	12,510
	Fringe (70%)	1,156	1,876	1,896	1,933	1,896	8,757
Spare Parts		9,150	14,850	15,000	15,300	15,000	69,300
Replacement		164,700	267,300	270,000	275,400	270,000	1,247,400
Vendor Costs		144,588	234,590	236,958	241,695	236,958	1,094,789
Device Total		321,246	521,296	526,562	537,090	526,562	2,432,756

Highway Advisory Radio (HAR)

		Region					State
		1	2	3	4	5	
Staffing	Salary Cost	-	-	710	-	-	710
	Fringe (70%)	-	-	497	-	-	497
Spare Parts		-	-	500	-	-	500
Replacement		-	-	4,750	-	-	4,750
Device Total		-	-	6,457	-	-	6,457

Icy Bridge Detectors

		Region					State
		1	2	3	4	5	
Staffing	Salary Cost	103	82	82	82	82	431
	Fringe (70%)	72	57	57	57	57	300
Spare Parts		1,250	1,000	1,000	1,000	1,000	5,250
Replacement		10,000	8,000	8,000	8,000	8,000	42,000
Vendor Costs		9,078	7,263	7,263	7,263	7,263	38,130
Device Total		20,503	16,402	16,402	16,402	16,402	86,111

Oversize Load Detectors

		Region 1	Region 2	Region 3	Region 4	Region 5	State
Staffing	Salary Cost	-	-	-	100	-	100
	Fringe (70%)	-	-	-	70	-	70
Spare Parts		-	-	-	1,250	-	1,250
Replacement		-	-	-	10,000	-	10,000
Vendor Costs		-	-	-	8,791	-	8,791
Device Total		-	-	-	20,211	-	20,211

Variable Speed Limit Signs

		Region 1	Region 2	Region 3	Region 4	Region 5	State
Staffing	Salary Cost	50	75	126	126	126	503
	Fringe (70%)	35	53	88	88	88	352
Spare Parts		500	750	1,250	1,250	1,250	5,000
Replacement		4,000	6,000	10,000	10,000	10,000	40,000
Vendor Costs		4,416	6,625	11,041	11,041	11,041	44,164
Device Total		9,001	13,503	22,505	22,505	22,505	90,019

Queue Detection System

		Region 1	Region 2	Region 3	Region 4	Region 5	State
Staffing	Salary Cost	-	645	-	-	-	645
	Fringe (70%)	-	452	-	-	-	452
Spare Parts		-	50	-	-	-	50
Replacement		-	225	-	-	-	225
Device Total		-	1,372	-	-	-	1,372

Weigh-in-Motion (WIM) Stations

		Region 1	Region 2	Region 3	Region 4	Region 5	State
Staffing	Salary Cost	179	107	143	143	179	751
	Fringe (70%)	125	75	100	100	125	525
Spare Parts		1,305	783	1,044	1,044	1,305	5,481
Replacement		11,745	7,047	9,396	9,396	11,745	49,329
Vendor Costs		15,987	9,592	12,790	12,790	15,987	67,146
Device Total		29,341	17,604	23,473	23,473	29,341	123,232

Downhill Speed Advisory Systems

		Region 1	2	3	4	5	State
Staffing	Salary Cost	-	5,430	12,289	15,868	14,038	47,625
	Fringe (70%)	-	3,801	8,602	11,108	9,827	33,338
Spare Parts		-	1,644	3,288	2,877	2,877	10,686
Replacement		-	14,796	29,592	25,893	25,893	96,174
Vendor Costs		-	20,550	41,101	35,963	35,963	133,577
Device Total		-	46,221	94,872	91,709	88,598	321,400

Fiber Optic Networks

		Region 1	2	3	4	5	State
Staffing	Salary Cost	198	-	-	-	-	198
	Fringe (70%)	139	-	-	-	-	139
Spare Parts		400	-	-	-	-	400
Replacement		7,600	-	-	-	-	7,600
Vendor Costs		24,319	-	-	-	-	24,319
Device Total		32,656	-	-	-	-	32,656

Radio Communications

		Region 1	2	3	4	5	State
Staffing	Salary Cost	5,626	6,125	5,132	5,418	5,304	27,605
	Fringe (70%)	3,938	4,288	3,592	3,793	3,713	19,324
Spare Parts		835	895	650	650	650	3,680
Replacement		7,515	8,055	5,850	5,850	5,850	33,120
Device Total		17,914	19,363	15,224	15,711	15,517	83,729

Maintenance Coordination

		Region 1	2	3	4	5	State
Staffing	Salary Cost	575	575	575	575	575	2,875
	Fringe (70%)	403	403	403	403	403	2,015
Replacement		38	38	38	38	38	190
Device Total		1,016	1,016	1,016	1,016	1,016	5,080

All Devices

		Region					State
		1	2	3	4	5	
Staffing	Salary Cost	119,793	160,984	66,398	85,610	100,183	532,968
	Fringe (70%)	83,857	112,692	46,480	59,928	70,129	373,086
Spare Parts		129,225	53,242	48,257	50,971	55,457	337,152
Replacement		1,422,280	664,500	579,222	596,223	730,997	3,993,222
Vendor Costs		585,181	425,714	437,911	474,445	454,975	2,378,226
Device Total		2,340,336	1,417,132	1,178,268	1,267,177	1,411,741	7,614,654

N.2 Maintenance Budget by Region

N.2.1 Existing Deployment

Region 1

Device	Staffing	Fringe	Spares	Replace	Vendor	Total
Closed-Circuit Television (CCTV)	26,644	18,651	14,700	124,725	-	184,720
Road and Weather Information System (RWIS)	9,209	6,446	1,250	10,875	-	27,780
Automatic Vehicle Location (AVL)	2,738	1,917	60	390	-	5,105
Advanced Traffic Management System	16,216	11,351	-	825	-	28,392
Incident Response Vehicles	4,916	3,441	1,050	18,900	-	28,307
Alphanumeric Paging	68	48	-	-	-	116
Tunnel Lane Closure CMS	386	270	50	450	-	1,156
Permanent Variable Message Signs	18,502	12,951	7,500	135,000	-	173,953
Portable Variable Message Signs	1,942	1,359	150	2,700	-	6,151
Icy Bridge Detectors	588	412	250	2,000	-	3,250
Radio Communications	1,353	947	335	3,015	-	5,650
All Devices	**82,562**	**57,793**	**25,345**	**298,880**	**-**	**464,580**

Region 2

Device	Staffing	Fringe	Spares	Replace	Vendor	Total
Closed-Circuit Television (CCTV)	4,089	2,862	1,750	15,750	-	24,451
Video Detectors	1,595	1,117	1,000	9,000	-	12,712
Road and Weather Information System (RWIS)	10,004	7,003	900	7,350	-	25,257
Advanced Traffic Management System	15,997	11,198	-	-	-	27,195
Computer-Aided Dispatch	3,183	2,228	-	188	-	5,599
800-number Information	11,278	7,895	-	75	-	19,248
Internet Access	35,669	24,968	-	75	-	60,712
Oversize Vehicle Restriction CMS	870	609	50	450	-	1,979
Permanent Variable Message Signs	10,448	7,314	3,125	56,250	-	77,137
Portable Variable Message Signs	47,416	33,191	2,850	51,300	-	134,757
Queue Detection System	653	457	50	225	-	1,385
Weigh-in-Motion (WIM) Stations	72	50	522	4,698	6,484	11,826
Radio Communications	1,736	1,215	375	3,375	-	6,701
All Devices	**143,010**	**100,107**	**10,622**	**148,736**	**6,484**	**408,959**

Region 3

Device	Staffing	Fringe	Spares	Replace	Vendor	Total
Closed-Circuit Television (CCTV)	894	626	350	3,150	-	5,020
Road and Weather Information System (RWIS)	3,534	2,474	250	1,875	-	8,133
Callboxes	759	531	-	2,700	-	3,990
Computer-Aided Dispatch	1,273	891	-	75	-	2,239
Icy Bridge Warning CMS	548	384	50	450	-	1,432
Permanent Variable Message Signs	5,039	3,527	1,250	22,500	-	32,316
Highway Advisory Radio (HAR)	741	519	500	4,750	-	6,510
Weigh-in-Motion (WIM) Stations	144	101	1,044	9,396	12,967	23,652
Radio Communications	763	534	150	1,350	-	2,797
All Devices	**13,695**	**9,587**	**3,594**	**46,246**	**12,967**	**86,089**

Region 4

Device	Staffing	Fringe	Spares	Replace	Vendor	Total
Closed-Circuit Television (CCTV)	12,434	8,704	3,550	31,575	-	56,263
Road and Weather Information System (RWIS)	21,221	14,855	1,650	14,475	-	52,201
Computer-Aided Dispatch	1,273	891	-	75	-	2,239
Radio-Controlled Snow Zone CMS	3,376	2,363	200	1,800	-	7,739
Permanent Variable Message Signs	3,552	2,486	625	11,250	-	17,913
Portable Variable Message Signs	11,271	7,890	450	8,100	-	27,711
Radio Communications	1,106	774	150	1,350	-	3,380
All Devices	**54,233**	**37,963**	**6,625**	**68,625**	**-**	**167,446**

Region 5

Device	Staffing	Fringe	Spares	Replace	Vendor	Total
Closed-Circuit Television (CCTV)	1,100	770	350	3,150	-	5,370
Road and Weather Information System (RWIS)	3,937	2,756	250	1,875	-	8,818
Telephone-Activated Snow Zone CMS	5,430	3,801	400	3,600	-	13,231
Permanent Variable Message Signs	14,627	10,239	3,125	56,250	-	84,241
Weigh-in-Motion (WIM) Stations	180	126	1,305	11,745	16,209	29,565
Downhill Speed Advisory Systems	2,781	1,947	411	3,699	4,545	13,383
All Devices	**28,055**	**19,639**	**5,841**	**80,319**	**20,754**	**154,608**

Statewide

Device	Staffing	Fringe	Spares	Replace	Vendor	Total
Closed-Circuit Television (CCTV)	45,161	31,613	20,700	178,350	-	275,824
Video Detectors	1,595	1,117	1,000	9,000	-	12,712
Road and Weather Information System (RWIS)	47,905	33,534	4,300	36,450	-	122,189
Automatic Vehicle Location (AVL)	2,738	1,917	60	390	-	5,105
Advanced Traffic Management System	32,213	22,549	-	825	-	55,587
Callboxes	759	531	-	2,700	-	3,990
Computer-Aided Dispatch	5,729	4,010	-	338	-	10,077
Incident Response Vehicles	4,916	3,441	1,050	18,900	-	28,307
Alphanumeric Paging	68	48	-	-	-	116
800-number Information	11,278	7,895	-	75	-	19,248
Internet Access	35,669	24,968	-	75	-	60,712
Icy Bridge Warning CMS	548	384	50	450	-	1,432
Tunnel Lane Closure CMS	386	270	50	450	-	1,156
Radio-Controlled Snow Zone CMS	3,376	2,363	200	1,800	-	7,739
Telephone-Activated Snow Zone CMS	5,430	3,801	400	3,600	-	13,231
Oversize Vehicle Restriction CMS	870	609	50	450	-	1,979
Permanent Variable Message Signs	52,168	36,517	15,625	281,250	-	385,560
Portable Variable Message Signs	60,629	42,440	3,450	62,100	-	168,619
Highway Advisory Radio (HAR)	741	519	500	4,750	-	6,510
Icy Bridge Detectors	588	412	250	2,000	-	3,250
Queue Detection System	653	457	50	225	-	1,385
Weigh-in-Motion (WIM) Stations	396	277	2,871	25,839	35,660	65,043
Downhill Speed Advisory Systems	2,781	1,947	411	3,699	4,545	13,383
Radio Communications	4,958	3,470	1,010	9,090	-	18,528
All Devices	**321,555**	**225,089**	**52,027**	**642,806**	**40,205**	**1,281,682**

N.2.2 STIP Deployment

Region 1

Device	Staffing	Fringe	Spares	Replace	Test Eq	Vendor	Total
Closed-Circuit Television (CCTV)	30,987	21,691	17,150	146,775	1,060	-	217,663
Road and Weather Information System (RWIS)	12,935	9,055	1,850	16,275	-	-	40,115
Automatic Vehicle Location (AVL)	3,001	2,101	60	390	-	-	5,552
Advanced Traffic Management System	16,762	11,733	-	863	-	-	29,358
Regional Incident Detection System	1,965	1,376	-	75	-	-	3,416
Incident Response Vehicles	4,916	3,441	1,050	18,900	-	-	28,307
Alphanumeric Paging	68	48	-	-	-	-	116
Tunnel Lane Closure CMS	386	270	50	450	-	-	1,156
Permanent Variable Message Signs	24,651	17,256	10,000	180,000	-	-	231,907
Portable Variable Message Signs	1,942	1,359	150	2,700	-	-	6,151
Icy Bridge Detectors	902	631	250	2,000	-	-	3,783
Weigh-in-Motion (WIM) Stations	180	126	1,305	11,745	-	16,209	29,565
Fiber Optic Networks	198	139	8,000	7,600	-	24,319	40,256
Radio Communications	1,353	947	335	3,015	-	-	5,650
Maintenance Coordination	600	420	-	38	8,000	-	9,058
All Devices	**100,846**	**70,593**	**40,200**	**390,826**	**9,060**	**40,528**	**652,053**

Region 2

Device	Staffing	Fringe	Spares	Replace	Test Eq	Vendor	Total
Closed-Circuit Television (CCTV)	5,725	4,008	2,450	22,050	1,060	-	35,293
Video Detectors	1,994	1,396	1,250	11,250	-	-	15,890
Road and Weather Information System (RWIS)	18,184	12,729	1,900	16,350	-	-	49,163
Automatic Vehicle Location (AVL)	2,691	1,884	45	255	-	-	4,875
Advanced Traffic Management System	15,997	11,198	-	-	-	-	27,195
Intersection-Based Incident Detection System	1,024	717	-	75	-	-	1,816
Computer-Aided Dispatch	3,183	2,228	-	188	-	-	5,599
Incident Response Vehicles	2,809	1,966	600	10,800	-	-	16,175
Highway Travel Conditions Reporting System	21,334	14,934	-	-	-	-	36,268
800-number Information	11,278	7,895	-	75	-	-	19,248
Internet Access	35,669	24,968	-	75	-	-	60,712
Oversize Vehicle Restriction CMS	870	609	50	450	-	-	1,979
Permanent Variable Message Signs	18,764	13,135	5,625	101,250	-	-	138,774
Portable Variable Message Signs	47,416	33,191	2,850	51,300	-	-	134,757
Queue Detection System	653	457	50	225	-	-	1,385
Weigh-in-Motion (WIM) Stations	108	76	783	7,047	-	9,726	17,740
Radio Communications	1,951	1,366	395	3,555	-	-	7,267
Maintenance Coordination	600	420	-	38	8,000	-	9,058
All Devices	**190,250**	**133,177**	**15,998**	**224,983**	**9,060**	**9,726**	**583,194**

Region 3

Device	Staffing	Fringe	Spares	Replace	Test Eq	Vendor	Total
Closed-Circuit Television (CCTV)	894	626	350	3,150	1,060	-	6,080
Road and Weather Information System (RWIS)	8,866	6,206	850	7,275	-	-	23,197
Callboxes	759	531	-	2,700	-	-	3,990
Computer-Aided Dispatch	1,273	891	-	75	-	-	2,239
Icy Bridge Warning CMS	548	384	50	450	-	-	1,432
Permanent Variable Message Signs	5,039	3,527	1,250	22,500	-	-	32,316
Highway Advisory Radio (HAR)	741	519	500	4,750	-	-	6,510
Weigh-in-Motion (WIM) Stations	144	101	1,044	9,396	-	12,967	23,652
Downhill Speed Advisory Systems	2,208	1,546	411	3,699	-	4,545	12,409
Radio Communications	763	534	150	1,350	-	-	2,797
Maintenance Coordination	600	420	-	38	8,000	-	9,058
All Devices	**21,835**	**15,285**	**4,605**	**55,383**	**9,060**	**17,512**	**123,680**

Region 4

Device	Staffing	Fringe	Spares	Replace	Test Eq	Vendor	Total
Closed-Circuit Television (CCTV)	18,543	12,980	5,300	47,325	1,060	-	85,208
Video Detectors	566	396	250	2,250	-	-	3,462
Road and Weather Information System (RWIS)	38,253	26,777	3,050	27,075	-	-	95,155
Automatic Vehicle Location (AVL)	14,710	10,297	225	1,875	-	-	27,107
Intersection-Based Incident Detection System	1,668	1,168	-	75	-	-	2,911
Computer-Aided Dispatch	1,273	891	-	75	-	-	2,239
Radio-Controlled Snow Zone CMS	3,376	2,363	200	1,800	-	-	7,739
Permanent Variable Message Signs	3,552	2,486	625	11,250	-	-	17,913
Portable Variable Message Signs	18,748	13,124	750	13,500	-	-	46,122
Oversize Load Detectors	9,156	6,409	1,250	10,000	-	-	26,815
Weigh-in-Motion (WIM) Stations	144	101	1,044	9,396	-	12,967	23,652
Radio Communications	3,250	2,275	350	3,150	-	-	9,025
Maintenance Coordination	600	420	-	38	8,000	-	9,058
All Devices	**113,839**	**79,687**	**13,044**	**127,809**	**9,060**	**12,967**	**356,406**

Region 5

Device	Staffing	Fringe	Spares	Replace	Test Eq	Vendor	Total
Closed-Circuit Television (CCTV)	19,802	13,861	6,300	56,700	1,060	-	97,723
Road and Weather Information System (RWIS)	45,365	31,756	4,050	36,075	-	-	117,246
Telephone-Activated Snow Zone CMS	5,430	3,801	400	3,600	-	-	13,231
Permanent Variable Message Signs	29,200	20,440	6,250	112,500	-	-	168,390
Weigh-in-Motion (WIM) Stations	180	126	1,305	11,745	-	16,209	29,565
Downhill Speed Advisory Systems	2,781	1,947	411	3,699	-	4,545	13,383
Maintenance Coordination	600	420	-	38	8,000	-	9,058
All Devices	**103,358**	**72,351**	**18,716**	**224,357**	**9,060**	**20,754**	**448,596**

Statewide							
Device	**Staffing**	**Fringe**	**Spares**	**Replace**	**Test Eq**	**Vendor**	**Total**
Closed-Circuit Television (CCTV)	75,951	53,166	31,550	276,000	5,300	-	441,967
Video Detectors	2,560	1,792	1,500	13,500	-	-	19,352
Road and Weather Information System (RWIS)	123,603	86,523	11,700	103,050	-	-	324,876
Automatic Vehicle Location (AVL)	20,402	14,282	330	2,520	-	-	37,534
Advanced Traffic Management System	32,759	22,931	-	863	-	-	56,553
Callboxes	759	531	-	2,700	-	-	3,990
Regional Incident Detection System	1,965	1,376	-	75	-	-	3,416
Intersection-Based Incident Detection System	2,692	1,885	-	150	-	-	4,727
Computer-Aided Dispatch	5,729	4,010	-	338	-	-	10,077
Incident Response Vehicles	7,725	5,407	1,650	29,700	-	-	44,482
Alphanumeric Paging	68	48	-	-	-	-	116
Highway Travel Conditions Reporting System	21,334	14,934	-	-	-	-	36,268
800-number Information	11,278	7,895	-	75	-	-	19,248
Internet Access	35,669	24,968	-	75	-	-	60,712
Icy Bridge Warning CMS	548	384	50	450	-	-	1,432
Tunnel Lane Closure CMS	386	270	50	450	-	-	1,156
Radio-Controlled Snow Zone CMS	3,376	2,363	200	1,800	-	-	7,739
Telephone-Activated Snow Zone CMS	5,430	3,801	400	3,600	-	-	13,231
Oversize Vehicle Restriction CMS	870	609	50	450	-	-	1,979
Permanent Variable Message Signs	81,206	56,844	23,750	427,500	-	-	589,300
Portable Variable Message Signs	68,106	47,674	3,750	67,500	-	-	187,030
Highway Advisory Radio (HAR)	741	519	500	4,750	-	-	6,510
Icy Bridge Detectors	902	631	250	2,000	-	-	3,783
Oversize Load Detectors	9,156	6,409	1,250	10,000	-	-	26,815
Queue Detection System	653	457	50	225	-	-	1,385
Weigh-in-Motion (WIM) Stations	756	530	5,481	49,329	-	68,078	124,174
Downhill Speed Advisory Systems	4,989	3,493	822	7,398	-	9,090	25,792
Fiber Optic Networks	198	139	8,000	7,600	-	24,319	40,256
Radio Communications	7,317	5,122	1,230	11,070	-	-	24,739
Maintenance Coordination	3,000	2,100	-	190	40,000	-	45,290
All Devices	**530,128**	**371,093**	**92,563**	**1,023,358**	**45,300**	**101,487**	**2,163,929**

N.2.3 Strategic Plan Deployment

Region 1

Device	Staffing	Fringe	Spares	Replace	Vendor	Total
Closed-Circuit Television (CCTV)	30,698	21,489	42,700	376,725	66,901	538,513
Video Detectors	19,567	13,697	25,000	225,000	-	283,264
Road and Weather Information System (RWIS)	3,030	2,121	2,850	25,275	32,017	65,293
Travel Time Estimation	1,462	1,023	6,025	54,075	127,528	190,113
Automatic Vehicle Location (AVL)	7,984	5,589	560	4,890	21,355	40,378
Advanced Traffic Management System	16,126	11,288	-	863	-	28,277
Regional Incident Detection System	1,924	1,347	-	75	-	3,346
Pre-Planned Detour Routes	108	76	-	-	-	184
Alphanumeric Paging	68	48	-	-	-	116
Kiosks	1,680	1,176	17,550	150,429	111,727	282,562
Tunnel Lane Closure CMS	381	267	50	450	-	1,148
Permanent Variable Message Signs	24,544	17,181	20,000	360,000	27,265	448,990
Portable Variable Message Signs	1,652	1,156	9,150	164,700	144,588	321,246
Icy Bridge Detectors	103	72	1,250	10,000	9,078	20,503
Variable Speed Limit Signs	50	35	500	4,000	4,416	9,001
Weigh-in-Motion (WIM) Stations	179	125	1,305	11,745	15,987	29,341
Fiber Optic Networks	198	139	8,000	7,600	24,319	40,256
Radio Communications	5,626	3,938	835	7,515	-	17,914
Maintenance Coordination	575	403	-	38	-	1,016
All Devices	**119,793**	**83,857**	**136,825**	**1,422,280**	**585,181**	**2,347,936**

Region 2

Device	Staffing	Fringe	Spares	Replace	Vendor	Total
Closed-Circuit Television (CCTV)	15,778	11,045	15,750	141,750	25,299	209,622
Video Detectors	1,609	1,126	1,250	11,250	-	15,235
Road and Weather Information System (RWIS)	5,875	4,113	4,900	43,350	54,886	113,124
Automatic Vehicle Location (AVL)	9,936	6,955	545	4,755	20,756	42,947
Advanced Traffic Management System	24,306	17,014	-	300	-	41,620
Intersection-Based Incident Detection System	1,014	710	-	75	-	1,799
Computer-Aided Dispatch	3,044	2,131	-	188	-	5,363
Incident Response Vehicles	2,193	1,535	600	10,800	-	15,128
Pre-Planned Detour Routes	108	76	-	-	-	184
Hazardous Material Response	1,787	1,251	-	75	-	3,113
Highway Travel Conditions Reporting System	21,297	14,908	-	-	-	36,205
800-number Information	11,197	7,838	-	75	-	19,110
Internet Access	35,628	24,940	-	75	-	60,643
Kiosks	543	380	4,550	38,646	38,365	82,484
Oversize Vehicle Restriction CMS	837	586	50	450	-	1,923
Permanent Variable Message Signs	10,113	7,079	5,625	101,250	7,788	131,855
Portable Variable Message Signs	2,680	1,876	14,850	267,300	234,590	521,296
Icy Bridge Detectors	82	57	1,000	8,000	7,263	16,402
Variable Speed Limit Signs	75	53	750	6,000	6,625	13,503
Queue Detection System	645	452	50	225	-	1,372
Weigh-in-Motion (WIM) Stations	107	75	783	7,047	9,592	17,604
Downhill Speed Advisory Systems	5,430	3,801	1,644	14,796	20,550	46,221
Radio Communications	6,125	4,288	895	8,055	-	19,363
Maintenance Coordination	575	403	-	38	-	1,016
All Devices	**160,984**	**112,692**	**53,242**	**664,500**	**425,714**	**1,417,132**

Region 3

Device	Staffing	Fringe	Spares	Replace	Vendor	Total
Closed-Circuit Television (CCTV)	16,120	11,284	14,350	129,150	23,050	193,954
Road and Weather Information System (RWIS)	4,291	3,004	4,850	43,275	54,886	110,306
Automatic Vehicle Location (AVL)	10,304	7,213	525	4,575	19,958	42,575
Advanced Traffic Management System	8,310	5,817	-	300	-	14,427
Callboxes	759	531	-	2,700	-	3,990
Computer-Aided Dispatch	1,218	853	-	75	-	2,146
Pre-Planned Detour Routes	108	76	-	-	-	184
Kiosks	431	302	4,500	38,571	28,648	72,452
Icy Bridge Warning CMS	538	377	50	450	-	1,415
Permanent Variable Message Signs	2,554	1,788	1,250	22,500	2,216	30,308
Portable Variable Message Signs	2,708	1,896	15,000	270,000	236,958	526,562
Highway Advisory Radio (HAR)	710	497	500	4,750	-	6,457
Icy Bridge Detectors	82	57	1,000	8,000	7,263	16,402
Variable Speed Limit Signs	126	88	1,250	10,000	11,041	22,505
Weigh-in-Motion (WIM) Stations	143	100	1,044	9,396	12,790	23,473
Downhill Speed Advisory Systems	12,289	8,602	3,288	29,592	41,101	94,872
Radio Communications	5,132	3,592	650	5,850	-	15,224
Maintenance Coordination	575	403	-	38	-	1,016
All Devices	**66,398**	**46,480**	**48,257**	**579,222**	**437,911**	**1,178,268**

Region 4

Device	Staffing	Fringe	Spares	Replace	Vendor	Total
Closed-Circuit Television (CCTV)	23,263	16,284	14,050	126,075	22,488	202,160
Video Detectors	487	341	250	2,250	-	3,328
Road and Weather Information System (RWIS)	6,310	4,417	7,450	66,675	84,616	169,468
Automatic Vehicle Location (AVL)	13,712	9,598	525	4,575	19,958	48,368
Advanced Traffic Management System	8,310	5,817	-	300	-	14,427
Intersection-Based Incident Detection System	1,655	1,159	-	75	-	2,889
Computer-Aided Dispatch	1,218	853	-	75	-	2,146
Pre-Planned Detour Routes	108	76	-	-	-	184
Kiosks	431	302	4,500	38,571	28,648	72,452
Radio-Controlled Snow Zone CMS	3,172	2,220	200	1,800	-	7,392
Permanent Variable Message Signs	1,870	1,309	625	11,250	1,192	16,246
Portable Variable Message Signs	2,762	1,933	15,300	275,400	241,695	537,090
Icy Bridge Detectors	82	57	1,000	8,000	7,263	16,402
Oversize Load Detectors	100	70	1,250	10,000	8,791	20,211
Variable Speed Limit Signs	126	88	1,250	10,000	11,041	22,505
Weigh-in-Motion (WIM) Stations	143	100	1,044	9,396	12,790	23,473
Downhill Speed Advisory Systems	15,868	11,108	2,877	25,893	35,963	91,709
Radio Communications	5,418	3,793	650	5,850	-	15,711
Maintenance Coordination	575	403	-	38	-	1,016
All Devices	**85,610**	**59,928**	**50,971**	**596,223**	**474,445**	**1,267,177**

Region 5

Device	Staffing	Fringe	Spares	Replace	Vendor	Total
Closed-Circuit Television (CCTV)	15,802	11,061	10,850	97,650	17,428	152,791
Road and Weather Information System (RWIS)	5,121	3,585	5,850	52,275	66,320	133,151
Automatic Vehicle Location (AVL)	12,349	8,644	525	4,575	19,958	46,051
Advanced Traffic Management System	8,310	5,817	-	300	-	14,427
Kiosks	431	302	4,500	38,571	28,648	72,452
Telephone-Activated Snow Zone CMS	5,275	3,693	400	3,600	-	12,968
Permanent Variable Message Signs	29,883	20,918	11,250	202,500	15,409	279,960
Portable Variable Message Signs	2,708	1,896	15,000	270,000	236,958	526,562
Icy Bridge Detectors	82	57	1,000	8,000	7,263	16,402
Variable Speed Limit Signs	126	88	1,250	10,000	11,041	22,505
Weigh-in-Motion (WIM) Stations	179	125	1,305	11,745	15,987	29,341
Downhill Speed Advisory Systems	14,038	9,827	2,877	25,893	35,963	88,598
Radio Communications	5,304	3,713	650	5,850	-	15,517
Maintenance Coordination	575	403	-	38	-	1,016
All Devices	**100,183**	**70,129**	**55,457**	**730,997**	**454,975**	**1,411,741**

Statewide

Device	Staffing	Fringe	Spares	Replace	Vendor	Total
Closed-Circuit Television (CCTV)	101,661	71,163	97,700	871,350	155,166	1,297,040
Video Detectors	21,663	15,164	26,500	238,500	-	301,827
Road and Weather Information System (RWIS)	24,627	17,240	25,900	230,850	292,725	591,342
Travel Time Estimation	1,462	1,023	6,025	54,075	127,528	190,113
Automatic Vehicle Location (AVL)	54,285	37,999	2,680	23,370	101,985	220,319
Advanced Traffic Management System	65,362	45,753	-	2,063	-	113,178
Callboxes	759	531	-	2,700	-	3,990
Regional Incident Detection System	1,924	1,347	-	75	-	3,346
Intersection-Based Incident Detection System	2,669	1,869	-	150	-	4,688
Computer-Aided Dispatch	5,480	3,837	-	338	-	9,655
Incident Response Vehicles	6,031	4,222	1,650	29,700	-	41,603
Pre-Planned Detour Routes	432	304	-	-	-	736
Hazardous Material Response	1,787	1,251	-	75	-	3,113
Alphanumeric Paging	68	48	-	-	-	116
Highway Travel Conditions Reporting System	21,297	14,908	-	-	-	36,205
800-number Information	11,197	7,838	-	75	-	19,110
Internet Access	35,628	24,940	-	75	-	60,643
Kiosks	3,516	2,462	35,600	304,788	236,036	582,402
Icy Bridge Warning CMS	538	377	50	450	-	1,415
Tunnel Lane Closure CMS	381	267	50	450	-	1,148
Radio-Controlled Snow Zone CMS	3,172	2,220	200	1,800	-	7,392
Telephone-Activated Snow Zone CMS	5,275	3,693	400	3,600	-	12,968
Oversize Vehicle Restriction CMS	837	586	50	450	-	1,923
Permanent Variable Message Signs	68,964	48,275	38,750	697,500	53,870	907,359
Portable Variable Message Signs	12,510	8,757	69,300	1,247,400	1,094,789	2,432,756
Highway Advisory Radio (HAR)	710	497	500	4,750	-	6,457
Icy Bridge Detectors	431	300	5,250	42,000	38,130	86,111
Oversize Load Detectors	100	70	1,250	10,000	8,791	20,211
Variable Speed Limit Signs	503	352	5,000	40,000	44,164	90,019
Queue Detection System	645	452	50	225	-	1,372
Weigh-in-Motion (WIM) Stations	751	525	5,481	49,329	67,146	123,232
Downhill Speed Advisory Systems	47,625	33,338	10,686	96,174	133,577	321,400
Fiber Optic Networks	198	139	8,000	7,600	24,319	40,256
Radio Communications	27,605	19,324	3,680	33,120	-	83,729
Maintenance Coordination	2,875	2,015	-	190	-	5,080
All Devices	**532,968**	**373,086**	**344,752**	**3,993,222**	**2,378,226**	**7,622,254**

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