Columbia Area Transportation Study Organization

Columbia Metro Area Intelligent Transportation Systems Regional Architecture

April, 2005

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Prepared by the Columbia Area Transportation Study Organization
John Fleck, Senior Planner
City of Columbia Department of Planning and Development
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1.1 INTRODUCTION

The Columbia Area Transportation Study Organization (CATSO) is responsible for coordinating transportation planning in the Columbia Metropolitan Area. As part of this effort, CATSO has developed the CATSO Regional ITS Architecture to support and enhance ITS interoperability and joint operations initiatives among the area's transportation and emergency response providers.

Section 6055(b) of the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) authorized the Federal Highway Administration (FHWA) to provide grants to state, local transportation agencies, and metropolitan planning organizations (MPOs) to conduct studies for the development of multi-year intelligent transportation systems (ITS) strategic deployment plans in metropolitan areas and along intercity corridors.

Urban applications of ITS have been principally implemented to better manage traffic and incidents, provide traveler information, and manage public transportation in congested urban areas. Because of ITS's ability to mitigate congestion and unproductive traveler delays, the earliest applications of ITS technology appeared in large congested cities, and current ITS deployment activities are largely concentrated in large urban areas.

For the Columbia Metropolitan Area the focus was on the expansion of existing ITS applications and identifying future applications for improved public safety. Turbo 3.0 software was used as a starting point to create the CATSO Regional Architecture and to create the architecture flows and interconnect diagrams.

The CATSO 2025 Transportation Plan, the MPO Long Range Transportation Plan (LRTP) will be amended to incorporate the contents of this document. In FY-2006, the ITS Regional Architecture will be revisited as part of the the five year update of the CATSO LRTP. The ITS architecture will also help CATSO meet federal transportation planning and funding requirements thereby ensuring that federal funds for ITS projects can be secured for in the future.

2.1 ITS Region Description

The ITS Regional Architecture covers the MPO planning area which includes the City of Columbia and a portion of Boone County. In addition to the local governmental jurisdictions, the Missouri Department of Transportation (MoDOT), the Missouri Department of Public Safety (Missouri DPS, the home agency of the Missouri State Highway Patrol), the University of Missouri and others have a considerable stake in the development of ITS services. The initial ITS equipment will be deployed on a jurisdiction by jurisdiction basis, MoDOT is the only agency with infrastructure management responsibilities throughout the metro area and will be a key stakeholder in future deployment efforts.

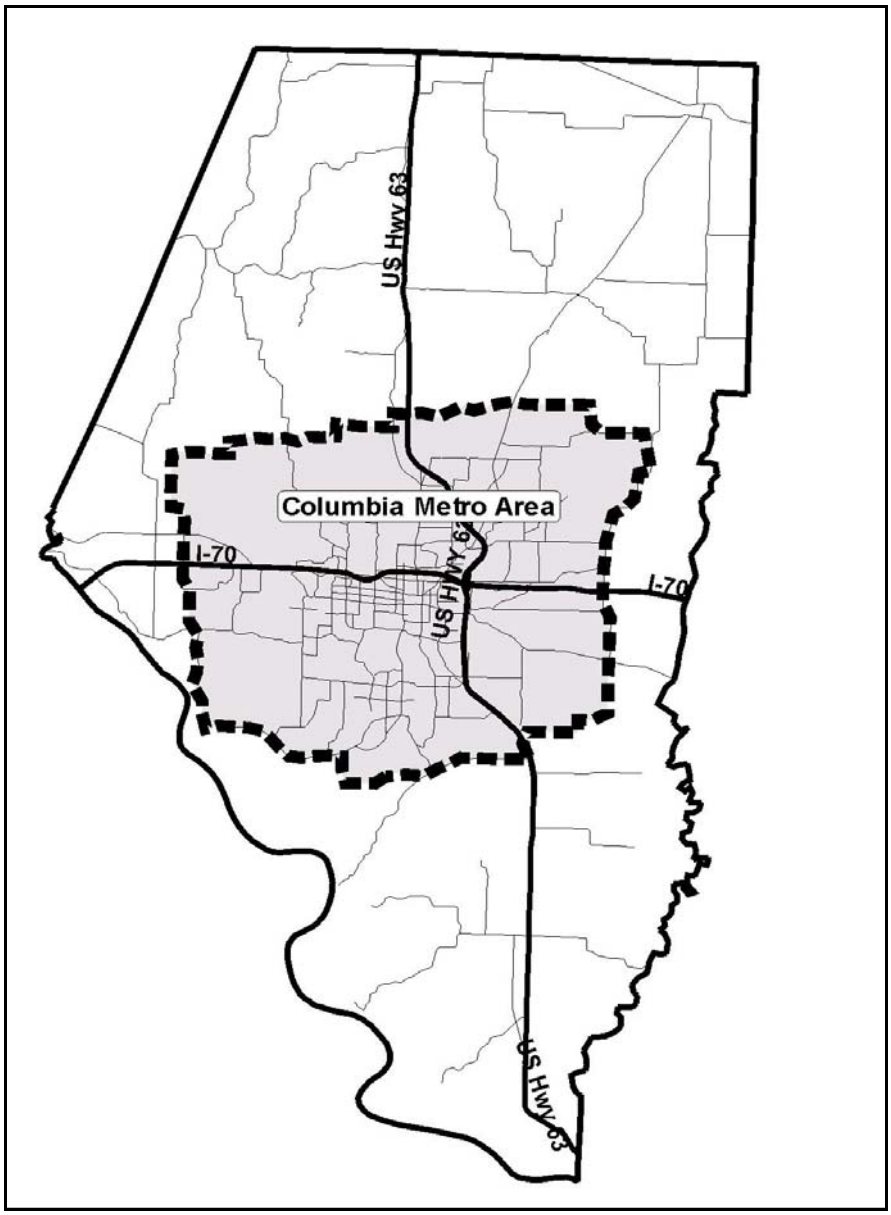


Figure 1: Columbia Metropolitan Area and Boone County, Missouri

Currently the Columbia Metro area metropolitan area covers 180.77 square miles with a 2000 population of 107,101. Population forecasts developed by the MPO for 2030 estimated that area population at 174,893.

2.2 Participating Agencies and Other Stakeholders

The Transportation and emergency services The following governmental entities and agencies were identified as potential ITS stakeholders:

City of Columbia:

- Department of Public Works: Columbia Transit System
- Department of Public Works: Traffic Engineering
- Police Department:
- Fire Department: Randy White
- Department of Water and Light: COLT Railroad
- Convention and Visitors Bureau

Columbia/Boone County Office of Public Safety Joint Communications (PSJC)

- Joint Communications Information Center (JCIC)

Boone County:

- Boone County Public Works:
- Boone County Sheriff:

University of Missouri:

- University Police

Missouri Department of Transportation (MoDOT):

- MoDOT District 5
- Missouri State Highway Patrol

OATS, Incorporated

Columbia Area Transportation Study Organization:

The development of the ITS Regional Architecture was done under the direction of the ITS Steering Committee which represents the major public and private transportation infrastructure stakeholders in the metro area. The ITS Steering Committee membership was self-selecting from the identified stakeholders.

3.1 Goals and Objectives

The purpose for developing the regional ITS architecture project is to provide a framework from which to conduct the assessment of new and/or enhanced opportunities for the implementation of intelligent transportation systems (ITS) applications in the Columbia Metro area, with a focus on improving the safety and efficiency of the transportation network.

Primary project objectives are as follows:

1. To establish ITS program policies that provide guidance for local and regional planning;

2. To involve stakeholders in the development of the regional ITS plan;

3. To identify ITS program priorities and recommend project areas for implementation over a 25-year planning period;

4. To identify regional issues, concerns and conditions that the Missouri Department of Transportation (MoDOT) should consider in its development of a regional/state-wide ITS;

5. To develop an ITS Regional Architecture for the Columbia Metropolitan Area.

The initial step was to create an inventory of the applications and systems relevant to the development of an ITS plan. The inventory included information related to mapping and data management systems, travel and transportation management systems, public transportation services and facilities, and the current status of the use of ITS services in the Columbia Metro area metropolitan area. This part of the project resulted in a geographic information systems (GIS) database, which contained much of the inventoried information, including traffic signal and signal systems, traffic counts, traffic accidents, and programmed facility improvements.

Using the inventory of existing systems, facilities, traffic and transportation characteristics and attributes, and existing ITS services, the steering committee targeted five topic areas for further development. For each application area, the stakeholder's identified goals and objectives, explored institutional issues, and outlined the systems requirements.

The ITS Plan was developed over a period of approximately 8 months. The completed Plan includes recommend short, medium and long-range ITS implementation strategies, identifies ITS policy issues, supports the regional ITS architecture efforts by the Missouri Department of Transportation (MoDOT), and positions the Columbia Area Transportation Study Organization

CATSO to meet the national architecture requirements of both the Federal Highway Administration (FHWA) and the Federal Transit Administration (FTA).

3.2 ITS Planning Principles

At present, the Columbia Metro metropolitan area does not experience significant main lane traffic delays on its major roadway corridors. The existing freeways, transit service, and arterial streets provide a relatively good level of service (LOS). Traffic delays at the peak hours are creating operational problems and are symptomatic of inadequate roadway facilities and intersections. Planned improvements to major roadway corridors, interchanges and intersection will provide the desired level of service (LOS) in 2030.

Columbia metro area, unlike large urbanized areas, is not motivated to develop ITS services as an alternative to large investments to improve road capacity and reduce delays by managing the transportation resources. The Columbia area has the opportunity to develop and identify ITS applications strategically, as part of the planned major investments in transportation infrastructure. With the opportunity to be proactive, rather then reactive, the Columbia metro area ITS plan is developed based on the following principles:

Identify specific ITS application components that could be implemented as part of a technology upgrade to an existing program or service.

Build the core infrastructure incrementally using interoperable systems, while recognizing that the development of the ITS infrastructure and the services identified require a long-term commitment.

Create new ITS infrastructure in partnership with other ITS stakeholders via development programs with similar objectives. Identify opportunities to implement elements of the ITS plan as part of area construction and safety projects to promote the completion of the ITS infrastructure.

3.3 ITS Needs and Opportunities

The plan attempts to identify ITS technology opportunities associated with existing solutions currently operated by local agencies and with future transportation projects. These opportunities vary from the replacement of loop detectors with video detection technology at signalized intersections, the replacement of fixed route and on-demand transit vehicle equipped with ITS technology such as GPS tracking and automatic vehicle location (AVL) to integrating the ITS elements identified as part of the improvements to I-70 in the EIS. There are important public benefits that could be derived from a coordinating system of data collection, data sharing, and information sharing between agencies and with the traveling public.

The MoDOT I-70 project provides a significant opportunity for the implementation of the

proposed ITS projects. Prior to reconstruction, the focus is on the incremental establishment of ITS services in the urban area and implementation of management systems to ease congestion during reconstruction. There will be a need to organize the data inputs from the preconstruction ITS assets to develop the ITS infrastructure on the I-70 corridor that will be necessary to manage traffic during the reconstruction of I-70. There will be a need to redirect and expand the capabilities of the ITS application put in place during the reconstruction of I-70 focus to manage incidents throughout the urban area.

The ITS applications associated with the MoDOT I-70 Environmental Impact Statement (EIS) are included in Appendix E.

4.1 ITS REGIONAL ARCHITECTURE

The regional ITS architecture identifies the stakeholders that are associated with each system in the region. The purpose of the ITS Regional Architecture is to plan for Intelligent Transportation System (ITS) deployment and provide for the future development of ITS infrastructure within the Metro Area. The regional ITS architecture shall include, at a minimum, the following:

1. A description of the region;
2. Identification of participating agencies and other stakeholders;
3. An operational concept that identifies the roles and responsibilities of participating agencies and stakeholders in the operation and implementation of the systems included in the regional ITS architecture;
4. Any agreements (existing or new) required for operations, including at a minimum those affecting integration of ITS projects; interoperability of different ITS technologies, utilization of ITS-related standards, and the operation of the projects identified in the regional ITS architecture;
5. System functional requirements;
6. Interface requirements and information exchanges with planned and existing systems and subsystems (for example, subsystems and architecture flows as defined in the National ITS Architecture);
7. Identification of ITS standards supporting regional and national interoperability;
8. The sequence of projects required for implementation of the regional ITS architecture

4.2 ITS Subsystems:

Subsystems are the principal structural element of the ITS architecture and represent the individual pieces of the intelligent transportation system. They are grouped into the following four classes:

1. Centers: Subsystems that provide management, administrative, and support functions for the transportation system. The center subsystems each communicate with other centers to enable coordination between modes and across jurisdictions. Some examples of center subsystems are Traffic Management, Transit Management, and Emergency Management.

2. Roadside: Intelligent infrastructure distributed along the transportation network which perform surveillance, information provision, and plan execution control functions and

whose operation is governed by center subsystems. Roadside subsystems also directly interface to vehicle subsystems.

3. Travelers: Equipment used by travelers to access ITS services pre-trip and en-route. This includes services that are owned and operated by the traveler as well as services that are owned by transportation and information providers.

4. Vehicles: Covers ITS related elements on vehicle platforms. Vehicle subsystems include general driver information and safety systems applicable to all vehicle types. Three fleet vehicle subsystems (Transit, Emergency, and Commercial Vehicles) add ITS capabilities unique to these special vehicle types.

4.3 Service Areas:

ITS services are improve the efficiency, safety and convenience of the regional transportation network through better information, advanced systems, and technology. The National ITS Program Plan lists 32 User Service Areas from which the ITS stakeholders identified the service areas that would be applicable within the Columbia Metro Area. Those service areas included:

1. Archived Data Management
2. Public Transportation
3. Travel Information
4. Traffic Management
5. Vehicle Safety
6. Commercial Vehicle Operations
7. Emergency Management
8. Maintenance and Construction Management.

Implementation of the identified service area and may expanded or organized in through the application of the market package concept. A Market Package represents a collection of equipment and capabilities that will required to provide the identified transportation services.

4.4 Market Packages

ITS market packages provide an accessible, deployment oriented perspective to the national architecture. They are tailored to fit - separately or in combination - real world transportation problems and needs. Market packages collect together one or more Equipment Packages that must work together to deliver a given transportation service and the Architecture Flows that connect them and other important external systems. In other words, they identify the pieces of the Physical Architecture that are required to implement a particular transportation service. Because they were evaluated during the architecture development, supporting benefits and costs analyses are also available for the market packages.

1. Transit Vehicle Tracking
2. Transit Fixed-Route Operations
3. Transit Security
4. Demand Response Transit Operations
5. Transit Passenger and Fare Management
6. Transit Security
7. Broadcase Traveler Information
8. Network Surveillance
9. Traffic Information Dissemination
10. Regional Traffic Control
11. Incident Management System
12. Road Weather Information System
13. Vehicle Safety Monitoring
14. Weigh-In-Motion
15. Roadside CVO Safety
16. HAZMAT Management
17. Emergency Response
18. Emergency Routing

For each topic, a different approach was taken to study related issues and to identify candidate ITS applications. For incident management, traveler information, and advanced traffic control,

For the commercial vehicle applications, staff relied on the I-70 EIS recommendations and MoDOT ITS policies.

Data management issues were identified through discussions with technical staff for the affected agencies. The work in each of these topic areas resulted in the identification of specific market packages for further focused refinement.

The next step in the planning process was to conduct a review of ITS technologies. To do this, a detailed evaluation was conducted of 169 technologies with respect to 12 criteria. The criteria included categorization and description of the technology, support of the technology, technology costs, and judgment evaluation of the technology''s benefits and negative and positive attributes.

Given an understanding of the technology, an understanding of the issue to which ITS can be applied, and an inventory of what already exists, the steering committee to identified specific ITS projects to be deployed over a 25-year planning horizon.

4.5 Operational Concepts

The operational concept identifies the roles and responsibilities of participating agencies and stakeholders in operating and implementing the system included in the Regional ITS Architecture. The operational concept provides the framework for institutional coordination and technical integration of ITS systems and a summary view of how each system works. This includes any interagency agreements necessary to operate and implement the system.

4.6 System Engineering Process:

Federal ITS requirements mandate that all ITS projects be based on a systems engineering analysis. The analysis should be on a scale commensurate with the project scope. The requirements for the systems engineering analysis includes the execution of the following seven elements:

1. Relationship to the Regional ITS Architecture: A description of how a project fits into the CATSO Regional ITS Architecture;

2. Participating Agencies - Roles and Responsibilities: Identification and description of key agency relationships and all copies of all agreements necessary to implement the project.

3. Requirements Definitions: Functional requirements, performance requirements and technical requirements: A description of what the project will accomplish, how are the functions will be performed and how frequently, and what equipment/standards are required for performing the functions.

4. Analysis of Alternative System Configurations and Technology Options to Meet Requirements. An description of the project cost, functionality, procurement schedule, maintenance, expandibility/adaptibility, equipment standards, security, etc.

5. Procurement Options: A description of options, if additional flexibility is desired for an ITS project

6. Identification of Applicable ITS Standards and Testing Procedures: All of the following procedures that apply;

    a. Daily Operating Procedures
    b. Operations Training
    c. System Monitoring
    d. Center Equipment Maintenance

e. Field Equipment Maintenance
f. Spare Equipment Stockpiles
g. Maintenance Activity Tracking
h. Equipment Maintenance Training
i. Maintenance Facilities and Related Tools
j. Data Management
k. Performance Requirements
l. Equipment Upgrades
m. Software Upgrades
n. Staffing Requirements
o. Development of Consensus for Multi-jurisdictional Operations
p. Development and Approval of Inter-agency Agreements
q. Procedures and Resources Necessary for Operations and Management of the System

DEPLOYMENT RECOMMENDATIONS

5.1 Introduction

Although the metropolitan area traffic volumes are growing, main lane congestion is not seen as a significant problem. The predominate areas of deployment involves several interrelated ITS market packages to manage traffic (both on arterial streets and the freeway system), to provide traveler information, and to manage incidents. The development of a transportation management center (TMC) is a common requirement to traffic and incident management and traveler information.

The plan addresses other areas where more modest deployment of ITS applications are planned involving advanced public transportation systems and commercial vehicle operations.

To date, MoDOT has the largest deployment of ITS applications in and around Columbia. Delays and congestion at key intersections on the MoDOT system has prompted the installation of video monitoring equipment. To date, MoDOT does not have a statewide regional ITS architecture in place in and around Columbia. ITS Deployment plan recommends that the MoDOT take the lead for future ITS deployment, while the Columbia Metro Area MPO serves as the champion for the plan's implementation in partnership with local jurisdictions.

5.2 Federal Transit Administration Project Implementation Requirements

All ITS projects funded with Mass Transit Funds from the Highway Trust Fund shall be based on a systems engineering analysis.

The analysis should be on a scale commensurate with the project scope. The systems engineering analysis shall include, at a minimum:

1. Identification of portions of the regional ITS architecture being implemented (or if a regional ITS architecture does not exist, the applicable portions of the National ITS Architecture).
2. Identification of participating agencies' roles and responsibilities;

3. Requirements definitions:

   a. Analysis of alternative system configurations and technology options to meet requirements;
   b. Analysis of financing and procurement options;
   c. Identification of applicable ITS standards and testing procedures; and
   d. Procedures and resources necessary for operations and management of the system;

Upon completion of the regional ITS architecture, the final design of all ITS projects funded with highway trust funds shall accommodate the interface requirements and information exchanges as specified in the regional ITS architecture. If the final design of the ITS project is inconsistent with the regional ITS architecture, then the regional ITS architecture shall be updated to reflect the changes.

Prior to completion of the regional ITS architecture, any major ITS project funded with highway trust funds that advances to final design shall have a project level ITS architecture that is coordinated with the development of the regional ITS architecture. The final design of the major ITS project shall accommodate the interface requirements and information exchanges as specified in this project level ITS architecture. If the project final design is inconsistent with the project level architecture, then the project level ITS architecture shall be updated to reflect the changes. The project level ITS architecture is based on results of the systems engineering analysis, and includes the following:

   1. A description of the scope of the ITS project An operational concept that identifies the roles and responsibilities of participating agencies and stakeholders in the operation and implementation of the ITS project;
   2. Functional requirements of the ITS project;
   3. Interface requirements and information exchanges between the ITS project and other planned and existing systems and subsystems; and
   4. Identification of applicable ITS standards

All ITS projects funded with Mass Transit Funds from the Highway Trust Funds are required to use the applicable ITS standards and interoperability tests that have been officially adopted through rulemaking by the United States Department of Transportation (US DOT).

5.3 MoDOT ITS Applications

ITS can be used to alleviate traffic congestion and improve roadway safety through the use of real-time traffic information to inform motorists about the best route to travel and allowing emergency services to remove roadway incidents quickly.

Roadway incidents are defined "as any unexpected events that have the potential to restrict the flow of traffic along an arterial roadway, that are temporary and localized in nature, and for which some form of intervention usually is necessary to complete and restore traffic flow." Approximately 60 percent of the traffic congestion on major urban arterials is the result of roadway incidents. The traffic operation impacts of roadway incidents can be significant and are outlined below:

> 1 minute of lane blockage = 5 minutes of traffic congestion
>
> During peak hours, 1 minute of lane blockage can cause about 20 minutes of traffic congestion.
>
> A vehicle on the shoulder of the road reduces the capacity of the closest lane by 20 percent.

The key factors that compromise incident management include (1) poor communication, coordination, planning and evaluation; (2) too little information, concern, and knowledge of incidents and their impact on traffic; and (3) too many responders who take too long to process and clear an incident from the roadway. A delayed response phase can be the result of any or all of these factors.

Active management of roadway incidents involves three objectives:

1. Protect life and property;
2. Minimize capacity loss (flow disruption) duration, intensity, and geographic extent; and
3. Gather required investigative information.

Improved incident management seeks to reduce the time of the "response phase," which starts when the roadway incident occurs and ends when all debris is cleared and normal traffic resumes.

The MoDOT ITS strategy is comprised of many components that are designed to provide an integrated network to address traffic safety and reduce travel delays.

1. Fiber-optic cables communicate information between monitoring devices and the MoDOT Traffic Operations Center.
2. Sensors provide information on average traffic speed and volume.
3. Closed-circuit cameras at major interchanges, intersections and river bridge crossings provide live video information on traffic flow.
4. Permanent mounted variable message signs inform motorists of incidents ahead and supply alternate route options.
5. Highway Advisory Radio signs equipped with lights that flash when there is new traffic information.
6. Integration of regional/urban traffic signal systems.
7. The toll-free cellular call-in system routed to the MoDOT Traffic Operations Center or the Missouri Highway Patrol for immediate response to incidents.
8. Improved highway milemarkers identify exactly where a motorist is to accurately pinpoint the location of incidents.
9. In Kansas City and St. Louis, Motorist Assist helps stranded motorists to get their vehicles out of traffic lanes and, if possible, running again.
10. Advanced Traveler Information on weather conditions, incidents and traffic congestion levels.
11. Direct media tie-in to traffic information for broadcast to motoring public.
12. Direct emergency services tie-in for immediate response to incidents.
13. Sharing information with transit centers regarding traffic flow.
14. In urban areas, ramp metering smooths traffic flow on the highway near entrance ramps.

5.4 Existing ITS Applications

In the Columbia metro area MoDOT and the City of Columbia have ITS applications in use in the field. Signal systems, video detection systems, paratransit sheduling software, farebox,

The Columbia Transit System (CTS) has two ITS applications; 1) the installation of automated farebox collection equipment on CTS fixed route transit vehicles, and 2) a computerized paratransit

scheduling system has been in place since 1992.

MoDOT has video detection equipment installed at several signalized intersections associated with the interchanges along I-70. The video cameras and software interface with the computerized signal controller equipment to detect the presence of vehicles, detect queues, count vehicles, and adjust the signal timing to reduce delay. The video cameras are not integrated into a system that provides data to a traffic management center and MoDOT personnel. MoDOT also operates 3 closed loop signal systems in the Columbia Metro Area.

Additional video detection equipment is being placed along I-70 to measure traffic volume, speed, density, occupancy and headway. That data can be used to manage highway flows and to determine capacities for long-term planning. The video camera output may be viewed authorized personnel through a URL address and internet access. In the future, local cable access channels could broadcast the live video images from the intersections, allowing citizens view weather and road surface conditions.

In January 2005, the FirstWatch biosurveillance system was implemented. The system can provide early warning for disease outbreaks and possible bioterrorist attacks in the community. The fully automated surveillance system, reviews real-time information from 9-1-1 calls for trends indicating the possible outbreak of disease, illness or patterns of injury, either from natural causes or acts of terrorism. FirstWatch continuously scans 9-1-1 calls, comparing the symptoms and complaints reported by patients that may be identified with specific events.

The implementation of the FirstWatch system has been a collaboration between the Columbia/Boone County Health Department (CBCHD) and the Columbia/Boone County Office of Public Safety Joint Communications (PSJC). The 9-1-1 calls are received by PSJC and the CBCHD then responds accordingly when alerted that a trigger has been activated. Funding for the system was provided through the 2003 Homeland Security Grant. FairCom donated the c-tree server database technology software component in support of public safety. The donated software is crucial to the operation of the FirstWatch system.

The City of Columbia Convention and Visitors Bureau is launching a radio information service for travelers and visitors to Columbia. Implementation of this project is anticipated in 2005.

5.5 Future Deployments

The principal focus for future ITS applications in the Columbia Metro area is to prepare for the reconstruction of I-70. The I-70 reconstruction project will present numerous transporation challenges and will require ITS solutions to address traffic management, incident management, and traveler information issues. There is no time line or funding identified for the planned

improvements to I-70. Plans for ITS deployments to support traffic and incident management and traveler information were parsed into three time frames: 1) prior to I-70 reconstruction, 2) during I-70 reconstruction, and 3) post I-70 reconstruction.

I-70 divides the Columbia Metro area running through the north side of the central business district and has been the single most important factors in forging commuting and development patterns in Columbia Metro area areas. As a result, arterial streets which parallel I-70 will be greatly impacted by the diversion of traffic from I-70 during reconstruction.

The I-70 Environment Impact Statement (EIS) includes specific mitigation strategies associated with the phased reconstruction and widening. The EIS identifies which routes need to be improved in advance of the reconstruction. This analysis not only helped to target improvements on the interstate system, but also identified the need to improve traffic control and signing along parallel arterials.

Currently there is no formal coordination of highway operations throughout the urban area . For example, which organization is responsible for clearing and managing an incident on the interstate system depends on the incident's location. Incidents occurring on the interstate system that are within a municipal boundary are the responsibility of the municipality. On parts of the system which are located in Boone County, incidents are the responsibility of the Missouri Highway Patrol.

All the traffic and incident management and travel information systems planned are based on the assumption that a MoDOT transportation management center (TMC) will be developed. The TMC will receive data from field data collection units (detectors and cameras) and observation data from field personnel (service patrol operators and enforcement) and motorists, fuse the data and coordinate or direct field personnel, manage traffic control systems and incident responders, and provide traveler information. The implementation of the TMC will require that an adequate communication system be developed using a fiber optic network. The resulting ITS recommendations included:

I-70 Preconstruction Deployment

During this period, only a small number of ITS field assets are recommended in the plan:

1. Consider the expansion of the area covered by the ITS Regional Architecture to include all of Boone County as part of the planned update of the CATSO Transportation Plan in FY-2006;

2. Placement of video surveillance cameras along I-70 and along major intersecting routes such as U.S. Highway 63 and MO 740 (Stadium Blvd);

3. Install of video traffic detectors at locations throughout the I-70 corridor and along major intersecting routes such as U.S. Highway 63 and MO 740 using radar/video technologies;

4. Transmit live video of traffic conditions over the government access cable TV channel and via the internet; and

5. Implementation of a low-power highway advisory radio (HAR) for traveler information.

I-70 Construction Phase Deployment

During the construction phase of I-70, the traffic and incident management and traveler information systems are likely to be most effective in managing traffic delays along I-70 and providing directions to businesses with access affected by the construction. The reconstruction of I-70 is anticipated to require approximately five-seven years to complete. Projects include:

1. Develop agreements to implement multi-jurisdictional traffic signal coordination along diversion routes which cross municipal boundaries; and

2. Placement of changeable message signs along I-70 and principal diversion routes and at locations in advance of possible route change locations (intersections).

Post I-70 Construction Deployment

The completion of the I-70 improvements would include include the ITS applications contained in the I-70 EIS document and focus on information and management projects:

1. Development of a freeway incident management plan for the entire metropolitan area

2. Include weather detection and forecasting technologies deployed on I-70 in combination with information disseminating equipment; and

3. Development of a highway service patrol, consisting of private or public sector operators with direct communication to the TMC and with an established control structure over the deployment and activities conducted by the service patrol (regardless of whether they are public or private.

5.6 ITS System Costs

The traffic and incident management and traveler information systems proposed for the Columbia Metro area are intended to keep in perspective the appropriate system cost and technology for an urbanized like Columbia Metro area. Significant parts of these systems should be implemented in conjunction with the reconstruction of I-70 and the possible construction of the eastern extension of MO 740 from U.S. Highway 63 to I-70. To reduce costs, the TMC is proposed to be located in an existing facility, such as the Joint Communication Information Center (JCIC) and integrated with existing communications infrastructure. Further, it is anticipated that the highway system is not densely populated with detectors, video cameras, CMS's, etc. and that video camera installations would two per interchange.

Cost estimates for the TMC and the communication system vary depending upon how the communication services are provided. The complete system cost forecast is between $185,000 to $300,000 per interstate mile. This includes the costs associated with the TMC. MoDOT may elect to provide the I-70 portion of the communication network as part of the I-70 reconstruction project and located fiber optic cables within the I-70 right-of-way easements.

5.7 Commercial Vehicle Operations

The CVO applications include a broad range of deployments that are focused on improved commercial vehicle safety and efficiency. Commercial Vehicle Operations (CVO) market packages mostly involve either functions which are the private responsibility of the carrier (e.g., automated dispatching and fleet management) or are under the purview of the state and federal government (e.g., electronic screening, automated safety inspections, and electronic procurement of credentials).

The application identified in the I-70 EIS as being the most appropriate for I-70 is Commercial Vehicle Electronic Clearance. Commercial Vehicle Electronic Clearance uses an automatic vehicle identification (AVI) systems, high speed "weigh-in-motion" systems and roadside databases to electronically identify and check the safety, credentials and size and weigh data for commercial vehicles while they travel on the interstate highway. AVI equipment includes roadside readers and antennae and in-vehicle transponders to communicate a vehicles unique identification code to the roadside equipment. Through the use of a AVI system, "weigh-in-motion" equipment and statewide and interstate commercial vehicle databases, legal commercial vehicles can travel on I-70 without stopping at weigh stations and state enforcement officials at weigh stations can concentrate their enforcement efforts on non-compliant or questionable commercial carriers.

Although most CVO applications envisioned are not under the control of public organizations in the Columbia metro area, three actions were recommended. They are:

1. Encourage state officials in Missouri and in adjacent states to adopt the applications market packages and system architecture defined as part of the national ITS program;

2. Maintain the static commercial traveler information system developed as a task within this project; and

3. Create an Operation Response Team to address hazard materials incidents. Purchase the necessary computer hardware and software to allow the City of Columbia Metro area Fire Department Hazardous Material Response Team participate in the Operation Response Team.

APPENDIX A: DEFINITIONS

Equipment Packages are the building blocks of the Physical Architecture subsystems which group like processes of a particular subsystem together into a package for implementation. The grouping also takes into account the user services and the need to accommodate various levels of functionality.

Intelligent Transportation Systems (ITS) means electronics, communications or information processing used singly or in combination to improve the efficiency or safety of a surface transportation system.

ITS project means any project that in whole or in part funds the acquisition of technologies or systems of technologies that provide or significantly contribute to the provision of one or more ITS user services as defined in the National ITS Architecture.

Logical Architecture defines what has to be done to support the ITS User Services. It defines the processes that perform ITS functions and the information or data flows that are shared between these processes.

Major ITS project means any ITS project that implements part of a regional ITS initiative that is multi-jurisdictional, multi-modal, or otherwise affects regional integration of ITS systems

National ITS Architecture (also "national architecture") means a common framework for ITS interoperability. The National ITS Architecture comprises the logical architecture and physical architecture which satisfy a defined set of user services. The National ITS Architecture is maintained by U.S. DOT (Department of Transportation).

Physical Architecture the Physical Architecture provides a physical representation (though not a detailed design) of the important ITS interfaces and major system components. It provides a high-level structure around the processes and data flows defined in the Logical Architecture.

Project level ITS Architecture is a framework that identifies the institutional agreement and technical integration necessary to interface a major ITS project with other ITS projects and systems.

Region is the geographical area that identifies the boundaries of the regional ITS architecture and is defined by and based on the needs of the participating agencies and other stakeholders. A region can be specified at a metropolitan, Statewide, multi-State, or corridor level. In metropolitan areas, a region should be no less than the boundaries of the metropolitan planning area.

Regional ITS architecture means a regional framework for ensuring institutional agreement and technical integration for the implementation of ITS projects or groups of projects.

Systems engineering is a structured process for arriving at a final design of a system. The final design is selected from a number of alternatives that would accomplish the same objectives and considers the total life-cycle of the project including not only the technical merits of potential solutions but also the costs and relative value of alternatives.

APPENDIX B: ITS STAKEHOLDERS & AFFECTED AGENCIES

City of Columbia:

- Police Department: Tim Moriarity and Scott Sergent
- Fire Department: Randy White
- Department of Water and Light: COLT Railroad
- Convention and Visitors Bureau
- Department of Public Works:
  - Columbia Transit System- Robert Cundiff
  - Traffic Engineering - Richard Stone

Columbia/Boone County Office of Public Safety Joint Communications (PSJC)

- Joint Communications Information Center (JCIC): Brian Maydwell

Boone County:

- Boone County Public Works
- Boone County Sheriff

University of Missouri:

- University Police

Missouri Department of Transportation (MoDOT):

- MoDOT District 5: Traffic Section - Matt Meyers, P.E.
- Missouri State Highway Patrol

OATS, Incorporated

Columbia Area Transportation Study Organization:

- John Fleck

APPENDIX C: INVENTORY TO MARKET PACKAGE COMPARISON

Inventory to Market Package Comparison

4/8/2005 1:52:58PM

Entity Name	Type	Element Name	
The following Element(s) are in the inventory, but do not participate in any of the selected Market Packages			
Weather Service	*Terminator*	I-70 Corridor ITS Applications	
Archived Data Management Subsystem	*Subsystem*	Joint Communications Information Center	
Market Package: (ATMS01) Network Surveillance			
Traffic Management	*Subsystem*	I-70 Corridor ITS Applications	
Traffic Management	*Subsystem*	Joint Communications Information Center	
Information Service Provider	*Subsystem*		Not in Inventory
Roadway Subsystem	*Subsystem*		Not in Inventory
Map Update Provider	*Terminator*		Not in Inventory
Other Roadway	*Terminator*		Not in Inventory
Traffic	*Terminator*		Not in Inventory
Traffic Operations Personnel	*Terminator*		Not in Inventory
Market Package: (ATMS06) Traffic Information Dissemination			
Traffic Management	*Subsystem*	I-70 Corridor ITS Applications	
Emergency Management	*Subsystem*	Joint Communications Information Center	
Traffic Management	*Subsystem*	Joint Communications Information Center	
Information Service Provider	*Subsystem*		Not in Inventory
Maintenance and Construction Management	*Subsystem*		Not in Inventory
Roadway Subsystem	*Subsystem*		Not in Inventory
Basic Vehicle	*Terminator*		Not in Inventory
Driver	*Terminator*		Not in Inventory
Media	*Terminator*		Not in Inventory
Other Roadway	*Terminator*		Not in Inventory
Traffic Operations Personnel	*Terminator*		Not in Inventory
Emergency Management	*Subsystem*	Columbia Transit System	Not Selected
Transit Management	*Subsystem*	Columbia Transit System	Not Selected
Market Package: (ATMS08) Traffic Incident Management System			
Emergency Vehicle Subsystem	*Subsystem*	Emergency Vehicles	
Traffic Management	*Subsystem*	I-70 Corridor ITS Applications	
Event Promoters	*Terminator*	I-70 Corridor ITS Applications	
Other Traffic Management	*Terminator*	I-70 Corridor ITS Applications	
Emergency Management	*Subsystem*	Joint Communications Information Center	
Traffic Management	*Subsystem*	Joint Communications Information Center	
Emergency Personnel	*Terminator*	Joint Communications Information Center	
Emergency System Operator	*Terminator*	Joint Communications Information Center	
Other Emergency Management	*Terminator*	Joint Communications Information Center	
Other Traffic Management	*Terminator*	Joint Communications Information Center	
Information Service Provider	*Subsystem*		Not in Inventory
Maintenance and Construction Management	*Subsystem*		Not in Inventory
Roadway Subsystem	*Subsystem*		Not in Inventory

Entity Name	Type	Element Name	
Market Package: (ATMS08) Traffic Incident Management System			
Intermodal Freight Depot	*Terminator*		Not in Inventory
Maintenance and Construction Center Personnel	*Terminator*		Not in Inventory
Map Update Provider	*Terminator*		Not in Inventory
Media	*Terminator*		Not in Inventory
Other MCM	*Terminator*		Not in Inventory
Other Roadway	*Terminator*		Not in Inventory
Rail Operations	*Terminator*		Not in Inventory
Traffic	*Terminator*		Not in Inventory
Traffic Operations Personnel	*Terminator*		Not in Inventory
Emergency Management	*Subsystem*	Columbia Transit System	Not Selected
Transit Management	*Subsystem*	Columbia Transit System	Not Selected
Other Emergency Management	*Terminator*	Columbia Transit System	Not Selected
Market Package: (APTS1) Transit Vehicle Tracking			
Transit Management	*Subsystem*	Columbia Transit System	
Transit Vehicle Subsystem	*Subsystem*	Transit Vehicles	
Information Service Provider	*Subsystem*		Not in Inventory
Vehicle	*Subsystem*		Not in Inventory
Basic Transit Vehicle	*Terminator*		Not in Inventory
Location Data Source	*Terminator*		Not in Inventory
Map Update Provider	*Terminator*		Not in Inventory
Market Package: (APTS2) Transit Fixed-Route Operations			
Transit Management	*Subsystem*	Columbia Transit System	
Transit Vehicle Subsystem	*Subsystem*	Transit Vehicles	
Information Service Provider	*Subsystem*		Not in Inventory
Maintenance and Construction Management	*Subsystem*		Not in Inventory
Transit System Operators	*Terminator*		Not in Inventory
Transit Vehicle Operator	*Terminator*		Not in Inventory
Traffic Management	*Subsystem*	I-70 Corridor ITS Applications	Not Selected
Traffic Management	*Subsystem*	Joint Communications Information Center	Not Selected
Market Package: (APTS3) Demand Response Transit Operations			
Transit Management	*Subsystem*	Columbia Transit System	
Transit Vehicle Subsystem	*Subsystem*	Transit Vehicles	
Information Service Provider	*Subsystem*		Not in Inventory
Maintenance and Construction Management	*Subsystem*		Not in Inventory
Transit System Operators	*Terminator*		Not in Inventory
Transit Vehicle Operator	*Terminator*		Not in Inventory
Traffic Management	*Subsystem*	I-70 Corridor ITS Applications	Not Selected
Traffic Management	*Subsystem*	Joint Communications Information Center	Not Selected
Market Package: (APTS4) Transit Passenger and Fare Management			
Transit Management	*Subsystem*	Columbia Transit System	
Other Transit Management	*Terminator*	Columbia Transit System	

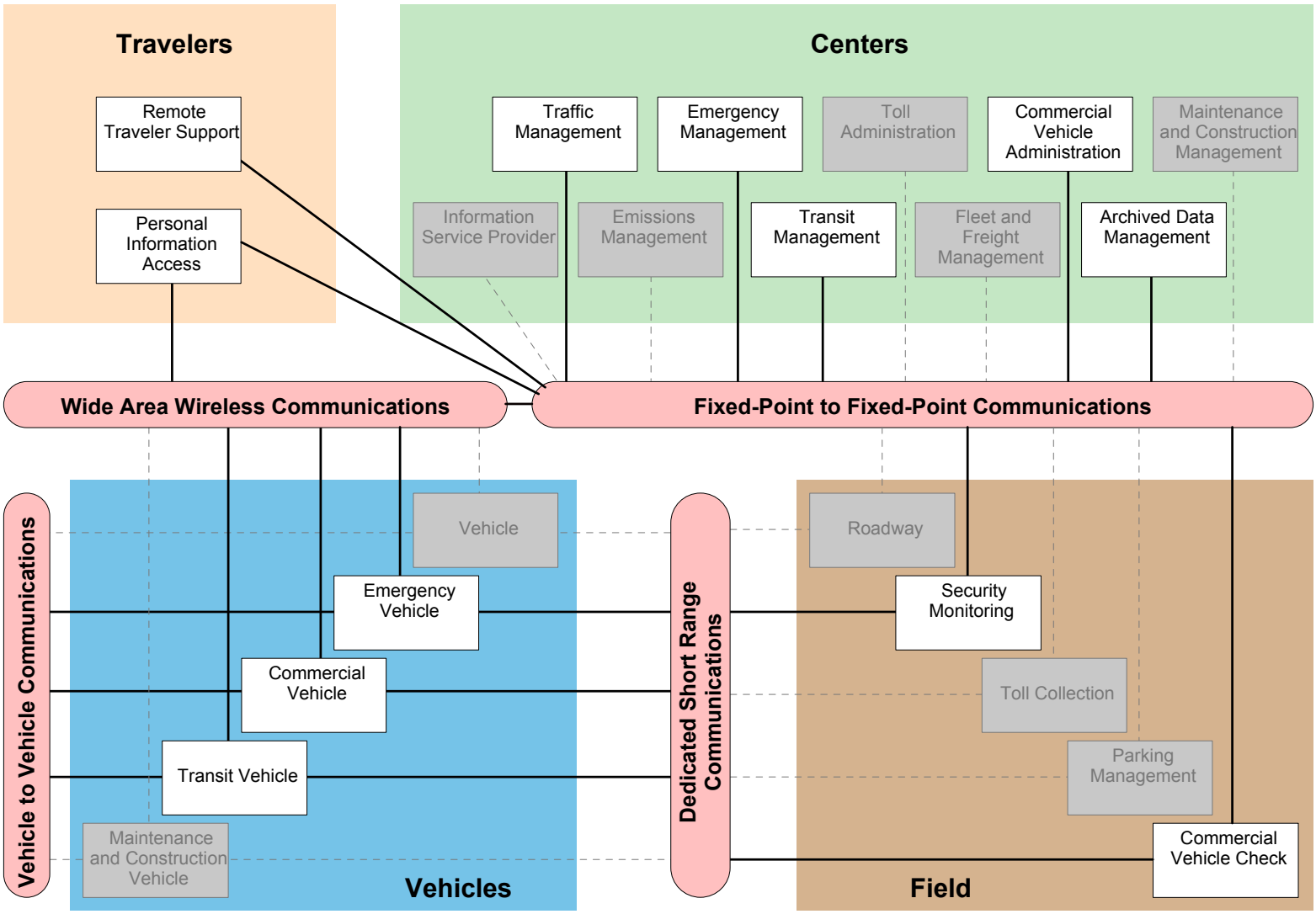
Entity Name	Type	Element Name	
Market Package: (APTS4) Transit Passenger and Fare Management			
Transit Vehicle Subsystem	*Subsystem*	Transit Vehicles	
Information Service Provider	*Subsystem*		Not in Inventory
Enforcement Agency	*Terminator*		Not in Inventory
Financial Institution	*Terminator*		Not in Inventory
Transit System Operators	*Terminator*		Not in Inventory
Traveler Card	*Terminator*		Not in Inventory
Traveler	*Terminator*	I-70 Corridor ITS Applications	Not Selected
Remote Traveler Support	*Subsystem*	Security Monitoring Field Equipment	Not Selected
Market Package: (APTS5) Transit Security			
Emergency Management	*Subsystem*	Columbia Transit System	
Transit Management	*Subsystem*	Columbia Transit System	
Other Emergency Management	*Terminator*	Columbia Transit System	
Remote Traveler Support	*Subsystem*	Security Monitoring Field Equipment	
Security Monitoring Subsystem	*Subsystem*	Security Monitoring Field Equipment	
Transit Vehicle Subsystem	*Subsystem*	Transit Vehicles	
Information Service Provider	*Subsystem*		Not in Inventory
Alerting and Advisory Systems	*Terminator*		Not in Inventory
Basic Transit Vehicle	*Terminator*		Not in Inventory
Media	*Terminator*		Not in Inventory
Rail Operations	*Terminator*		Not in Inventory
Secure Area Environment	*Terminator*		Not in Inventory
Transit System Operators	*Terminator*		Not in Inventory
Transit Vehicle Operator	*Terminator*		Not in Inventory
Traveler	*Terminator*	I-70 Corridor ITS Applications	Not Selected
Emergency Management	*Subsystem*	Joint Communications Information Center	Not Selected
Emergency System Operator	*Terminator*	Joint Communications Information Center	Not Selected
Other Emergency Management	*Terminator*	Joint Communications Information Center	Not Selected
Market Package: (APTS6) Transit Maintenance			
Transit Management	*Subsystem*	Columbia Transit System	
Transit Vehicle Subsystem	*Subsystem*	Transit Vehicles	
Basic Transit Vehicle	*Terminator*		Not in Inventory
Transit System Operators	*Terminator*		Not in Inventory
Market Package: (APTS8) Transit Traveler Information			
Transit Management	*Subsystem*	Columbia Transit System	
Other Transit Management	*Terminator*	Columbia Transit System	
Transit Vehicle Subsystem	*Subsystem*	Transit Vehicles	
Information Service Provider	*Subsystem*		Not in Inventory
Media	*Terminator*		Not in Inventory
Traveler	*Terminator*	I-70 Corridor ITS Applications	Not Selected
Remote Traveler Support	*Subsystem*	Security Monitoring Field Equipment	Not Selected
Market Package: (CVO06) Weigh-In-Motion			
Commercial Vehicle Check	*Subsystem*	I-70 Corridor ITS Applications	
Commercial Vehicle Subsystem	*Subsystem*	I-70 Corridor ITS Applications	

Entity Name	Type	Element Name	
Market Package: (CVO06) Weigh-In-Motion			
Basic Commercial Vehicle	*Terminator*		Not in Inventory
Commercial Vehicle Driver	*Terminator*		Not in Inventory
Market Package: (CVO07) Roadside CVO Safety			
Commercial Vehicle Administration	*Subsystem*	I-70 Corridor ITS Applications	
Commercial Vehicle Check	*Subsystem*	I-70 Corridor ITS Applications	
Commercial Vehicle Subsystem	*Subsystem*	I-70 Corridor ITS Applications	
Other CVAS	*Terminator*	I-70 Corridor ITS Applications	
Fleet and Freight Management	*Subsystem*		Not in Inventory
Basic Commercial Vehicle	*Terminator*		Not in Inventory
Commercial Vehicle Driver	*Terminator*		Not in Inventory
CVO Inspector	*Terminator*		Not in Inventory
Enforcement Agency	*Terminator*		Not in Inventory
Market Package: (CVO10) HAZMAT Management			
Commercial Vehicle Subsystem	*Subsystem*	I-70 Corridor ITS Applications	
Emergency Management	*Subsystem*	Joint Communications Information Center	
Fleet and Freight Management	*Subsystem*		Not in Inventory
Vehicle	*Subsystem*		Not in Inventory
Freight Equipment	*Terminator*		Not in Inventory
Emergency Management	*Subsystem*	Columbia Transit System	Not Selected
Market Package: (EM01) Emergency Call-Taking and Dispatch			
Emergency Vehicle Subsystem	*Subsystem*	Emergency Vehicles	
Traffic Management	*Subsystem*	I-70 Corridor ITS Applications	
Emergency Management	*Subsystem*	Joint Communications Information Center	
Traffic Management	*Subsystem*	Joint Communications Information Center	
Emergency Personnel	*Terminator*	Joint Communications Information Center	
Emergency System Operator	*Terminator*	Joint Communications Information Center	
Emergency Telecommunications System	*Terminator*	Joint Communications Information Center	
Other Emergency Management	*Terminator*	Joint Communications Information Center	
Fleet and Freight Management	*Subsystem*		Not in Inventory
Map Update Provider	*Terminator*		Not in Inventory
Emergency Management	*Subsystem*	Columbia Transit System	Not Selected
Transit Management	*Subsystem*	Columbia Transit System	Not Selected
Other Emergency Management	*Terminator*	Columbia Transit System	Not Selected
Market Package: (EM02) Emergency Routing			
Emergency Vehicle Subsystem	*Subsystem*	Emergency Vehicles	
Traffic Management	*Subsystem*	I-70 Corridor ITS Applications	
Emergency Management	*Subsystem*	Joint Communications Information Center	
Traffic Management	*Subsystem*	Joint Communications Information Center	
Emergency Personnel	*Terminator*	Joint Communications Information Center	
Emergency System Operator	*Terminator*	Joint Communications Information Center	
Maintenance and Construction Management	*Subsystem*		Not in Inventory

Entity Name	Type	Element Name	
Market Package: (EM02) Emergency Routing			
Roadway Subsystem	*Subsystem*		Not in Inventory
Vehicle	*Subsystem*		Not in Inventory
Care Facility	*Terminator*		Not in Inventory
Map Update Provider	*Terminator*		Not in Inventory
Emergency Management	*Subsystem*	Columbia Transit System	Not Selected
Market Package: (EM05) Transportation Infrastructure Protection			
Emergency Management	*Subsystem*	Joint Communications Information Center	
Traffic Management	*Subsystem*	Joint Communications Information Center	
Emergency System Operator	*Terminator*	Joint Communications Information Center	
Other Emergency Management	*Terminator*	Joint Communications Information Center	
Remote Traveler Support	*Subsystem*	Security Monitoring Field Equipment	
Security Monitoring Subsystem	*Subsystem*	Security Monitoring Field Equipment	
Maintenance and Construction Management	*Subsystem*		Not in Inventory
Roadway Subsystem	*Subsystem*		Not in Inventory
Alerting and Advisory Systems	*Terminator*		Not in Inventory
Rail Operations	*Terminator*		Not in Inventory
Secure Area Environment	*Terminator*		Not in Inventory
Emergency Management	*Subsystem*	Columbia Transit System	Not Selected
Transit Management	*Subsystem*	Columbia Transit System	Not Selected
Other Emergency Management	*Terminator*	Columbia Transit System	Not Selected
Traffic Management	*Subsystem*	I-70 Corridor ITS Applications	Not Selected
Market Package: (EM06) Wide-Area Alert			
Traffic Management	*Subsystem*	I-70 Corridor ITS Applications	
Telecommunications System for Traveler Information	*Terminator*	I-70 Corridor ITS Applications	
Traveler	*Terminator*	I-70 Corridor ITS Applications	
Emergency Management	*Subsystem*	Joint Communications Information Center	
Traffic Management	*Subsystem*	Joint Communications Information Center	
Emergency System Operator	*Terminator*	Joint Communications Information Center	
Other Emergency Management	*Terminator*	Joint Communications Information Center	
Information Service Provider	*Subsystem*		Not in Inventory
Maintenance and Construction Management	*Subsystem*		Not in Inventory
Roadway Subsystem	*Subsystem*		Not in Inventory
Toll Administration	*Subsystem*		Not in Inventory
Toll Collection	*Subsystem*		Not in Inventory
Vehicle	*Subsystem*		Not in Inventory
Alerting and Advisory Systems	*Terminator*		Not in Inventory
Driver	*Terminator*		Not in Inventory
ISP Operator	*Terminator*		Not in Inventory
Maintenance and Construction Center Personnel	*Terminator*		Not in Inventory
Toll Administrator	*Terminator*		Not in Inventory
Traffic Operations Personnel	*Terminator*		Not in Inventory
Transit System Operators	*Terminator*		Not in Inventory

Entity Name	Type	Element Name	
Market Package: (EM06) Wide-Area Alert			
Emergency Management	*Subsystem*	Columbia Transit System	Not Selected
Transit Management	*Subsystem*	Columbia Transit System	Not Selected
Other Emergency Management	*Terminator*	Columbia Transit System	Not Selected
Remote Traveler Support	*Subsystem*	Security Monitoring Field Equipment	Not Selected
Transit Vehicle Subsystem	*Subsystem*	Transit Vehicles	Not Selected

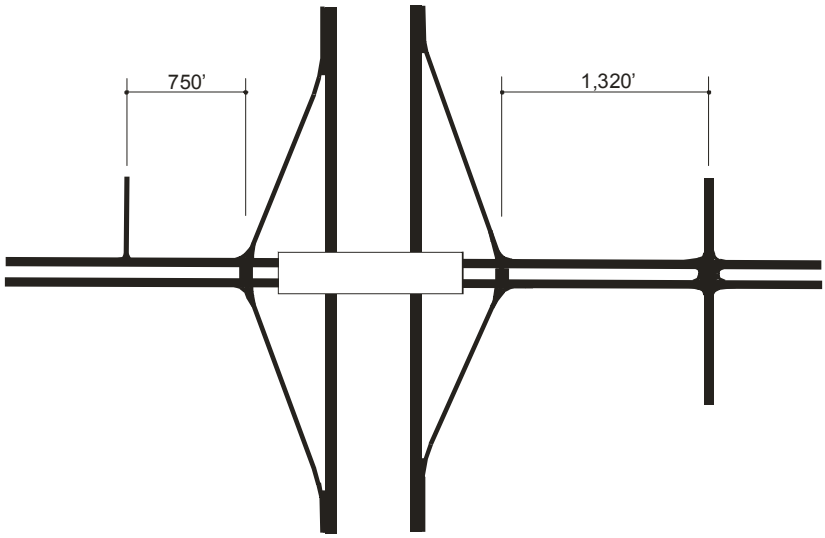
APPENDIX D: ITS SUBSYSTEM DIAGRAM


Travelers
Remote Traveler Support
Personal Information Access
Centers
Traffic Management
Emergency Management
Toll Administration
Commercial Vehicle Administration
Maintenance and Construction Management
Information Service Provider
Emissions Management
Transit Management
Fleet and Freight Management
Archived Data Management
Wide Area Wireless Communications
Fixed-Point to Fixed-Point Communications
Vehicle to Vehicle Communications
Vehicle
Emergency Vehicle
Commercial Vehicle
Transit Vehicle
Maintenance and Construction Vehicle
Vehicles
Dedicated Short Range Communications
Roadway
Security Monitoring
Toll Collection
Parking Management
Commercial Vehicle Check
Field

APPENDIX E: I-70 EIS ITS RECOMMENDATIONS

next intersecting roadway that only allows right turns in and right turns out. If the next intersection allows left turns to and from the intersecting roadway, then the minimum distance between that intersection and the ramp intersection with the crossroad is 1,320 feet.

Figure 18: Typical Access Management Improvements for I-70 Interchanges (Minimum Intersection Spacing)



6. ITS PLAN

One aspect of the selected preferred strategy is the implementation of Intelligent Transportation System (ITS) enhancements. ITS systems utilize advanced technologies, including computer communications and process control technologies to improve the efficiency and safety of the transportation network. ITS encompasses a variety of components that are deployed by both public and private entities and can be deployed apart from or in combination with traditional transportation facility infrastructure improvements. ITS deployments which support the purpose and need of the I-70 corridor include Commercial Vehicle Operations (CVO), Road-Weather Information Systems, Incident Management, and Traveler Information Systems.

a. Commercial Vehicle Operations (CVO)

The CVO applications include a broad range of deployments that are focused on improved commercial vehicle safety and efficiency. The most appropriate application for the I-70 corridor is Commercial Vehicle Electronic Clearance. Commercial Vehicle Electronic Clearance uses automatic vehicle identification (AVI) systems, high-speed weigh-in-motion systems and roadside databases to electronically identify and check the safety, credentials and size and weight data for commercial vehicles while they travel on the interstate. AVI equipment includes roadside readers and antennae and in-vehicle transponders to communicate a vehicle's unique identification code with the roadside equipment. Through the use of the AVI equipment, weigh-in-motion equipment and statewide and interstate commercial vehicle databases, legal commercial vehicles can travel on the interstate without stopping at weigh stations and state enforcement officials at weigh stations can concentrate their enforcement activities on non-compliant or questionable commercial carriers. These systems also improve safety on the interstate by reducing or removing commercial vehicle queues that back up from the weigh station onto the Interstate.

b. Road/Weather Information Systems

Road/Weather Information Systems (R/WIS) include weather detection and forecasting technologies, deployed on the interstate in combination with information dissemination systems. These systems alert drivers to upcoming hazardous driving conditions resulting from weather conditions and also provide data and information to the Department of Transportation and other agencies responsible for road maintenance and emergency response. The systems include technologies that detect changes in atmospheric and road surface conditions. Potential conditions to be monitored include water surface levels of nearby streams and rivers, precipitation, fog and other visibility impairing atmospheric conditions, and road surface temperature, ice and the presence of de-icing materials. Information dissemination systems associated with R/WIS can include electronic roadside signing, commercial and highway advisory radio broadcasts, in-vehicle information systems and pre-trip information sources such as the Internet and local television broadcasts. These information systems can be deployed in the form of a travel information system to alert drivers to upcoming conditions and take corrective actions.

c. Incident Management Systems

Incidents that cause non-recurring congestion are responsible for a significant proportion of the delays and associated costs. Incident management systems focus on enhancing incident detection, response and clearance. Incident management also focuses on efficient maintenance of traffic during the incident. Incident detection along the I-70 corridor would be enhanced through the use of advanced sensor technologies and communication systems which would allow local emergency service providers to more quickly and accurately identify a variety of incidents. The incident management systems would improve the coordination between jurisdictions and the immediate deployment of actions to minimize the effects of incidents. Technologies which encompass an incident detection and management system include in-road and non-intrusive vehicle detectors, video surveillance equipment, wide-area network communications between the various emergency service providers along the corridor and central or distributed command and control centers. These systems can also provide inputs to travel and tourism information systems, providing data on road closures and delays.

d. Traveler Information Systems

Traveler information systems provide I-70 travelers with pre-trip, en-route and on-site traffic and travel information. The specific information provided by these systems could include interstate and local arterial traffic conditions, weather conditions along the roadway, incidents and delays, alternative route and modal choices and construction activities along the corridor. Additionally these systems can provide localized travel and tourism information such as information on special events (i.e. State Fair or University of Missouri sporting events), seasonal traffic conditions, roadside services or amenities (i.e. gas stations, restaurants and lodging), and the location of the nearest hospitals, medical facilities, police and fire and rescue. Traveler information systems can use a variety of information dissemination resources including dynamic message signs, highway advisory radio, in-vehicle displays, cable television broadcast, commercial radio and the Internet.

H. Summary of Preferred Strategy Impacts

1. ENVIRONMENTAL IMPACTS

Through a comprehensive review of the potentially affected environment and environmental consequences during the First Tier EIS, no known issues were identified that would necessarily preclude or prevent the implementation of the Widen Existing I-70 Strategy. However, there were a number of environmental issues that will need further investigation as part of Second Tier Studies. These investigations will need to include considerations of avoidance,