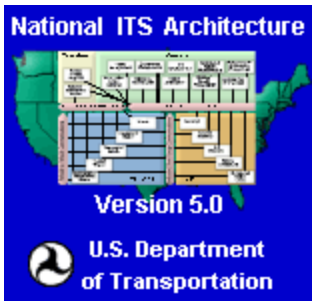
CHAPTER

3 REGIONAL ITS ARCHITECTURE

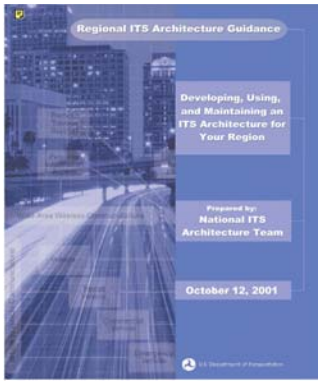
3.1 INTRODUCTION



This chapter provides a summary of the National ITS Architecture[1] and how it applies to the deployment of intelligent transportation systems in the Salem-Keizer Metropolitan Area. This includes definitions of National ITS Architecture terminology, the Salem-Keizer Metropolitan area ITS systems inventory, descriptions of the user services and market packages selected by the Steering Committee to meet the needs of the Salem-Keizer area transportation network, and applicable ITS standards.

3.1.1 Why Develop an ITS Architecture?

The U.S. Department of Transportation (U.S. DOT) developed the National ITS Architecture to ensure that intelligent transportation systems deployed around the country can communicate with each other and share information to maximize the return of investment on ITS. The architecture is a framework that describes the functions of system components, how these components interconnect, the organizations involved, and the type of information to be shared.



For example, if a transportation agency wants to clear incidents faster, the architecture defines a function to monitor roadways and identifies the interconnection and information flows between the roadway, the traffic management center, and the emergency management center needed to provide responders with incident information. The architecture provides the framework for the process, but does not define how this is done with technology or management techniques.

The reasons for developing a regional ITS architecture tailored to the Salem-Keizer Metropolitan area include the following:

- Develop a framework for institutional agreements and technical integration for organized ITS project deployment that meets local transportation user needs.
- Build consensus among regional stakeholders about resource and information sharing and activity coordination.
- Meet federal funding requirements.

[1] *National ITS Architecture, Version 5.0.* U.S. Department of Transportation. April 1, 2004. http://itsarch.iteris.com/itsarch/. Accessed April 19, 2005.

The Federal Highway Administration (FHWA) published a final rule[2] that all agencies seeking federal highway trust funding for ITS projects must develop a regional architecture that is compliant with the National ITS Architecture. The Federal Transit Administration (FTA) published a similar policy[3] that applies to federal funding from the mass transit account of the highway trust fund.

The Regional ITS Architecture must include the following elements:

- **Description of the Region**: Included in Chapter 1 and Turbo Architecture
- **Identification of Stakeholders**: Included in Chapter 2 and Turbo Architecture
- **Operational Concept**: Included in Turbo Architecture and Chapter 4
- **Interface Requirements and Information Exchanges**: Included in Turbo Architecture
- **Identification of ITS Standards**: Included in Section 3.4 and Turbo Architecture
- **Sequence of Projects Required for Implementation**: Presented in Implementation Plan (Chapter 6)

3.2 Regional ITS Architecture Development Approach

The Salem-Keizer Regional ITS Architecture was developed based upon the regional transportation network infrastructure, the user needs identified by stakeholders through interviews, questionnaires, and the user needs assessment workshop, and the *Regional ITS Architecture Guidance*[4]. *Turbo Architecture*[5], a software tool designed to support development of regional and project architectures based on the National ITS Architecture, was used to document the Salem-Keizer Regional ITS Architecture. This *Turbo Architecture* database is intended to be a living document that will be updated by the key stakeholders as regional needs change over time. The Salem-Keizer Turbo Architecture file will be managed by the Mid Willamette Valley Council of Governments (MVCOG) with support from ODOT.

The following steps, illustrated in Figure 3-1, were followed in the development of the regional architecture:

- **Stakeholder Input**: Key and expanded stakeholders, who are listed in Chapter 2, provided input throughout the architecture development process to obtain regional consensus.

---

[2] *Intelligent Transportation System Architecture and Standards: Final Rule*, U.S. Department of Transportation, Federal Highway Administration, FHWA Docket No. FHWA-99-5899, Jan. 8, 2001.
[3] *Federal Transit Administration National ITS Architecture Policy on Transit Projects: Notice*, Federal Transit Administration, FTA Docket No. FTA-99-6147, Jan. 8, 2001.
[4] National ITS Architecture Team. *Regional ITS Architecture Guidance: Developing, Using, and Maintaining an ITS Architecture for Your Region*. Prepared for U.S. Department of Transportation, Federal Highway Administration, and Federal Transit Administration. FHWA-OP-02-024. Oct. 12, 2001.
[5] *Turbo Architecture, Version 3.0*, developed by Iteris for the U.S. Department of Transportation, Federal Highway Administration, 2004.

- **Systems Inventory**: Existing and planned ITS system elements, described in Chapter 1, were input into the architecture. The *Turbo Architecture* inventory report for the regional architecture can be found in Appendix G.
- **Map User Needs to User Services**: The transportation user needs, documented in Chapter 2, were mapped to user services to ensure the architecture meets the regional needs.
- **Market Package Selection**: Market packages were selected based on the systems inventory and user needs.
- **Interconnect and Information Flow Customization**: Information flows between subsystems were customized to ensure that the architecture reflects existing and planned regional interconnects. The *Turbo Architecture* information flows can be found in Appendix H.

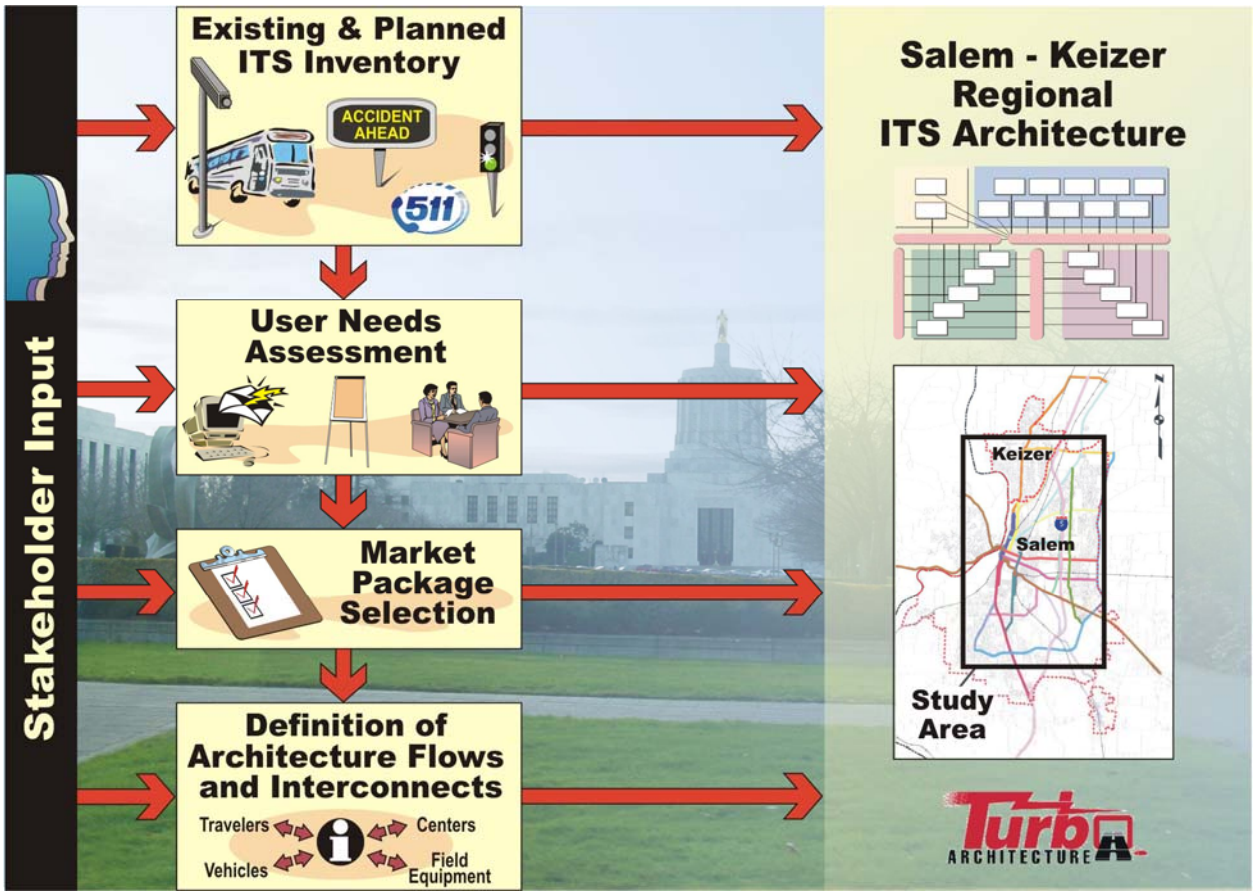


Figure 3-1. Regional ITS Architecture Development Process

The Salem-Keizer regional architecture has been constructed to be compliant with the existing Oregon statewide architecture. The Salem-Keizer regional architecture provides more detail about the stakeholders and the system elements in the region, while the Oregon statewide architecture provides a higher level view of ITS in Oregon. Common elements existing in both architectures and identify interfaces between the two architectures.

3.3 National ITS Architecture Overview

The National ITS Architecture provides a common framework for planning, defining, and integrating intelligent transportation systems. It is a mature product that reflects the contributions of a broad cross-section of the ITS community (transportation practitioners, systems engineers, system developers, technology specialists, etc.). The architecture defines:

- The functions (e.g., gather traffic information or request a route) that are required for ITS applications.
- The physical entities or subsystems where these functions reside (e.g., the roadside or the vehicle).
- The information flows that connect these functions and physical subsystems together into an integrated system.[6]

The purpose of a Regional Architecture is not to specify specific technologies that will be used in ITS deployments, but rather to define the functions that the technologies should perform. The architecture provides structure for defining general ITS functional requirements during the planning and design process. Key terms and concepts related to the National ITS Architecture are discussed below.

3.4 Salem-Keizer Regional ITS Architecture

This section includes further descriptions of the National ITS Architecture user services, subsystems, and market packages that were selected for the Salem-Keizer Metropolitan Area. Additional details may be found in the Salem-Keizer Turbo Architecture database.

3.4.1 User Services

User services describe what functions intelligent transportation systems should perform from the user's perspective. Users encompass a broad range including groups such as the traveling public, transportation agency personnel, emergency management personnel, and commercial vehicle operators. Although a user service is a functional requirement of the system, it does not describe where components fit into the architecture or how the service will be implemented. Selection of user services provides a high-level means of identifying the services to provide that address the regional user needs and problems. To simplify the range of requirements in a broad area of services, the user services are logically grouped into the following eight user services bundles.

[6] US DOT, National ITS Architecture, Version 5.0

- Travel & Traffic Management
- Public Transportation Management
- Electronic Payment
- Commercial Vehicle Operations
- Emergency Management
- Advanced Vehicle Safety Systems
- Information Management
- Maintenance & Construction Management

Table 3-1 includes the 33 nationally defined user services and indicates the ones selected by the Steering Committee based on the regional user needs documented in Chapter 2. A description of each user service may be found on the National ITS Architecture website[7].

[7] *User Services Bundles and User Services*. U.S. Department of Transportation. Nov. 3, 2003. itsarch/iteris.com/itsarch/html/user/userserv.htm. Accessed March 24, 200.

Table 3-1. User Service Bundles and User Services

User Services Bundles and User Services	User Need Areas						
	Traffic Operations & Management	Incident Response	Traveler Information	Public Transportation Management	Emergency Management Operations	Information Management	Maintenance & Construction Management
Travel & Traffic Management							
Pre-Trip Travel Information			✓				
En-Route Driver Information		✓	✓	✓	✓		
Route Guidance		✓	✓	✓	✓		
Ride Matching & Reservation			✓	✓			
Traveler Services Information			✓				
Traffic Control	✓		✓	✓	✓	✓	
Incident Management	✓	✓	✓		✓		
Travel Demand Management	✓		✓	✓			
Emissions Testing & Mitigation							
Highway Rail Intersection	✓						
Public Transportation Management							
Public Transportation Management			✓	✓			
En-Route Transit Information			✓	✓			
Personalized Public Transit				✓		✓	
Public Travel Security				✓			
Electronic Payment							
Electronic Payment Services				✓			
Commercial Vehicle Operations							
Commercial Vehicle Electronic Clearance	✓						
Automated Roadside Safety Inspection							
On-Board Safety & Security Monitoring							
Commercial Vehicle Administrative Processes	✓						
Hazardous Material Security & Incident Response	✓	✓					
Freight Mobility	✓		✓				✓
Emergency Management							
Emergency Notification & Personal Security	✓	✓			✓		
Emergency Vehicle Management		✓			✓		
Disaster Response & Evacuation	✓	✓			✓		
Advanced Vehicle Safety Systems							
Longitudinal Collision Avoidance							
Lateral Collision Avoidance							
Intersection Collision Avoidance	✓						
Vision Enhancement for Crash Avoidance							
Safety Readiness							
Pre-Crash Restraint Deployment							
Automated Vehicle Operation							
Information Management							
Archived Data Function	✓			✓		✓	
Maintenance & Construction Management							
Maintenance & Construction Operations	✓			✓			✓

3.4.2 Physical Architecture for Salem-Keizer

The physical architecture provides a framework for the physical elements of ITS systems. It consists of subsystems, equipment packages, terminators, architecture flows, and architecture interconnects, which are all described in this section. Figure 3-2 illustrates the high-level physical architecture customized for the Salem-Keizer metropolitan area. The intent is to show the existing and planned subsystems in the region, and the types of communications links between them.

3.4.2.1 Subsystems

A subsystem represents a grouping of processes defined in the logical architecture that may be defined by single entities. There are 19 subsystems in the physical architecture that are assigned to four overarching classes that correspond to the physical world as described in Table 3-2 and illustrated in Figure 3-2.

Table 3-2. Subsystem Classes

Subsystem Class	Function	Real World Examples
Centers	Systems or applications that process and use information to control the transportation network.	✦ ODOT Northwest Transportation Operations Center (NWTOC) ✦ 911 Centers
Field	Provide direct interface to the roadway network, vehicles traveling on the roadway network, and travelers in transit.	✦ Dynamic Message Signs ✦ Highway Advisory Radio ✦ Weigh-in-Motion Stations
Vehicles	Use the roadway network and provide driver information and safety systems.	✦ Cherriots Buses ✦ Emergency Response Vehicles
Travelers	Systems or applications that provide information to travelers.	✦ TripCheck Website ✦ 511 Traveler Information Number

3.4.2.2 Equipment Packages

Equipment packages group similar processes of a subsystem together into an implementable package that addresses user services. The equipment packages are considered the building blocks of the physical architecture subsystems. Table 3-3 lists several examples of equipment packages in the National ITS Architecture.

Table 3-3. Sample Equipment Packages

Equipment Package	Process Specifications (PSpecs)	User Service Addressed
Roadway Basic Surveillance	✦ Process Traffic Sensor Data ✦ Process Traffic Images	Traffic Control
Transit Center Tracking and Dispatch	✦ Manage Transit Vehicle Operations ✦ Update Transit Map Data	Public Transportation Management
Emergency Evacuation Support	✦ Manage Emergency Response ✦ Provide Operator Interface for Emergency Data ✦ Provide Evacuation Coordination	Disaster Response and Evacuation

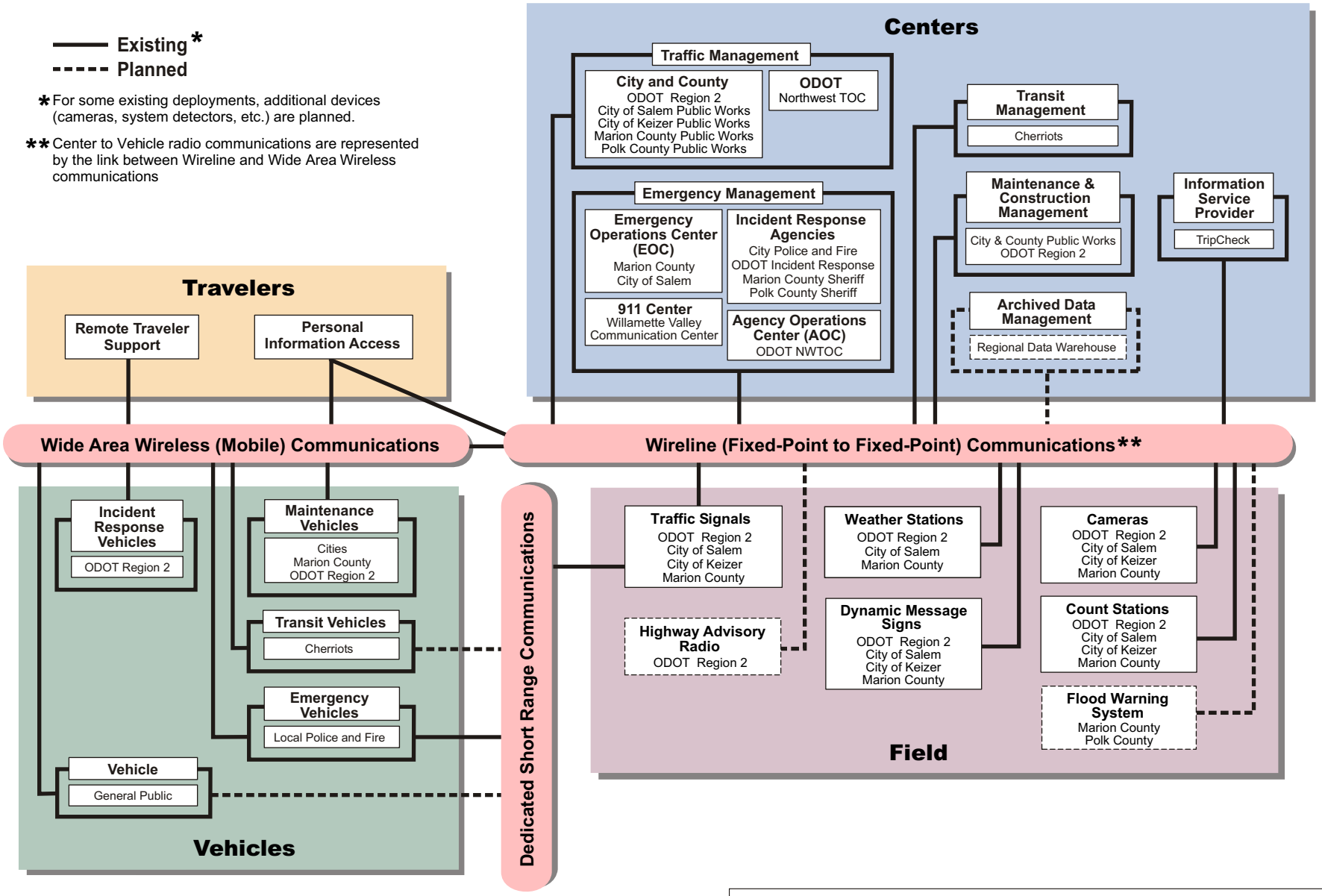


Figure 3-2
Salem-Keizer Metropolitan Area
HIGH-LEVEL PHYSICAL ARCHITECTURE

3.4.2.3 Terminators

Terminators are generally defined as people, systems and the general environment that are outside the boundary or control of ITS, but still impact ITS systems. Interfaces between subsystems and terminators need to be defined, but there are no ITS-related functional requirements associated with terminators. Since regional architectures are usually developed from a specific agency(s) perspective, an entity that impacts ITS but is out of the bounds of the primary agency's perspective is called a terminator. This is done to illustrate ownership/ control of the proposed services. Examples of terminators include "Transit Vehicle Operator", "Other Traffic Management" (such as a traffic management center that is outside of the study area but that still interacts with entities within the study area), and "Financial Institution" (such as a bank that holds revenues from transit fares or toll collection).

3.4.2.4 Architecture Flows

An architecture flow is the information that is exchanged between subsystems and terminators in the physical architecture. These flows and their communication requirements are used to define the interfaces which are the basis for much of the ongoing standards development in the National ITS Architecture program. The current US DOT guidelines require that a Regional ITS Architecture be developed at a sufficient level of detail to show subsystems and architecture flows.

3.4.2.5 Architecture Interconnects

Architecture interconnects, also called information interconnects, are the communications paths that carry architecture flows between the subsystems and terminators. These interconnects are typically grouped into one of the four categories listed in Table 3-4. Chapter 5 provides a detailed summary of the communications requirements for the Salem-Keizer Regional ITS Architecture.

Table 3-4. Architecture Interconnects

Interconnect	Function	Real World Example
Fixed-Point to Fixed-Point Communications	Uses a communications network to link stationary entities.	✦ Fiber optic connection between a traffic management center and a CCTV camera
Wide Area Wireless Communications	Uses wireless devices to link users and infrastructure-based systems.	✦ Mobile telephone used to access traveler information
Dedicated Short Range Communications	Uses short to medium range (300-1000 feet) wireless communications channels to link vehicles and the infrastructure.	✦ Radio waves between a roadside transmitter and a vehicle
Vehicle to Vehicle Communications	Uses a wireless system to link communications between vehicles.	✦ Future vehicle collision avoidance systems

3.4.3 Market Packages

Market packages are deployment-oriented groupings of physical architecture entities that address specific user services. The user services identified in Section 3.3.1 are too broad in scope to aid in the planning of actual deployments. Market packages are made up of one or more equipment packages that work together to deliver a transportation service and the architecture flows that connect them with subsystems and terminators. Figure 3-3 illustrates a sample market package that includes subsystems (the large rectangular boxes), the equipment packages (the small rectangular boxes), the terminators (the ovular boxes), and the architecture flows (the arrows).

Market packages for the Salem-Keizer metropolitan area were selected early in the ITS plan development process to stimulate ideas about regional needs that may not have been previously identified. Table 3-5 lists the market packages selected by the Steering Committee and includes both existing market packages already deployed and planned market packages that will be deployed within the next 20 years as part of this plan. Eight broad categories of interest are used to group the 85 market packages and a description of each market package may be found on the National ITS Architecture website[8].

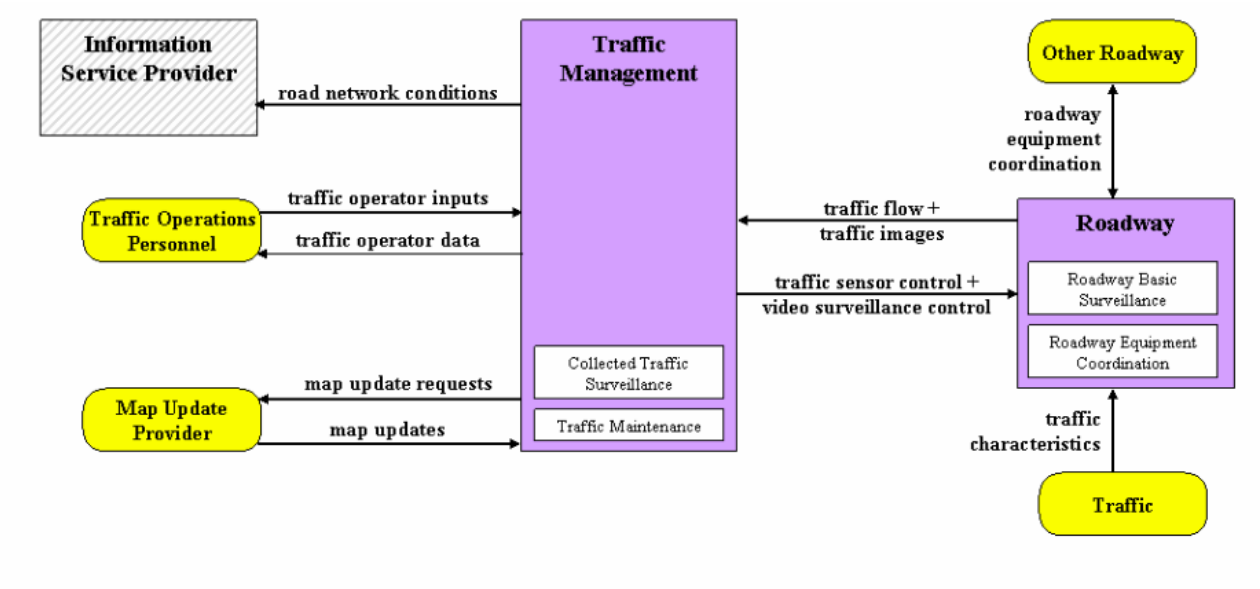


Figure 3-3. Sample Market Package Graphic: Network Surveillance

[8] *Market Packages*. U.S. Department of Transportation. Nov. 3, 2003. itsarch/iteris.com/itsarch/html/user/userserv.htm. Accessed March 24, 2004.

Table 3-5. Existing and Planned Market Packages (Page 1 of 3)

Market Packages (E = Existing, P = Planned)	Key Stakeholders							
	ODOT	City of Salem	City of Keizer	Marion County	Polk County	MWVCOG	Cherriots	Emergency Management
Archived Data (AD) Management								
AD1: ITS Data Mart	E	E	E	E	E	E	E	E
AD2: ITS Data Warehouse						P		
Advanced Public Transportation Systems (APTS)								
APTS1: Transit Vehicle Tracking							P	
APTS2: Transit Fixed-Route Operations							P	
APTS3: Demand Response Transit Operations							E	
APTS4: Transit Passenger & Fare Management							P	
APTS5: Transit Security							E	
APTS6: Transit Maintenance							E	
APTS7: Multi-Modal Coordination	P	P	P	P			P	
APTS8: Transit Traveler Information							P	
Advanced Traveler Information Systems (ATIS)								
ATIS1: Broadcast Traveler Information	P	P	P	P			P	
ATIS2: Interactive Traveler Information	E	P	P	P			P	
ATIS3: Autonomous Route Guidance								
ATIS4: Dynamic Route Guidance	P	P	P	P			P	
ATIS5: ISP Based Route Guidance	P							
ATIS6: Integrated Transportation Mgmt/Route Guidance								
ATIS7: Yellow Pages & Reservation	P	P						
ATIS8: Dynamic Ridesharing	P						P	
ATIS9: In Vehicle Signing	P	P	P	P			P	
Advanced Traffic Management Systems (ATMS)								
ATMS1: Network Surveillance	E	E	P	P	P		E	
ATMS2: Probe Surveillance	P	P					P	
ATMS3: Surface Street Control	E	E	E	P	P			
ATMS4: Freeway Control	P							
ATMS5: HOV Lane Management								
ATMS6: Traffic Information Dissemination	E	P	P	P	P		P	
ATMS7: Regional Traffic Control	P	P	P	P	P			
ATMS8: Traffic Incident Management System	E	E	E	E	P			E
ATMS9: Traffic Forecast & Demand Management	E	P	P	P	P	E		
ATMS10: Electronic Toll Collection								
ATMS11: Emissions Monitoring & Management								
ATMS12: Virtual TMC & Smart Probe Data								
ATMS13: Standard Railroad Grade Crossing	E	E	E	E	E			
ATMS14: Advanced Railroad Grade Crossing								
ATMS15: Railroad Operations Coordination	P	P	P					
ATMS16: Parking Facility Management		P						
ATMS17: Regional Parking Management		P						
ATMS18: Reversible Lane Management	P	P						
ATMS19: Speed Monitoring								

Table 3-5. Existing and Planned Market Packages (Page 2 of 3)

Market Packages (E = Existing, P = Planned)	Key Stakeholders							
	ODOT	City of Salem	City of Keizer	Marion County	Polk County	MWVCOG	Cherriots	Emergency Management
ATMS20: Drawbridge Management								
ATMS21: Roadway Closure Management				**P**	**P**			
Advanced Vehicle Safety Systems (AVSS)								
AVSS1: Vehicle Safety Monitoring								
AVSS2: Driver Safety Monitoring								
AVSS3: Longitudinal Safety Warning								
AVSS4: Lateral Safety Warning								
AVSS5: Intersection Safety Warning	**P**	**P**	**P**	**P**				
AVSS6: Pre-Crash Restraint Deployment								
AVSS7: Driver Visibility Improvement								
AVSS8: Advanced Vehicle Longitudinal Control								
AVSS9: Advanced Vehicle Lateral Control								
AVSS10: Intersection Collision Avoidance	**P**	**P**	**P**	**P**				
AVSS11: Automated Highway System								
Commercial Vehicle Operations (CVO)								
CVO1: Fleet Administration								
CVO2: Freight Administration								
CVO3: Electronic Clearance	**E**							
CVO4: CV Administrative Processes	**E**							
CVO5: International Border Electronic Clearance								
CVO6: Weigh-in-Motion	**E**			**P**				
CVO7: Roadside CVO Safety								
CVO8: On-Board CVO & Freight Safety & Security								
CVO9: CVO Fleet Maintenance								
CVO10: HAZMAT Management	**P**	**P**						**P**
CVO11: Roadside HAZMAT Security Detection & Mitigation	**P**	**P**	**P**	**P**	**P**			**P**
CVO12: CV Driver Security Authentication								
CVO13: Freight Assignment Tracking								
Emergency Management (EM)								
EM1: Emergency Call-Taking & Dispatch								**E**
EM2: Emergency Routing								**P**
EM3: Mayday Support	**P**							**P**
EM4: Roadway Service Patrols	**E**							
EM5: Transportation Infrastructure Protection								
EM6: Wide-Area Alert	**E**							**E**
EM7: Early Warning System								
EM8: Disaster Response & Recovery	**P**	**P**	**P**	**P**	**P**		**P**	**P**
EM9: Evacuation & Reentry Management	**P**	**P**						**P**
EM10: Disaster Traveler Information	**P**	**P**	**P**	**P**	**P**			**P**

Table 3-5. Existing and Planned Market Packages (Page 3 of 3)

Market Packages (E = Existing, P = Planned)	Key Stakeholders							
	ODOT	City of Salem	City of Keizer	Marion County	Polk County	MWVCOG	Cherriots	Emergency Management
Maintenance & Construction (MC) Management								
MC1: Maintenance & Construction Vehicle & Equipment Tracking	**P**	**P**		**P**				
MC2: Maintenance & Construction Vehicle Maintenance								
MC3: Road Weather Data Collection	**E**	**P**		**E**				
MC4: Weather Information Processing & Distribution	**E**	**P**		**P**				
MC5: Roadway Automated Treatment								
MC6: Winter Maintenance	**P**	**P**		**P**				
MC7: Roadway Maintenance & Construction	**E**	**E**	**E**	**E**				
MC8: Work Zone Management	**P**	**P**	**P**	**P**	**P**			
MC9: Work Zone Safety Monitoring	**P**	**P**	**P**	**P**	**P**			
MC10: Maintenance & Construction Activity Coordination	**P**	**P**	**P**	**P**	**P**			

3.5 ITS STANDARDS

This section presents some general information on common ITS standards and their relevance to the implementation of ITS systems, both nationally and for the Salem-Keizer Metropolitan area. The US DOT supports the development of standards for specific systems through the ITS Standards Program, which has cooperative agreements with six standards development organizations[9].

Intelligent transportation systems depend on the ability to integrate many advanced technologies; ITS standards enhance this integration through interoperability and interchangeability. ITS standards contribute to interoperability by specifying consistency and compatibility between different ITS systems and components, including interconnects, interfaces, hardware and software. This allows agencies to deploy systems and technologies that can exchange information efficiently. These standards also promote interchangeability and assist in the selection and maintenance of ITS systems including: equipment replacement, system upgrades and system expansions.

As the development and testing of ITS standards progresses, requirements may be developed for their use on ITS projects that are accepting federal funding. Currently, there are no such federal mandates for ITS standards; however, there are many benefits of using standards and the US DOT strongly encourages their use as soon as possible. In some cases, agencies may have already procured systems that were developed prior to the development of the ITS standards, or

[9] Standard Development Organizations include: AASHTO, ITE, NEMA, ASTM, IEEE, SAE

that conform to another set of standards. In all cases, system engineering analysis[10] should be conducted to determine where ITS standards applications are feasible. The primary focus is on implementing standards on current and future projects so agencies interface ITS systems consistently and travelers can utilize technologies more efficiently. The sooner that the standards become recognized as an essential part of the deployment process, the sooner that the benefits can be recognized by agencies and travelers. Although standardizing may cost more initially, the long term benefits and cost savings can be substantial.

As of January 2005 there are 75 published standards with approximately 45 more approved, in ballot or under development. The U.S. Department of Transportation maintains an up-to-date, online summary on the status of ITS standards[11]. This web site provides an explanation of key standards and provides additional contact information for more details. ITS standards are under active development; information is being updated regularly at the US DOT web site and should be consulted for the latest information.

3.5.1 Standards and the National ITS Architecture

ITS standards define how system components operate within the National ITS Architecture. The National ITS Architecture links standards to market packages as a starting point for determining which ITS Standards may be applicable to a region. The Turbo Architecture database includes recommended/relevant standards for each architecture flow between elements. This information may be output as customized reports for specific architecture elements (such as, all of the potentially relevant standards for exchanging information between the ODOT NWTOC and OSP CAD).

3.5.2 Common Standards

Although the standards development effort is broad and many standards are still under development, there are a series of common standards that define terms, message sets and foundation standards that apply to many market packages. These standards form the basis for interoperability among systems by defining a common set of terms and message sets. Key standards that should be adopted and used by regional jurisdictions in the development of ITS applications are included in Table 3-6. These key baseline standards are critical for the deployment of a wide range of market packages because they establish the common vocabulary that allows different systems to speak with each other.

[10]Title 23, Code of Federal Regulations (CFR), Highways, Chapter 1: FHWA, Department of Transportation, Part 940: Intelligent Transportation Systems Architecture and Standards

[11] ITS Standards. US Department of Transportation. Site accessed April 8, 2005 http://www.standards.its.dot.gov/resource4.htm#gen

Table 3-6. Key Standards Recommended for the Salem-Keizer Region

Standard Development Organizations	Applicable Architecture Interfaces	Key ITS Standards Recommended for Salem-Keizer Regional ITS Architecture
AASHTO ITE NEMA	Traffic Management Centers to Other Centers	✦ National Transportation Communications for ITS Protocol (NTCIP) –
	Traffic Management Center to Field Devices	
	Roadside Signal Controllers	✦ Advanced Transportation Controller (ATC)
	Transit Center to Other Centers and Vehicles	✦ Transit Communications Interface Profile (TCIP)
ITE	Traffic Management Center to Other Centers	✦ Traffic Management Data Dictionary (TMDD) ✦ Message Sets for External Traffic Management Center Communications (MS/ETMCC)
IEEE	Emergency Management Center to Other Centers	✦ Standard for Incident Management Message Sets (IMSS) for Use by Emergency Management Centers
	General	✦ Standard for Data Dictionaries for Intelligent Transportation Systems
ASTM	Archived Data Management Center Interfaces	✦ Standard Guide for Archiving and Retrieving ITS-Generated Data
ASTM IEEE	Vehicle to Roadside	✦ Dedicated Short Range Communications (DSRC)
SAE	Traveler Information (Information Service Provider (ISP) Interfaces)	✦ Advanced Traveler Information Systems (ATIS) Data Dictionary ✦ Advanced Traveler Information Systems (ATIS) Core Message List and Data Dictionary
	Location Referencing	✦ Location Referencing Standards

3.5.3 National Transportation Communications for ITS Protocol

National Transportation Communications for ITS Protocol (NTCIP) provides communications protocols and data definitions for two different types of ITS communications. The first type of ITS communications is between two transportation management centers (or systems) and is called center-to-center (C2C). The second type is called center-to-field (C2F) and is the link from a transportation management system or center to a field device like a traffic signal or dynamic message sign.[12]

[12] *NTCIP: The National Transportation Communications for ITS Protocol Online Resource.* AASHTO, ITE, and NEMA. March 22, 2005. www.nctip.org. Accessed March 24, 2005

✦ **Center-to-Center Standards:** ODOT is planning on utilizing XML[13] for center-to-center communication, as opposed to either DATEX[14] or CORBA[15]. Many standards for XML have already been developed and are used widely in the IT industry. Message sets and data dictionaries for ITS utilizing XML are currently being converted from DATEX message sets by the Standard Development Organizations (SDO's).

✦ **Center-to-Field Standards:** For C2F applications, NTCIP offers the potential for interchangeability and interoperability of equipment from different suppliers on the same system. This family of standards provides both the rules for communicating (called protocols) and the vocabulary (called objects) necessary to allow electronic traffic control equipment from different manufacturers and transportation management centers to operate with each other as a system.[16] Key C2F standards that should be adopted and used by regional jurisdictions are included in Table 3-7.

Table 3-7. Key Center-to-Field Standards

NTCIP Standard	Name	Description
NTCIP 1201	Global Object Definitions	Provides the vocabulary—commands, responses and information—necessary for general device management, including those objects required for device identification, time-based schedule configuration, and event log configuration.
NTCIP 1203	Object Definitions for Dynamic Message Signs (DMS)	Defines data that is specific to dynamic message signs including all types of signs that can change state, such as blank- out signs, changeable signs, and variable signs.
NTCIP 1204	Object Definitions for Environmental Sensor Stations & Roadside Weather Information Systems	Defines those objects used to describe ambient conditions (including air pressure, wind, temperature, precipitation, sunlight, visibility, and air quality) and pavement conditions (including surface and subsurface temperature, moisture, treatment, etc.)
NTCIP 1205	Data Dictionary for Closed Circuit Television (CCTV)	A database for closed circuit television systems. The format of the database is identical to other NTCIP devices and uses Abstract Syntax Notation One (ASN. 1) representation. Targeted devices include cameras, lenses, video switches, and positioning controls for aiming and identification, such as videotext overlays.
NTCIP 1206	Data Collection and Monitoring Devices	Specifies object definitions that may be supported by data collection and monitoring devices, such as roadway loop detectors.

[13] eXtensible Markup Language (XML): a universal structured data transfer methodology that is currently widely used in e-business and e-government applications.
[14] DATa EXchange Between Systems (DATEX): one of the two approved NTCIP standards for center-to-center communications.
[15] Common Object Request Broker Architectures (CORBA): one of the two approved NTCIP standards for center-to-center communications.
[16] U.S. Department of Transportation. *Intelligent Transportation Systems, Standards Fact Sheet*. October 1999, AASHTO/ITE/NEMA TS 3.1, National Transportation Communications for ITS Protocol (NTCIP) Overview.

Table 3-7. Key Center-to-Field Standards (cont)

NTCIP Standard	Name	Description
NTCIP 1207	Ramp Meter Controller Objects	Specifications for objects that are specific to ramp metering controller operations.
NTCIP 1208	Object Definitions for Video Switches	Deals with the data needed to control a video switch enabling multiple monitors to view multiple video feeds.
NTCIP 1209	Transportation System Sensor Objects	Object definitions that are specific to and guide the data exchange content between advanced sensors and other devices in an NTCIP network. Advanced sensors include video-based detection sensors, inductive loop detectors, sonic detectors, infrared detectors, and microwave/radar detectors.
NTCIP 1210	Objects for Signal Systems Master	Defines the objects necessary to manage a field master.
NTCIP 1211	Objects for Signal Control Priority	Defines the management information base for Signal Control and Prioritization (SCP) Systems. It defines individual parameters that represent the configuration, status, and control information that is unique to an SCP and also defines specific groupings of these parameters and others to address the operational configuration, monitoring, and control of the device/entity in a baseline system configuration.

3.5.4 Transit Communications Interface Profiles (TCIP)

The Transit Communications Interface Profiles (TCIP)[17], a subset of NTCIP are communications standards for interfaces between subsystems involving transit elements such as public transportation vehicles, transit management centers, other transit facilities, and other ITS centers and subsystems. TCIP standards provide conformance requirements for automated information exchange, mechanical and electrical interfaces, data integrity and required message set. Most of these standards are still in draft form so they have not been put to use by most ITS transit vendors. As transit projects are developed, a systems engineering approach will need to be used to determine whether compliance with TCIP standards is feasible.

[17] Transit Communications for ITS Protocols (TCIP), Institute of Transportation Engineers. http://www.ite.org/standards/tcip.asp