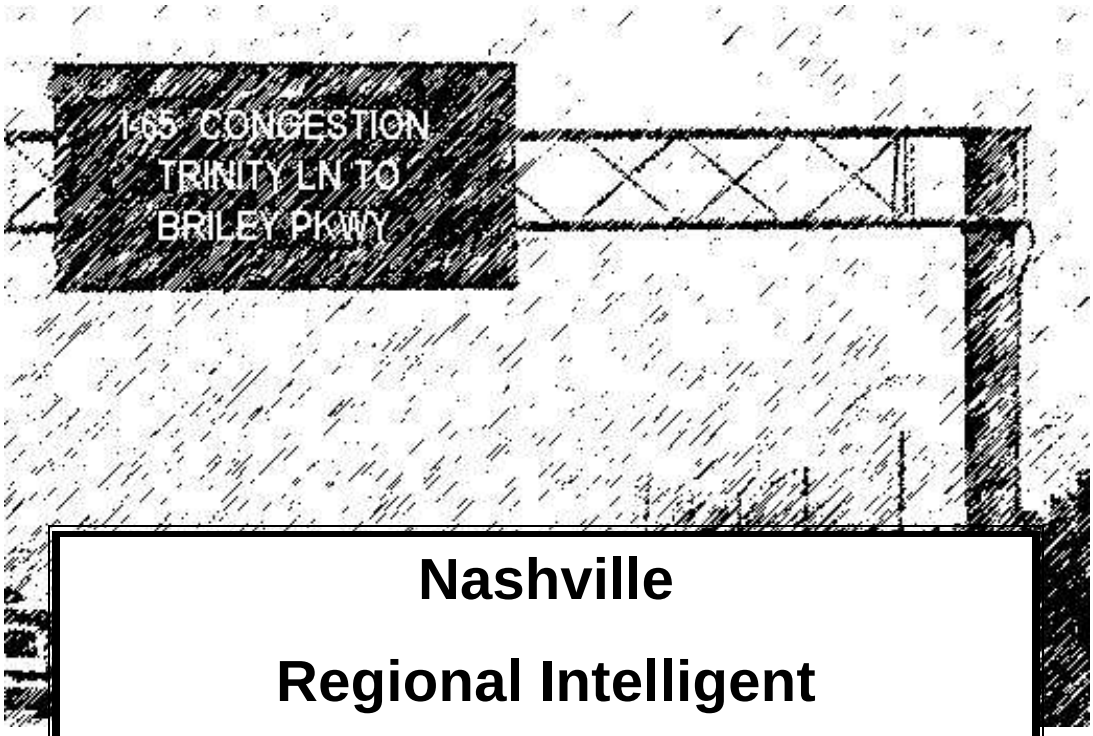
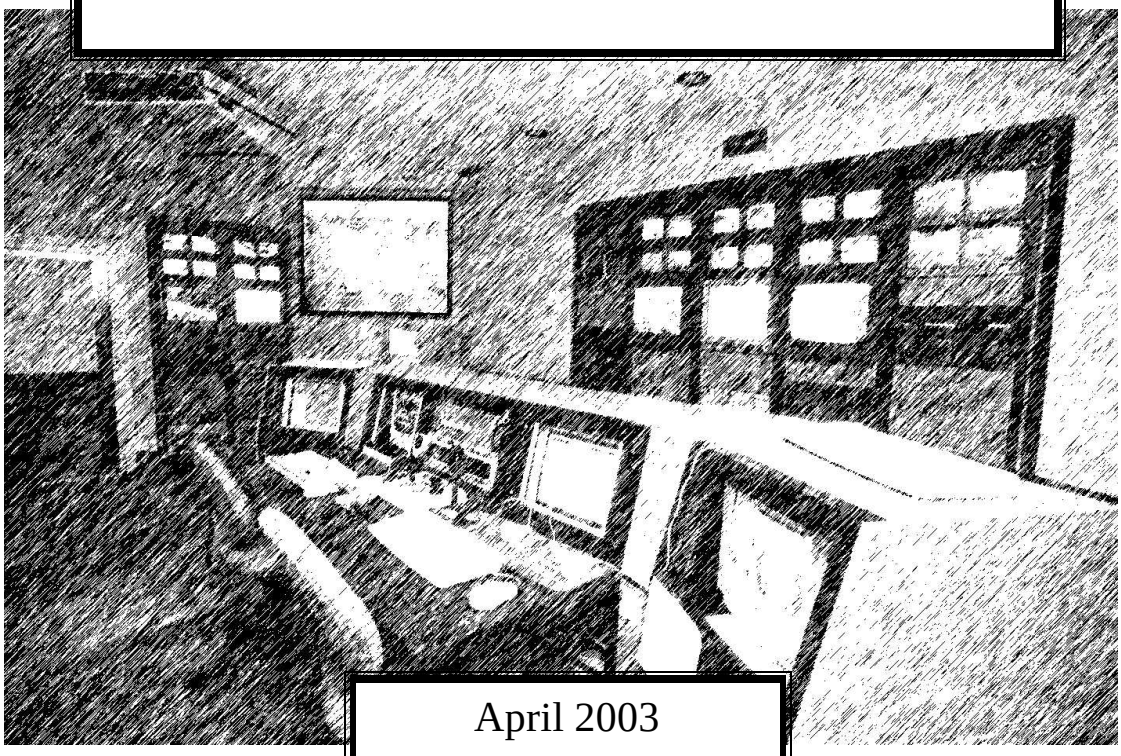


Nashville Regional Intelligent Transportation Systems Architecture



April 2003

Please Note:

This plan reflects the preferred intelligent transportation systems (ITS) deployment strategy without explicit consideration of funding availability. Funding projections were not available at the time the plan was developed. Funding availability for deploying, operating and maintaining ITS projects will impact the extent and timing of system implementation.

This plan does not constitute a commitment by any participating agency to fund recommended ITS deployments. Funding for ITS improvements must be considered along with funding of other transportation improvements in the normal transportation planning and programming processes.

Preface

The Nashville Regional Intelligent Transportation Systems (ITS) Architecture is the product of a multi-stakeholder process involving the Federal Highway Administration, Tennessee Department of Transportation and local officials representing cities and counties in the Nashville area. Facilitated by Vanderbilt University, with consultant support provided by Gresham Smith and PB Farradyne, a stakeholder working group was formed with the goal of achieving consensus on priority ITS needs for the Nashville region as well as an appropriate plan for implementing an integrated system over a 20-year horizon. This document contains the result of that effort and should be viewed as an important reference as ITS projects are defined, funded and made operational.

As ITS technology and management practices evolve, ITS projects are initiated, and there are changes in transportation, land use and other socio-economic factors in the area, there will be a need to modify the Nashville Regional ITS Architecture. The Nashville MPO will serve as the responsible agency for maintaining and updating this information.

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Glossary of Terms and Acronyms

CCTV	Closed circuit television that is used for surveillance
CV	Commercial Vehicle
FHWA	Federal Highway Administration
GPS	Global Positioning System
HAZMAT	Hazardous Materials
High-Level Freeway Surveillance	Deployment of vehicle detection and CCTV surveillance.
High-Level Surface Street Control	Traffic signal system deployment that allows remote real-time timing changes, system vehicle detection and CCTV surveillance.
ITS	Intelligent Transportation Systems
ITS Equipment Package	A grouping of ITS components that can be deployed in standalone increments.
ITS Market Package	An incremental ITS deployment package that provides a distinct transportation service (e.g., network surveillance or transit vehicle tracking).
ITS Stakeholder	A person or organization having a share or an interest in ITS.
ITS User Services	A definition of benefits that ITS can provide the transportation system user (e.g., traffic control or incident management).
Kiosks	Light structures that impart information about transit routes, traffic conditions, tourist attractions and other relevant topics.
LOS	Level-Of-Service (LOS ratings range from A to F with A being the best LOS and F the worst)
Medium-Level Surface Street Control	Traffic signal system deployment that allows remote real-time timing changes and system vehicle detection.
MPO	Metropolitan Planning Organization
National ITS Architecture	Provides a comprehensive framework for how various ITS components can be integrated and used as a basis for developing a regional ITS architecture.
Para-Transit	On-demand transit service provider that serves rural areas, the disabled and special need passengers.

Regional ITS Architecture	Specifies how the various ITS components in a region should be integrated logically, physically and institutionally.
RTMC	Regional Transportation Management Center
TDOT.....	Tennessee Department of Transportation
TMC	Transportation Management Center
TOC.....	Traffic Control Center

Executive Summary

The Nashville Regional Intelligent Transportation Systems (ITS) Architecture was prepared to guide the implementation of ITS systems in the Nashville region, with a goal of improved system-wide traffic and incident management. The Nashville region is defined to include Cheatham, Davidson, Robertson, Rutherford, Sumner, Williamson and Wilson Counties. The time frame considered in the Plan is a 20-year horizon.

The Plan was developed through a consensus process that involved a variety of ITS stakeholders in the study area. This included representatives from the Tennessee Department of Transportation (TDOT), the Nashville Area Metropolitan Planning Organization (MPO), local traffic management agencies, emergency service providers, transit system operators, the Federal Highway Administration (FHWA), local planning agencies and other transportation stakeholders.

In conducting this effort, a systematic approach was taken that utilized nationally available information on ITS deployment along with the results of several recent ITS-related studies that have taken place in the Nashville region. This included the *Nashville Area ITS Early Deployment Plan* and the *Nashville Regional Incident Management Plan*. As an initial step, traffic performance measures were generated and user service needs were defined, leading to the selection of ITS deployment locations and market packages that would meet the priority traffic and incident management needs of the Nashville region.

Over the 20-year planning horizon, the following ITS elements are recommended for implementation in the Nashville region:

- Freeway surveillance, covering 320 centerline miles
- Surface street control and surveillance, covering 296 centerline miles
- Freeway service patrols, covering 320 centerline miles
- Construction of a regional transportation management center and nine traffic operations centers
- Use of electronic fare boxes and automated tracking on transit vehicles
- Operation of two transit management centers
- Installation of 19 transit traveler information sites
- Communications to support the private broadcast of interactive traveler information
- Communications to support regional traffic control
- Communications to improve railroad highway grade crossing safety
- Installation of ten roadside weather stations
- Communications to support emergency response/routing
- Traffic signal preemption on selected surface streets
- Implementation of a virtual data warehouse for traffic/safety information storage and transfer
- Support for traffic forecasting and demand management
- Parking facilities management in downtown Nashville

- Reversible lane management on selected surface streets

As with any major transportation initiative, ITS deployment should be implemented incrementally, both to maximize system effectiveness and to recognize limitations on available funding. With this in mind, the recommended implementation schedule was divided into three phases: 0-5 years, 5-10 years and 10-20 years. Projects were assigned to each phase based on a desire to address the most critical traffic and safety needs first.

For each phase, estimates of capital, operations and maintenance (O&M), and capital replacement costs were developed, as shown below:

ITS Funding Requirements
(millions of 1999 dollars) ①

	Capital	O&M	Capital Replace-ment	Total
0 to 5 Year Increment	$42.49	$14.65	$0.00	$57.14
5 to 10-Year Increment	$30.22	$29.20	$0.00	$59.42
10 to 20-Year Increment	$58.91	$69.18	$36.96	$165.05
20-Year Plan	**$131.62**	**$113.03**	**$36.96**	**$281.61**

① The discount rate used was 7.00%

These cost estimates are inclusive of funding requirements for the entire integrated system, recognizing that different stakeholders will be bearing the cost of different ITS components. Moreover, it includes consideration of existing and programmed ITS projects.

The approach recommended for the Nashville region assumes decentralized management and operation of ITS components that are integrated into an overall regional system. As a result, providing an ITS system that appears seamless to the traveling public becomes an important institutional challenge. To successfully implement ITS within the region, agreements must be reached between involved parties to ensure that respective roles and responsibilities are clearly understood and that a full commitment of all involved has been made.

This is considered a living document that should be updated on a regular basis to reflect changes in travel patterns, gains in local ITS knowledge and experience, advances in ITS technology, access to improved cost estimates and changes affecting funding availability. The preferred update schedule is every three years, to be consistent with the Long Range Transportation Plan updating process.

1. Objective and Scope

The objective of the Nashville Regional Intelligent Transportation Systems (ITS) Architecture is to guide implementation of ITS systems in the Nashville region, leading to efficient and effective traffic and incident management. The Nashville region was defined to include Cheatham, Davidson, Robertson, Rutherford, Sumner, Williamson and Wilson Counties. Although Cheatham and Robertson Counties are not part of the Nashville Metropolitan Planning Organization, they were included based on their geographic location and potential for ITS deployment.

The Nashville Regional ITS Architecture was developed through a consensus process that involved a variety of ITS stakeholders from the study area. This included representatives from the Tennessee Department of Transportation (TDOT), the Nashville Area Metropolitan Planning Organization (MPO), local traffic management agencies, emergency service providers, transit system operators, the Federal Highway Administration (FHWA), local planning agencies and other transportation stakeholders (see Appendix A for a complete list). The stakeholders convened monthly to develop the Plan. Stakeholders that did not attend meetings were kept informed through the distribution of detailed meeting minutes.

At the outset of this process, the stakeholders developed the following vision for how the Plan can best serve the Nashville region:

> *The Nashville Regional ITS Architecture will serve as a "road map" to guide in the selection, placement and implementation of ITS-related technologies in the Nashville urban area. The Architecture will serve to integrate ITS with traditional multi-modal transportation improvements for the purpose of enhancing travel mobility, safety and environmental quality. Both technical and institutional considerations will be addressed in meeting these needs. The Architecture will be the product of a consensus process, aimed at achieving compatibility and integration involving traffic control and incident management between controlled-access highways and local streets.*

The time frame considered in the Plan is a 20-year horizon. It is expected that the Plan will be reviewed and updated on a regular basis, preferably every three years to be consistent with the Long Range Transportation Plan updating process.

2. Candidate ITS Locations

Identifying areas of high traffic demand and congestion within the Nashville region was an important initial step in determining candidate locations for ITS deployment. This was accomplished by utilizing the following traffic performance measures: 1) average daily traffic volume and 2) average daily traffic volume per lane. These measures were generated for all freeways in the region, as well as key arterial roadways. Key arterial roadways were defined as those that have average daily traffic volumes exceeding 10,000

vehicles per day, provide continuity in the roadway network or are situated parallel to a freeway (for more information see Appendix B).

Average daily traffic volume provides a relative indication of the number of people that will benefit from improved efficiency, such as a reduction in nonrecurring congestion. Average daily traffic volume per lane provides a surrogate measure of congestion. As the per lane volume increases, there is a corresponding increase in the likelihood that an incident will trigger congestion.

Performance measure results are shown in Figures 2-1(a and b) and 2-2 (a and b). Figures 2-1a and 2-1b illustrate the current daily traffic volumes, with Figure 2-1a showing the entire seven county study area and Figure 2-1b providing an enlarged view of central Davidson County. Similarly, the current daily volumes per lane are shown in Figures 2-2a and 2-2b.

As expected, the higher traffic volume freeway segments occur in and around downtown Nashville. The higher traffic volume arterial roadways are also concentrated in central Nashville, but occur in some suburban locations as well. Beyond identification of high traffic demand and congested areas, these performance measures were also used to determine the phasing of ITS deployments.

3. System and User Needs

Any successful plan to deploy ITS must be responsive to system and user needs. The approach used to address these considerations was to select relevant ITS Market Packages. ITS Market Packages are defined by the National ITS Architecture (Version 3.0) as incremental ITS deployments that provide a distinct transportation service (e.g., network surveillance or transit vehicle tracking). As an example, the *Network Surveillance* Market Package provides the equipment required to collect and transmit traffic surveillance data to a transportation management center. The equipment includes traffic detectors, environmental sensors, other surveillance devices, supporting field devices and communication lines. The *Network Surveillance* Market Package is one of several market packages that combine to provide *Traffic Control* as an ITS User Service. There are currently 63 ITS Market Packages contained in the National ITS Architecture.

Each ITS Market Package was evaluated by the stakeholders to determine its relevance in addressing system and user needs in the Nashville region over the next twenty years. Screening criteria consisted of ITS User Services identified as relevant for Nashville that were cited in earlier ITS planning studies[1, 2]. The relationship between ITS User Services and the ITS Market Package concept as well as a complete list of ITS Market Packages considered by stakeholders are provided in Appendix C.

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[1] *TDOT ITS Strategic Plan*, 1999, Tennessee Department of Transportation

[2] *Nashville Area Intelligent Transportation Systems Early Deployment Study*, Nashville Metropolitan Planning Organization, March 1997.

Figure 2-1a. 1999 Daily Traffic Volumes for the Nashville Study Area

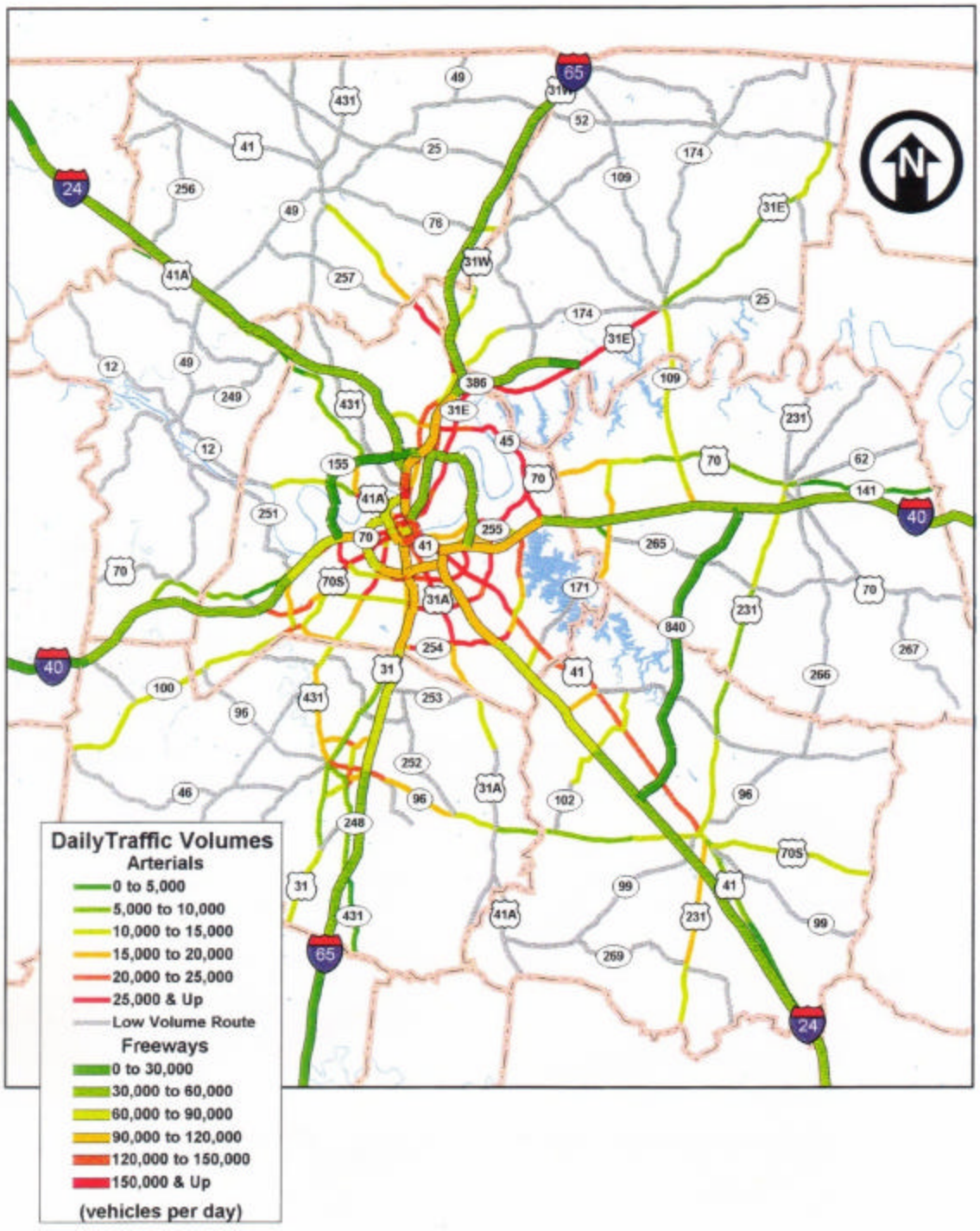


Figure 2-1b. 1999 Daily Traffic Volumes for Central Davidson County

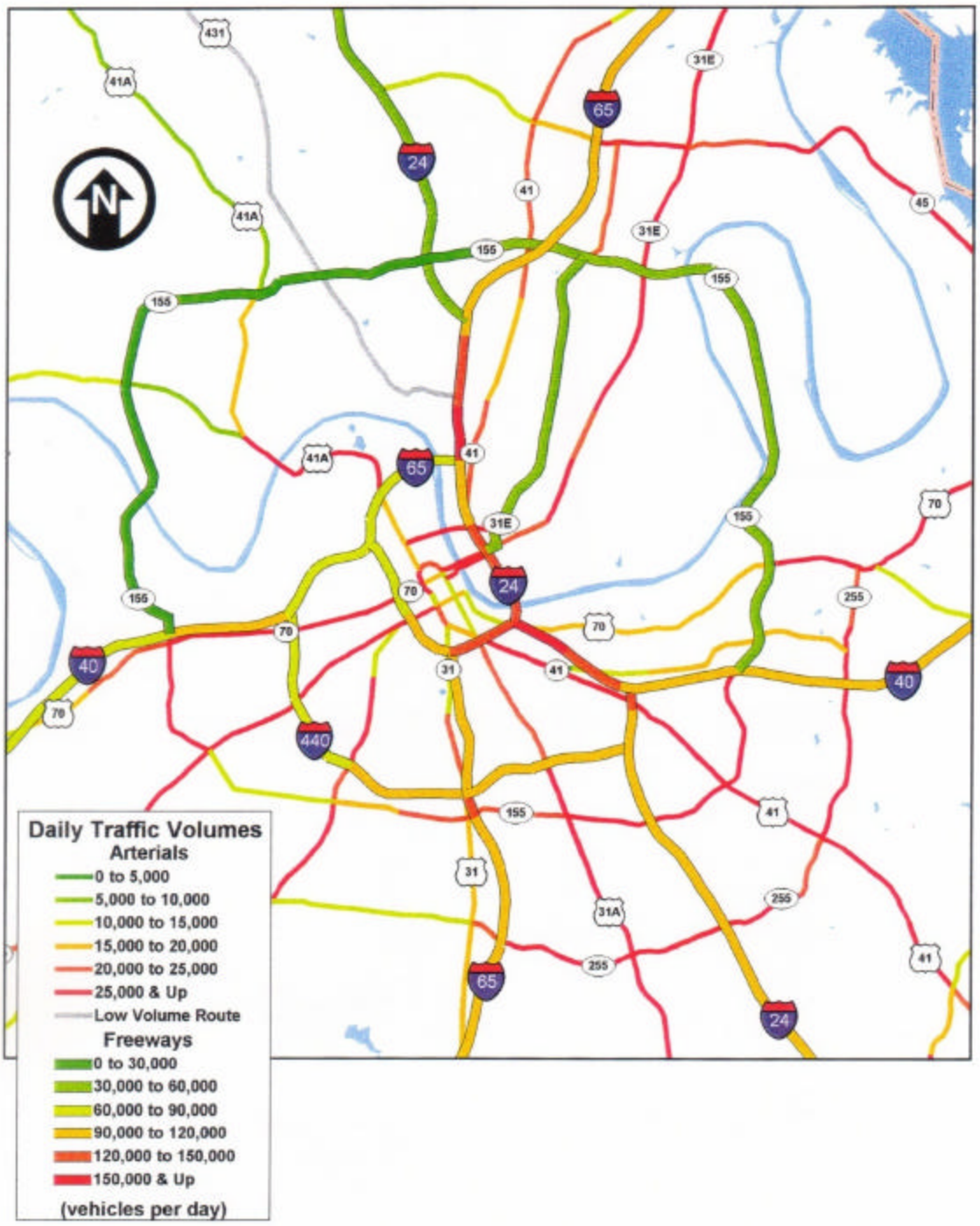


Figure 2-2a. 1999 Daily Traffic Volumes Per Lane for the Nashville Study Area

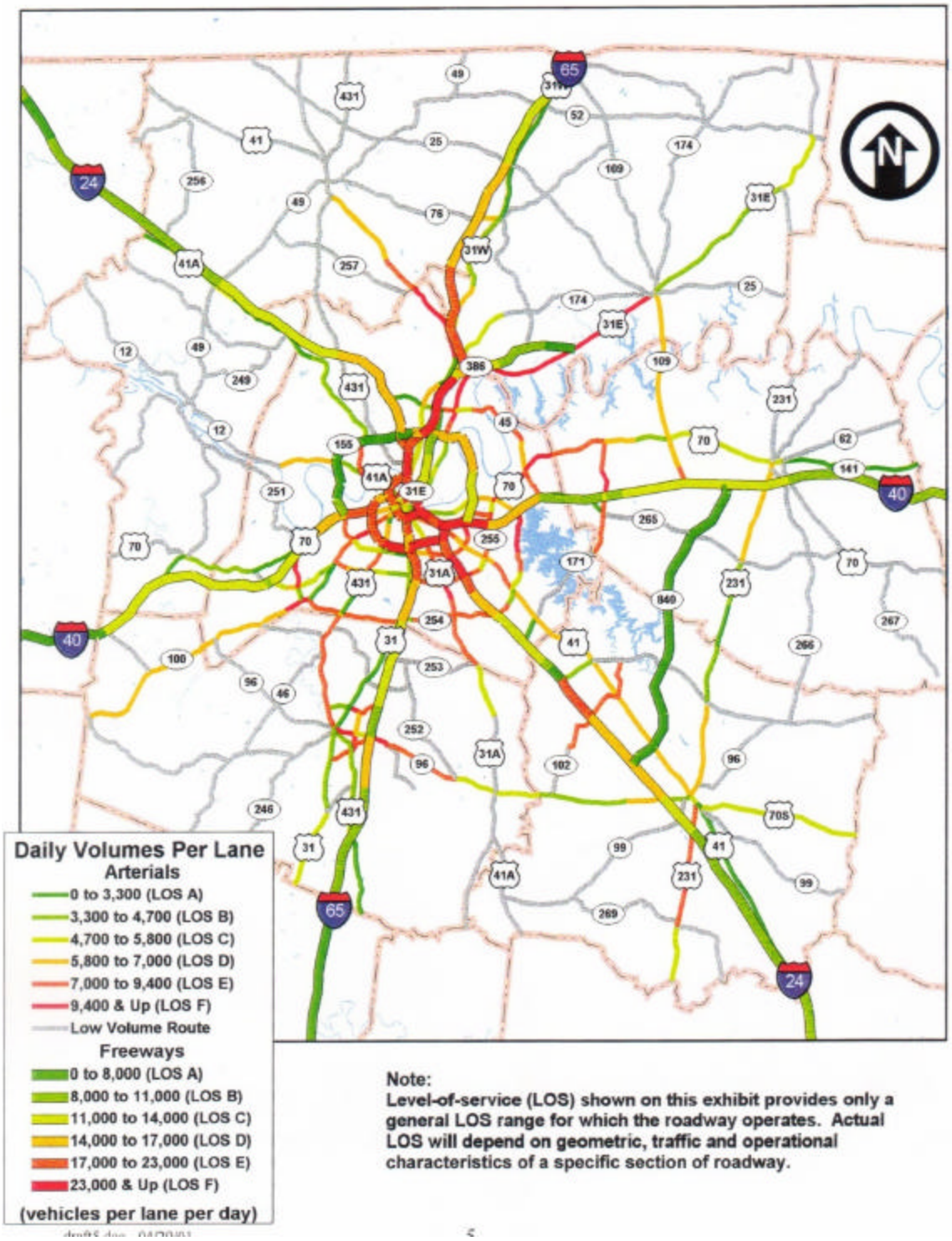
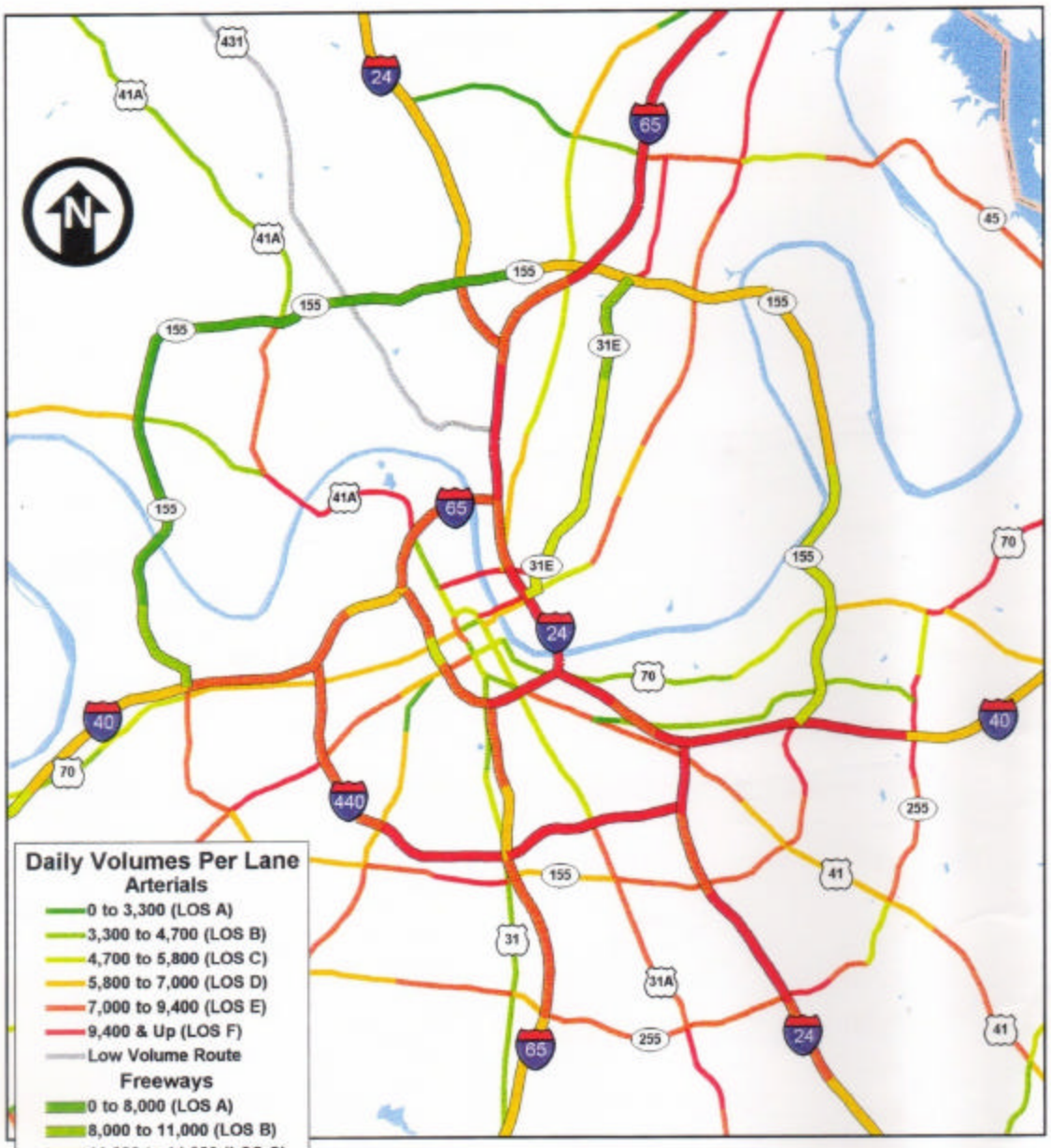


Figure 2-2b. 1999 Daily Traffic Volumes Per Lane for Central Davidson County



The ITS Market Packages selected by the stakeholders as relevant to the Nashville region in the next 20 years appear in Table 3-1.

Table 3-1. Relevant ITS Market Packages

Name	Description
Network Surveillance	This market package includes traffic detectors, environmental sensors, other surveillance equipment, the supporting field equipment, and wireline communications to transmit the collected data back to a transportation management or traffic operations center.
Surface Street Control	This market package provides the central control and monitoring equipment, communication links, and the signal control equipment that support local surface street control and/or arterial traffic management.
Freeway Control	This market package provides the communications and roadside equipment to support ramp control, lane controls, and interchange control for freeways.
Traffic Information Dissemination	This market package allows traffic information to be disseminated to drivers and vehicles using roadway equipment such as dynamic message signs or highway advisory radio.
Regional Traffic Control	This market package advances the Surface Street Control and Freeway Control Market Packages by adding the communications links and integrated control strategies that enable integrated interjurisdictional traffic control.
Incident Management System	This market package manages both predicted and unexpected incidents so that the impact to the transportation network and traveler safety is minimized.
Traffic Forecast and Demand Management	This market package includes advanced algorithms, processing, and mass storage capabilities that support historical evaluation, real-time assessment, and forecast of the roadway network performance.
Standard Railroad Grade Crossing	This market package manages highway traffic at highway-rail intersections where operational requirements do not dictate more advanced features (e.g., where rail operational speeds are less than 80 miles per hour). Both passive and active warning systems are supported.
Railroad Operations Coordination	This market package provides an additional level of strategic coordination between rail operations and traffic operations centers. Rail operations provide train schedules, maintenance schedules, and any other forecast events, which will result in highway-rail intersection closures.
Parking Facility Management	This market package provides enhanced monitoring and management of a parking facility. The included equipment assists in the management of parking operations, coordinates with transportation authorities, and supports electronic collection of parking fees.
Reversible Lane Management	This market package provides for the management of reversible lane facilities.
Road Weather Information System	This market package monitors current and forecast road and weather conditions using a combination of weather service information and data collected from environmental sensors deployed on and about the roadway.
Electronic Clearance	This market package provides for automated clearance at roadside check facilities.
CV Administrative Processes	This market package provides for electronic application, processing, fee collection, issuance, and distribution of CVO credential and tax filing.
Weigh-In-Motion	This market package provides for high speed weigh-in-motion with or without AVI attachment.
HAZMAT Management	This market package integrates incident management capabilities with commercial vehicle tracking to assure effective treatment of HAZMAT material and incidents.
ITS Data Mart	This market package provides a focused archive that houses data collected and owned by a single agency, district, private sector provider, research institution, or other organization.

Table 3-1. Relevant ITS Market Packages

Name	Description
ITS Virtual Data Warehouse	This market package provides broad access to multimodal, multidimensional data from varied data sources using enhanced interoperability between physically distributed ITS archives that are each locally managed.
Transit Vehicle Tracking	This market package provides for an Automated Vehicle Location System to track the transit vehicle's real time schedule adherence and updates the transit system's schedule in real-time.
Transit Fixed-Route Operations	This market package performs automatic driver assignment and monitoring, as well as vehicle routing and scheduling for fixed-route services.
Demand Response Transit Operations	This market package performs automatic driver assignment and monitoring as well as vehicle routing and scheduling for demand response transit services.
Transit Passenger and Fare Management	This market package allows for the management of passenger loading and fare payments on-board vehicles using electronic means.
Transit Maintenance	This market package supports automatic maintenance scheduling and monitoring. On-board condition sensors monitor critical system status and transmit critical status information to the Transit Management Subsystem.
Multi-modal Coordination	This market package establishes two-way communications between multiple transit and traffic agencies to improve service coordination.
Transit Traveler Information	This market package provides transit users at transit stops and on-board transit vehicles with ready access to transit information.
Emergency Response	This market package provides the computer-aided dispatch systems, emergency vehicle equipment, and wireless communications that enable safe and rapid deployment of appropriate resources to an emergency.
Emergency Routing	This market package supports dynamic routing of emergency vehicles and coordination with the Traffic Management Subsystem for special priority on the selected route(s).
Broadcast Traveler Information	This market package provides the user with a basic set of advanced traveler information services (ATIS). It involves the collection of traffic conditions, advisories, general public transportation and parking information and the near real time dissemination of this information over a wide area through existing infrastructures and low cost equipment (e.g., FM subcarrier, cellular data broadcast).
Interactive Traveler Information	This market package provides tailored information in response to a traveler request. Both real-time interactive request/response systems and information systems that "push" a tailored stream of information to the traveler based on a submitted profile are supported.
Dynamic Ridesharing	This market package enhances the Interactive Traveler Information package by adding infrastructure provided dynamic ridesharing capability to tailored requests for information regarding traffic conditions, transit services, traveler services, ride share/ride match, parking management, and pricing information.

4. ITS Strategies

The next step in the process involved the linking of selected ITS Market Packages to deployment scenarios. Each deployment scenario is constructed of various ITS equipment packages.

ITS equipment packages represent sets of ITS components that are deployable in standalone increments. Each ITS Market Package selected for consideration in the Nashville region over the next 20 years requires the deployment of one or more ITS equipment packages (see Figure 4-1). As an example, the *Network Surveillance* ITS

Market Package requires roadside, communications and management/control center equipment. Roadside and communications equipment is included in the freeway surveillance and the surface street control and surveillance ITS equipment packages. Center equipment is included in the regional transportation management and local traffic control center equipment packages.

Figure 4-1. Market vs. Equipment Package Matrix

ITS Market Package / Equipment Packages	Freeway Surveillance①	Surface Street Control and Surveillance	Freeway Service Patrol	TMC / TOC	Transit Vehicle Equipment	Transit Management Center	Transit Traveler Information	Broadcast Traveler Information	Interactive Traveler Information	Regional Traffic Control	Railroad-Highway Grade Crossings	Roadside Weather Stations	Emergency Response/Routing	Traffic Signal Preemption	Archive Data Function	Traffic Forecast and Demand Mgt.	Parking Facilities Management	Reversible Lane Management
Network Surveillance	◆	◆		◆														
Surface Street Control		◆		◆														
Traffic Information Dissemination	◆			◆														
Regional Traffic Control				◆						◆								
Incident Management System	◆		◆	◆														
Traffic Forecast and Demand Management				◆												◆		
Standard Railroad Grade Crossing				◆							◆							
Railroad Operations Coordination				◆							◆							
Parking Facility Management				◆													◆	
Reversible Lane Management				◆														◆
Road Weather Information System				◆							◆							
Electronic Clearance	Part of Statewide Deployment																	
CV Administrative Processes																		
Weigh-In-Motion																		
HAZMAT Management				◆									◆					
ITS Data Mart															◆			
ITS Virtual Data Warehouse															◆			
Transit Vehicle Tracking					◆	◆												
Transit Fixed-Route Operations						◆												
Demand Response Transit Operations					◆	◆												
Transit Passenger and Fare Management					◆	◆												
Transit Maintenance						◆												
Multi-modal Coordination				◆		◆												
Transit Traveler Information						◆	◆											
Emergency Response				◆									◆					
Emergency Routing				◆									◆	◆				
Broadcast Traveler Information				◆				◆										
Interactive Traveler Information				◆					◆									

① The freeway surveillance equipment package includes dynamic message signs.

Deployment scenarios associating each ITS Market Package with various ITS equipment packages are described in detail in Appendix D.

5. Recommended Placement of ITS Equipment Packages

Stakeholder recommendations concerning the physical location and extent of ITS equipment packages over a 20-year time horizon are provided below. This includes consideration of existing equipment, programmed capital investments and recommended future projects.

5.1 Existing Equipment Inventory

ITS initiatives that have occurred or are under development in the Nashville region are listed in Table 5-1.

Table 5-1. Current ITS Studies and Projects

Project	Sponsor
Regional/Statewide Studies	
Early Deployment Study	MPO
Regional Incident Management Plan	MPO
TDOT ITS Strategic Plan	TDOT
Funded or Recently Completed Projects	
Metro Signal System Upgrades (multiple projects)	Metro/TDOT
Incident Detection and Response System	Metro
Automated Collision Database	Metro
Metro Traffic Operations Center	Metro
Emergency Vehicle Traffic Signal Preemption	Metro
Franklin Traffic Operations Center Study	City of Franklin
Real-Time Traveler Information System	City of Franklin
Franklin Traffic Operations Center	City of Franklin
Franklin ATIS & ATMS Phase 1	City of Franklin
Murfreesboro Arterial Surveillance System	City of Murfreesboro
LaVergne Signal System ②	LaVergne
I-65 North Corridor ITS Deployment	TDOT
TDOT Regional Transportation Management Center	TDOT
Freeway Service Patrols	TDOT
Rest Area Kiosks (weather and construction information)	TDOT
AccessRide AVL System	MTA
AccessRide Digital Communications	MTA
MTA Fare box System	MTA
Nashville Airport Parking Management System	Nashville Airport Authority
FM Traveler Advisory Radio (TAR) ①	BNA/NCVB
Enhanced Nashville Area Web Page	Commercial ISPs
GIS Database Enhancement ①	NCVB/Metro
GIS Database Standardization and Completion ①	MPO
CVO AVL ①	Trucking Industry
Proposed Projects (projects at some stage of planning)	
Enhanced Visitor Kiosks ①	Tourist Development Dept.

Table 5-1. Current ITS Studies and Projects

Project	Sponsor
Proposed Projects (continued)	
Special Event Control Protocol ①	Metro
Incident Team (response/removal/clean-up)	TDOT/Public Safety/ Metro
AVL on Vanpool Fleet ②	Williamson Co./TMA
Transit Traveler Information System ②	MTA
Nashville/Davidson County Signal System ②	Metro
Smyrna Signal System ②	Smyrna
Franklin ATIS & ATMS Phase 2	Franklin
Hendersonville Signal System ②	Hendersonville
Gallatin Signal System ②	Gallatin
Brentwood Signal System ②	Brentwood
Lebanon Signal System ②	Lebanon
Nashville MPO Area Freeway Management	TDOT
Nashville Area ITS Plan	TDOT
① From the 1997 Nashville Area Intelligent Transportation Systems Early Deployment Study. ② From 2025 Long Range Transportation Plan	

The "Nashville MPO Area Freeway Management" and the "Nashville Area ITS Plan" projects from the *2025 Long Range Transportation Plan* (see Table 5-1) do not reflect specific projects; rather they provide funding placeholders within the financially constrained plan. The current I-65 North Corridor ITS project and the development of the regional transportation management center at TDOT Region III would fall within this funding item. The "Nashville MPO Area Freeway Management" project funding level is $120,000,000 in the 0 to 5-year time frame, while the "Nashville Area ITS Plan" designates a $60,000,000 investment in the 5 to 10-year time frame. Total funding for local signal systems and other ITS projects in the 25-year plan is $30,500,000.

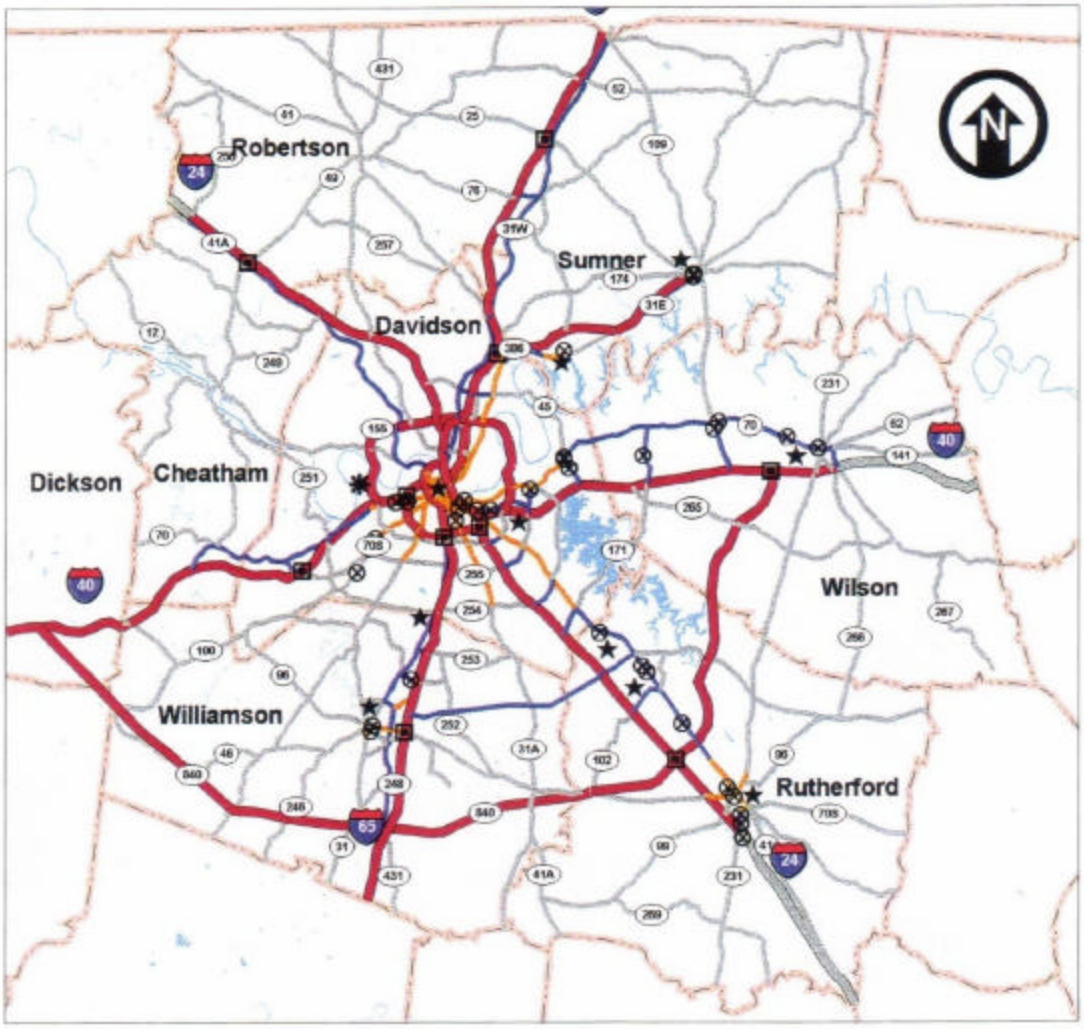
5.2 Twenty-Year Plan

The 20-year plan calls for placement of ITS equipment packages on select roadway facilities and at certain point locations. Roadway coverage includes freeway surveillance, surface street control and surveillance, and the freeway service patrol component of incident management. Figure 5-1 illustrates the extent of this roadway coverage as well as the locations of other ITS equipment packages. The following discussion provides additional details.

5.2.1 Freeway Surveillance

Over a 20-year time horizon, high-level freeway surveillance would cover 320 centerline miles of freeway in the Nashville area. This designation was based on traffic patterns apparent from the performance measure maps and general knowledge of commute patterns in the Nashville region.

Figure 5-1. 20-Year ITS Plan



The high-level freeway surveillance ITS equipment package includes vehicle detection, video surveillance, dynamic message signs and a communications network. Freeway service patrol operation would cover the same freeway sections in order to minimize the effect of incidents identified by the freeway surveillance system.

Fully access controlled portions of Briley Parkway, Ellington Parkway and Vietnam Veterans Parkway (including planned extension to SR 109 in Gallatin) are included for implementation of high-level freeway surveillance along with State Route 840 from I-40 on the east to I-40 on the west. Interstate 440 is fully covered along with the radial Interstates. Interstate 40 is covered from just west of the proposed State Route 840 interchange (State Route 46 - milepost 172) to just east of Lebanon (US 70 interchange - milepost 239). Interstate 65 is covered from the Kentucky State line to just south of Franklin. Interstate 24 is covered from the State Route 256 interchange (milepost 19) in Robertson County to just south of Murfreesboro (US 231 interchange - milepost 81).

5.2.2 Surface Street Control and Surveillance

The arterial roadways designated for medium-level and high-level surface street control and surveillance (see Figure 5-1) were selected to support sections of freeway chosen for high-level surveillance or based on each local jurisdiction's plans for system enhancement. For each segment of freeway covered with high-level surveillance, an arterial roadway that is the best alternative route is designated for at least medium-level surface street control and surveillance. An upgrade to high-level was made if the local agency with jurisdiction over the parallel route indicated plans to provide video surveillance. Other arterial roadways in the region were designated for medium-level or high-level coverage based on the local agency's plan for enhancement. A total of 80 centerline miles of arterial roadway are designated to have high-level surface street control and surveillance, with 216 centerline miles of arterial roadway recommended to have medium-level surface street control and surveillance.

5.2.3 Incident Management

The primary component of incident management outside of the regional transportation management center is operation of freeway service patrols. To fully leverage the incident detection and verification benefits provided by the freeway surveillance system, freeway service patrols would be operated on all freeway segments with high-level freeway surveillance. In the 20-year plan, freeway service patrols will operate on the full 320-mile coverage of high-level freeway surveillance, as shown in Figure 5-1.

5.2.4 Transportation Management/Traffic Operations Centers

The 20-year plan includes the construction and operation of a regional transportation management center managed by the TDOT, with traffic operations centers functioning in eight local communities and at the Nashville airport (see Figure 5-2). Community traffic operations centers are planned in Brentwood, Franklin, Gallatin, Hendersonville, LaVergne, Lebanon, Metro Nashville, Murfreesboro, and Smyrna. The regional transportation management center will require the construction of a new building. It is assumed that the local traffic operations centers will be housed in existing public buildings.

5.2.5 Transit Vehicle Equipment

The Metropolitan Transit Authority (MTA) fleet used to provide fixed route service and the para-transit fleet for the region would be furnished with electronic fare boxes and the equipment required for automated vehicle tracking. It is estimated that 239 vehicles would be outfitted in this fashion based on the current size of the transit vehicle fleet. It is assumed that as the transit fleet grows, new vehicles will be equipped with the required equipment.

5.2.6 Transit Management Center

Two transit management centers are included in the Plan. One center would focus on fixed route and para-transit service in Davidson County, while the other center would manage para-transit in the area outside of Davidson County. The transit management center for Davidson County would require a building expansion, while it is assumed that the other center would not. Locations for the transit management centers have not been identified.

5.2.7 Transit Traveler Information

Within the 20-year planning period, a total of nineteen transit traveler information sites would be established. Two sites would be the Petway Transit Center and the Clement Landport. Five sites are planned for commuter rail stations and the remaining twelve would be implemented at park and ride lots (an average of two located along each radial Interstate route).

5.2.8 Broadcast/Interactive Traveler Information

Only limited broadcast and interactive traveler information would be provided by the public sector. Although the regional transportation management center and some local traffic operations centers would provide broadcast and interactive information via the Internet, it is anticipated that large-scale systems would be provided by the private sector. The regional transportation management center would provide the necessary hardware to allow private sector information service providers to access traffic data. The public sector would not subsidize this function beyond what is required to allow the private sector access to traffic data and video feeds.

5.2.9 Regional Traffic Control

Regional traffic control would be limited to sharing of information on traffic conditions and control plans. Autonomy of control would exist throughout the 20-year planning period. Coordination of traffic control for the region would be based on full communication between agencies affected by an incident. Automated or systematic regional control plans are not anticipated in the 20-year time frame.

5.2.10 Railroad-Highway Grade Crossings

ITS related railroad-highway grade crossing enhancements would focus on providing status information to the local jurisdiction that has responsibility for traffic operations on the arterial roadway affected by the grade crossing. A total of thirty-five grade crossings (see Figure 5-2) are recommended for enhancement in the 20-year planning period. This

would include an improved train detection system and equipment required to communicate grade crossing status to the local traffic operations center. Some additional hardware and software required to communicate and monitor the grade crossings would be required at the local traffic operations center.

5.2.11 Roadside Weather Stations

Roadside weather stations are recommended for installation at ten strategic locations in the Nashville region (see Figure 5-2). At present, one station exists at the I-65/I-440 interchange. The strategic locations are dispersed throughout the region at locations with major roadway structures.

5.2.12 Emergency Response/Routing

Emergency management centers and emergency vehicle equipment are not included in the Plan. It is assumed that funding to equip emergency management centers and vehicles would be obtained from sources other than transportation related funding programs. However, the regional transportation management center and the local traffic operation centers would be equipped to enable communication with emergency management centers.

5.2.13 Traffic Signal Preemption

A project programmed by Metro to provide traffic signal preemption in the vicinity of hospitals is included in the Plan.

5.2.14 Archive Data Function

The archive data function would be implemented by ITS data marts in the regional transportation management center and local traffic operations centers. Region-wide integration of archived ITS data would be provided through a virtual data warehouse system. Access to the archived data by all the data marts in the region would be provided through the virtual data warehouse.

5.2.15 Traffic Forecast and Demand Management

Hardware, software and staffing required to provide traffic forecast and demand management would be provided in the regional transportation management center.

5.2.16 Parking Facilities Management

A parking and traffic guidance system is under consideration by Metro for downtown Nashville. The system would monitor parking availability in downtown Nashville parking facilities and disseminate information to motorists via dynamic message signs. The Nashville International Airport has a parking management system in operation, but is not included in this plan because funding for the system is not from the Highway Trust Fund.

5.2.17 Reversible Lane Management

Additional reversible lanes are not expected to be implemented in the region over the next 20 years. Enhancement to reversible lane management is limited to providing the ability for Metro to remotely monitor and adjust existing reversible lane control signal systems.

5.3 Phasing of the 20-Year Plan

As with any major infrastructure or system implementation, successful ITS deployment should be implemented incrementally. Moreover, the rate of deployment must be synchronized with available funding. The phasing proposed herein assumes that the most critical problem areas would be addressed first.

Implementation of the 20-year plan is divided into three periods: 0 to 5-years, 5 to 10-years and 10 to 20-years. Figures 5-2 and 5-3 illustrate the level of ITS deployment recommended by the end of the 0 to 5-year and 5 to 10-year periods, respectively. Figure 5-2a shows the 0 to 5-year plan for the entire study area and Figure 5-2b provides an enlarged view of the 0 to 5-year plan in central Davidson County, Franklin and Murfreesboro. The phasing of each ITS equipment package is discussed in Appendix E.

6. Estimated Implementation Costs

An estimate of the cost associated with the recommended 20-year ITS deployment in the Nashville region was prepared using available unit cost data (see Appendix F). This estimate includes the projected capital, operations and maintenance (O&M), and capital replacement costs for the systems. All costs have been discounted to present dollars using a discount rate of 7 percent[3]. An average functional life of 10 years was used to estimate capital replacement costs. All costs are presented in 1999 dollars. Estimated costs for the three increments of the plan (first five year, second five year and last ten year increments) and the entire 20-year plan are summarized in Table 6-1.

[3] The Office of Management and Budget specifies a discount rate of 7 percent to be used for benefit-cost analyses of Federal programs (OMB Circular A-94, Office of Management and Budget, October 29, 1992).

Figure 5-2a. 5-Year ITS Plan for the Nashville Study Area

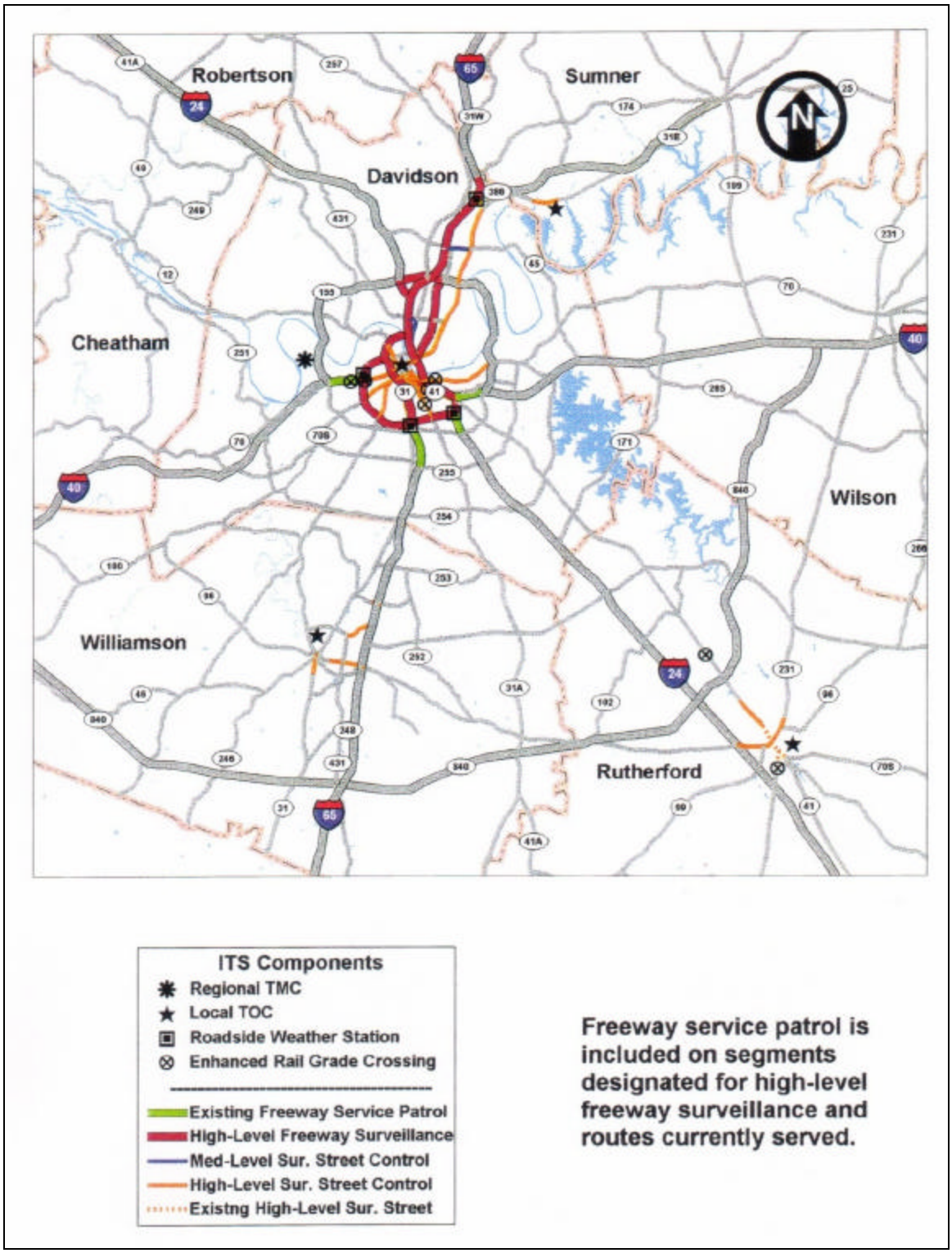
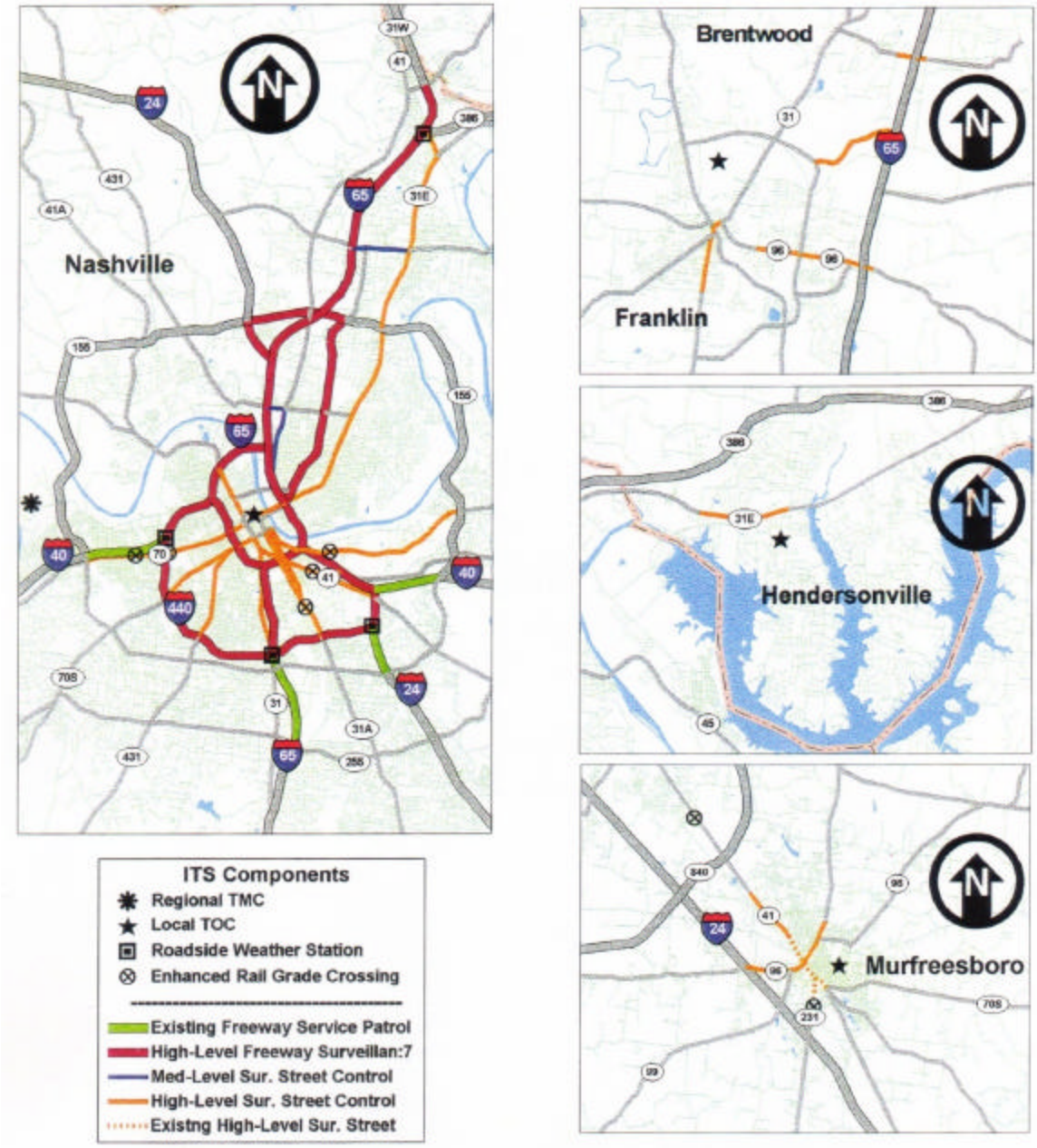
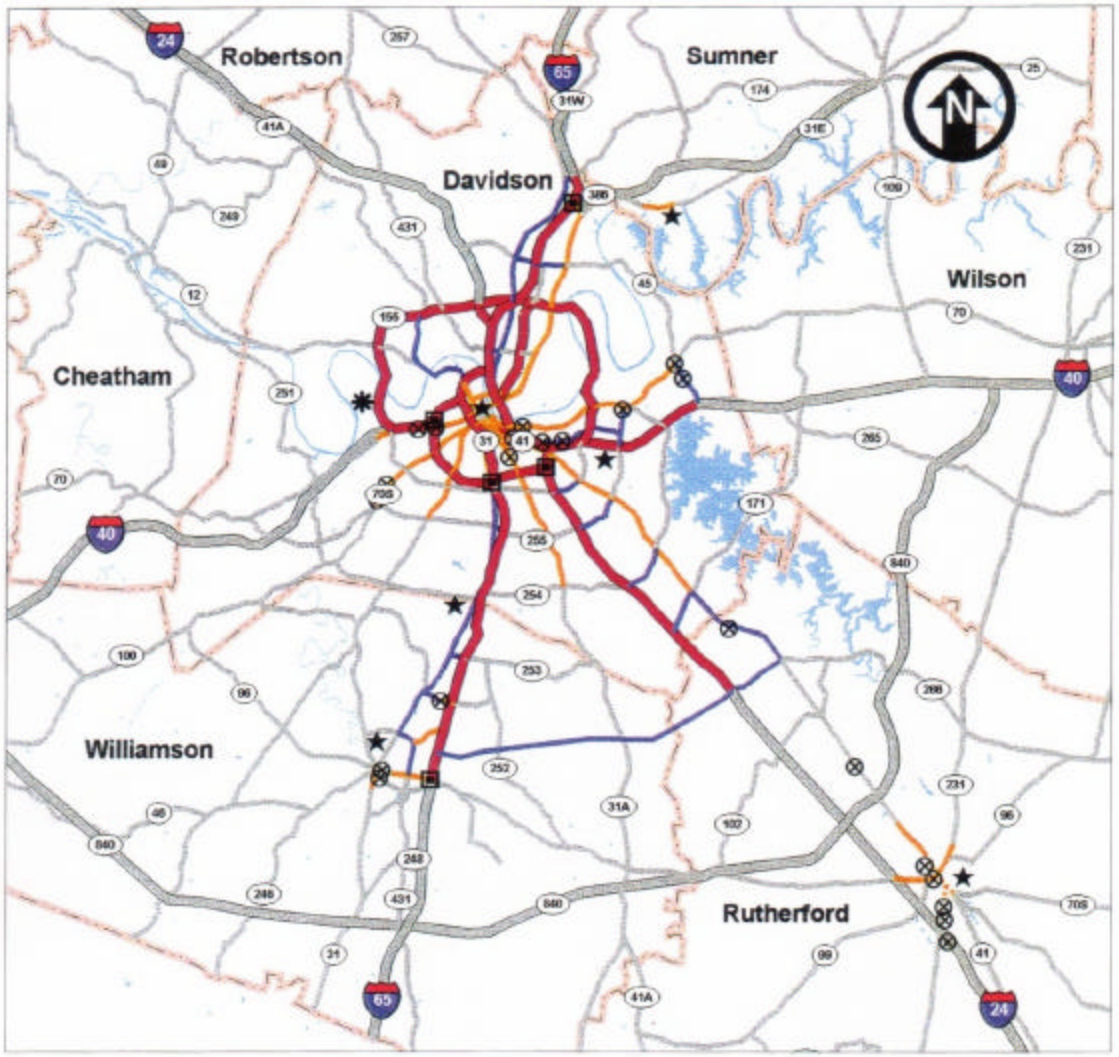


Figure 5-2b. 5-Year ITS Plan Enlarged Views



The freeway service patrol is included on segments designated for high-level freeway surveillance and routes currently served.

Figure 5-3. 10-Year ITS Plan



ITS Components

- Regional TMC
- Local TOC
- Roadside Weather Station
- Enhanced Rail Grade Crossing

- High-Level Freeway Surveillance
- Med-Level Sur. Street Control
- High-Level Sur. Street Control
- Existng High-Level Sur. Street

Freeway service patrol is included on segments designated for high-level freeway surveillance.

Table 6-1. Total Discounted Cost Estimate

(millions of 1999 dollars)①

	Capital	O&M	Capital Replace-ment	Total
0 to 5 Year Increment	$42.49	$14.65	$0.00	$57.14
5 to 10-Year Increment	$30.22	$29.20	$0.00	$59.42
10 to 20-Year Increment	$58.91	$69.18	$36.96	$165.05
20-Year Plan	**$131.62**	**$113.03**	**$36.96**	**$281.61**

① The discount rate used was 7.00%

Table 6-2 provides a breakdown of these costs by ITS equipment package.

Table 6-2. 20-Year Plan Cost Estimate Detailed Summary

(millions of 1999 dollars)

ITS Equipment Package	Capital	O & M	Capital Replace-ment
Freeway Surveillance ①	$101.25	$61.75	$24.12
Surface Street Control and Surveillance	$12.84	$9.25	$5.77
Incident Management	$0.98	$14.44	$0.17
Transportation Management/Traffic Operations Centers	$6.81	$15.06	$3.27
Transit	$3.29	$2.90	$1.17
Traveler Information Service ②	$0.00	$0.00	$0.00
Regional Traffic Control	$0.35	$1.05	$0.15
Railroad-Highway Grade Crossings	$2.13	$0.82	$0.82
Roadside Weather Information System	$0.32	$0.07	$0.10
Emergency Response/Routing	$0.39	$0.05	$0.20
Archived Data Function	$2.87	$4.29	$1.18
Traffic Forecast and Demand Management	$0.40	$3.35	$0.00
Parking Facility Management	$0.00	$0.00	$0.00
Reversible Lane Management ③	$0.00	$0.00	$0.00
Total	**$131.62**	**$113.03**	**$36.96**

① Includes roadside information dissemination and leased communications (with TDOT owned fiber, the capital cost increases by approximately 25%)

② Approximately 30% ($64 million) of the freeway surveillance capital cost is spent on dynamic message signs used to provide traveler information.

③ Cost for reversible lane management is included in traffic operations center costs.

A more detailed explanation of the cost estimation methodology is provided in Appendix F.

7. Integration of Regional ITS

7.1 Communications plan

A regional ITS communications study was completed for the Nashville region in 1999[4]. The purpose of this study was to develop a 10-year strategic plan for the communications system that will support regional ITS deployment. The study focused on communications needs for a freeway management system. Various communications media options and network topologies were evaluated for a state-owned network. Leasing communications from the private sector was also compared to operating a state-owned communication network.

The study concluded that the most viable communications options are leased facilities from BellSouth or installation of an optical fiber system that is owned and operated by the TDOT. The study also recommended that the lease option be used for the I-65 North project that is currently under design. The communications plan also includes a phased plan for implementing a TDOT-owned fiber optic network.

The cost estimates provided in the Nashville Regional ITS Architecture reflect the use of leased communications for the freeway surveillance system, as recommended in the communications study. If the State of Tennessee decides to develop a state owned communications network, the capital cost for freeway surveillance will increase by approximately 25 percent and annual O&M costs will be reduced by approximately 75 percent.

7.2 Location of Transportation Management/Traffic Operations Centers

As part of the I-65 North Corridor ITS design project, the location for TDOT's regional transportation management center was considered[5]. The TDOT Region III office complex was recommended as the preferred site for constructing a regional transportation management center. The study also included consideration of what functions to include in the center as well as its physical layout. It was recommended that the regional center include shared space for the Tennessee Department of Safety (State Highway Patrol), Metro police and the media.

Metro and the City of Murfreesboro have traffic operations centers that are currently in operation. Metro is planning a significant enhancement to its center in the next several years. The City of Franklin is currently in the design process for implementing a traffic operations center, to be located at Franklin City Hall.

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[4] PB Farradyne Inc. Nashville Region ITS Communications Requirement Study and Strategic Plan. Tennessee Department of Transportation. 1999.

[5] Gresham Smith and Partners. Location Analysis for the Nashville Regional Transportation Management Center. Tennessee Department of Transportation. April 2000.

7.3 Regional Architecture

The regional ITS architecture specifies how various ITS equipment packages should be integrated to maximize the collective return on investment (see Section I). To be successful, this integration must address both physical and institutional considerations. The regional ITS architecture guides transportation agencies in coordinating individual ITS applications.

The Regional Architecture for Nashville identifies what information will flow between specific subsystems (e.g., regional transportation management center) and terminators (e.g., travelers), as well as the mode of communication that will be used (e.g., wireline or wireless). Institutional considerations are also presented[6].

8. Institutional Roles and Responsibilities

ITS stakeholders in the region must work together to develop integrated ITS systems in the region. Consensus developed through working together on integration will result in several types of formal documents, which will provide guidance at various stages of ITS project implementation process. This plan is one of the formal documents, along with the multiple interagency agreements that will be produced. ITS projects must ultimately be included in the applicable regional and statewide transportation plans (long range transportation plan, TIP and STIP). To ensure that these documents are developed and remain current, responsibility for development and maintenance must be assigned.

8.1 Interagency Agreements

In order to implement an integrated ITS system, agreements must be reached between involved parties to ensure that respective roles and responsibilities are clearly understood and that a full commitment of all involved has been made. As an example, a formal agreement would be needed for data and video to be shared between the regional transportation management center and a local traffic operations center.

Deployment of ITS in a region involves unprecedented coordination among various agencies at many levels. In general, the ITS system purpose is to be responsive to traffic and incident conditions without regard to jurisdictional boundaries. Providing an ITS system that appears seamless to the traveling public becomes more challenging when it is deployed and operated in the context of decentralized functions and responsibilities. Formally defining roles and responsibilities can help eliminate battles over turf, duplication of work and delays in deployment caused by unresolved issues.

The approach recommended for the Nashville region assumes decentralized implementation of equipment packages. Individual agencies will implement their own ITS projects that must integrate into the overall system. With each agency developing

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[6] PB Farradyne, Inc. Nashville Area Regional ITS Architecture. Tennessee Department of Transportation. 2000.

individual systems, reaching prior agreements on interface points between systems is important. This consideration is paramount to effective communication between the regional transportation management center and the local traffic operations center and in establishing protocols for coordinated operations.

In order to maximize effectiveness, the proposed ITS system must be operated in a cooperative manner that includes the involvement of multiple State and local agencies. A series of formal agreements, such as memoranda of understanding, are recommended to establish and support a cooperative working relationship. Multiple written agreements are advisable (instead of a single document), since this provides flexibility as system operation evolves. This also prevents a change in one area from adversely impacting other areas.

Below are examples of issues that may need to be addressed in written memoranda of understanding:

- Ownership of transportation data
- Ability to distribute transportation data
- Camera control
- Jurisdiction at incidents for police, fire and rescue, and TDOT staff
- When signal timing will be modified and who can make the modifications
- How and when incident notification will occur
- When traffic can be diverted to other roadways
- Funding of capital cost
- Funding for operations
- Funding for maintenance
- Responsibility for maintenance
- Timing of system upgrades (operating systems, application software)
- Requirement for advanced notice of system upgrades
- Use of video for law enforcement
- Taping of video (liability issue)
- Responsibility for design, testing and implementation
- Staff availability (weekday 8:00 to 5:00 vs. 24-7)
- Joint statement of support for the ITS system
- Control center roles
- Field equipment ownership
- Administration and management

- Staffing
- Communication responsibilities of the TMC
- On site coordination (incident manager, call for tow trucks, etc.)
- Roles and limitations of service patrols
- Identification and management of diversion routes
- Operation of dynamic message signs and motorist information systems
- Data links between centers (CCTV, traffic counts, operating speeds, etc.)
- Control plans for recurring special events
- Control plans for unique special events
- Maintenance of traffic during construction
- Control plans for special incidents, such as HAZMAT spills

Section 9 details the ITS project implementation process, which includes checkpoints when considering the need for interagency agreements and actual agreements must be produced. Prior to a project being funded for implementation with Federal funds, interagency agreements identified as being beneficial must be completed.

8.2 Regional ITS Architecture Maintenance

An additional responsibility of all stakeholders will be periodic updating of the Nashville Regional ITS Architecture. As ITS deployment occurs, the local knowledge and experience gained, advances in technology and the availability of better cost data will influence the most cost-effective way to address traffic and safety concerns in the Nashville region.

Responsibility for maintaining the regional ITS architecture has been accepted by the MPO with assistance from TDOT. The maintaining and updating process will be facilitated by the MPO, but will require involvement of all ITS stakeholders in the process.

The ITS Regional Architecture will be formally updated just prior to the update of the Long Range Transportation Plan, now every three years. Between formal updates, new ITS project descriptions and proposed updates to the regional ITS architecture will be inserted into a Regional ITS Architecture appendix (see Appendix G). These incremental updates will be made available to other ITS stakeholders to keep them informed about what ITS projects are being planned and deployed. If all stakeholders are aware of projects that are underway, integration opportunities can be identified. The administrative procedures for initiating a new ITS project that is expected to use Highway Trust Fund money is discussed in the next section.

9. ITS Project Implementation Procedures

Planning and implementing an ITS project must occur within specific administrative procedures if Highway Trust Fund money will be used on the project at any time. Federal regulations enumerate the following policy:

> *ITS projects shall conform to the National ITS Architecture and standards in accordance with the requirements contained in this part. Conformance with the National ITS Architecture is interpreted to mean the use of the National ITS Architecture to develop a regional ITS architecture, and the subsequent adherence of all ITS projects to that regional ITS architecture. Development of the regional ITS architecture should be consistent with the transportation planning process for Statewide and Metropolitan Transportation Planning.*- 23CFR940.5

The responsibility for determining whether ITS projects adhere to that regional ITS architecture and meet all other ITS architecture conformity regulations is delegated to the Tennessee Division of the FHWA. They also have the responsibility of determining whether or not a complete regional ITS architecture exists. The Tennessee Division has developed administrative procedures in concert with local ITS stakeholders to help in the efficient submittal, evaluation and approval of proposed ITS projects.

Submission of a project checklist form that describes the proposed ITS project is the first step in the process. The completed checklist form will provide enough information to allow a determination of what Federal regulations apply to the project and what steps are required to determine that the proposed project conforms to the regional ITS architecture or an applicable project architecture. A detailed flow chart has been developed to illustrate the steps in the process (see Appendix H). An ITS project checklist form for submittal of a project for consideration and a form for documenting regional ITS architecture modifications are also provided (see Appendix H). Review of project submittals will be by the ITS Project Review Team, which includes the FHWA ITS Engineer, MPO, TDOT and local ITS stakeholders. The Review Team will convene and review project submittals at the discretion of the Tennessee Division of the FHWA.

A determination must be made by the Review Team whether a project is an "ITS Project", whether any exceptions apply, and whether or not the project is a "Major ITS Project". If the regional ITS architecture is complete, the Review Team must determine whether the project is consistent with the architecture. When a project is determined to be inconsistent with the current regional ITS architecture, the project must be revised to be consistent with the regional ITS architecture or the regional ITS architecture must be revised.

Proposed revisions to the regional ITS architecture must be submitted to the Review Team with supporting documentation. The documentation must address why the existing ITS architecture cannot accommodate the proposed system and how the regional ITS architecture must be revised. The Review Team will determine whether the regional ITS architecture should be revised in consultation with the agency proposing the revision.

If the regional ITS architecture is not complete, a project architecture must be developed for a "Major ITS Project". Once conformity with the ITS architecture has been determined, the project must follow a normal path through the appropriate transportation planning process.

Before an ITS project is authorized by FHWA, there should be a formal review process to consider whether any interagency agreements will be beneficial in achieving integrated ITS systems. The format and nature of the agreements will depend on the significance of the interaction between agencies that is being addressed in the agreement. Interagency agreements, when deemed necessary, will be included in Appendix I of the regional ITS architecture. Appendix I will be kept current between formal regional ITS architecture updates to provide information on existing agreements at any given time and to provide sample agreements that can be used as a starting point for developing new agreements.

APPENDIX A

ITS Stakeholder List

ITS Stakeholder Organizations

Cheatham County
City of Murfreesboro
Dickson County
Federal Highway Administration
Tennessee Emergency Management
Greater Nashville Regional Council
Gresham, Smith and Partners
Kimley-Horn and Associates, Inc.
Metro Nashville Emergency Management
Metro Nashville Fire Department
Metro Nashville Police Department
Metro Nashville Public Works
Metropolitan Transit Authority
Nashville Area Metropolitan Planning
Regional Transportation Authority
Robertson County
Rutherford County
Sumner County
TDOT Headquarters
TDOT Region III
The TMA Group
Williamson County
Wilson County

List of Stakeholders with Responsibilities

Stakeholder name	Responsible for the following systems:
City of Ashland	City of Ashland City Fire EOC
	City of Ashland City Police EOC
City of Brentwood	City of Brentwood Fire EOC
	City of Brentwood Police EOC
	City of Brentwood TOC
City of Franklin	City of Franklin Fire EOC
	City of Franklin Police EOC
	City of Franklin TOC
City of Gallatin	City of Gallatin Fire EOC
	City of Gallatin Police EOC
	City of Gallatin TOC
City of Goodlettsville	City of Goodlettsville Fire EOC
	City of Goodlettsville Police EOC
City of Hendersonville	City of Hendersonville EOC
	City of Hendersonville Police EOC
	City of Hendersonville TOC
City of LaVergne	City of LaVergne Fire EOC
	City of LaVergne Police EOC
	City of LaVergne TOC
City of Lebanon	City of Lebanon Fire EOC
	City of Lebanon Police EOC
	City of Lebanon TOC
City of Murfreesboro	City of Murfreesboro Fire EOC
	City of Murfreesboro Police EOC
	City of Murfreesboro TOC
City of Nashville	City of Nashville TOC
	City of Nashville Metro 911 EOC
	City of Nashville Metro EMS EOC
	City of Nashville Metro Fire/Rescue EOC
	City of Nashville Metro Police EOC
	City of Nashville Metro Public Works (HAZMAT) EOC
	City of Nashville Metro Transit Authority MC
City of Portland	City of Portland Fire EOC
	City of Portland Police EOC
City of Smyrna	City of Smyrna Fire EOC
	City of Smyrna Police EOC
	City of Smyrna TOC
City of Springfield	City of Springfield Fire EOC
	City of Springfield Police EOC
Cheatham County	County of Cheatham County 911 EOC
	County of Cheatham County EMS EOC
	County of Cheatham County Sheriff EOC
	County of Cheatham Local TOC
Robertson County	County of Robertson County 911 EOC
	County of Robertson County EMS EOC
	County of Robertson County Sheriff EOC
	County of Robertson Local TOC

Rutherford County	County of Rutherford County 911 EOC
	County of Rutherford County EMS EOC
	County of Rutherford County Sheriff EOC
Sumner County	County of Sumner County 911 EOC
	County of Sumner County EMS EOC
	County of Sumner County Sheriff EOC
Williamson County	County of Williamson County 911 EOC
	County of Williamson County EMS EOC
	County of Williamson County Sheriff EOC
Wilson County	County of Wilson County 911 EOC
	County of Wilson County EMS EOC
	County of Wilson County Sheriff EOC
	County of Wilson Local TOC
Data Archivers	Archived Data Management System
General Public	City of Nashville Metro Traffic Engineering TOC
	ISP Remote Traveler Support
	Personal Information Access
	Vehicle
ISP Operator	Information Service Provider
	Information Service Provider Kiosks
	ISP Operator
	Other ISP
Local Emergency Management Agency	Emergency Vehicles
	Local Emergency Response Center
	Local Emergency Response Center Personnel
	Other Emergency Management Systems
Local PSAP	Emergency Telecommunications System
Local Public Works	Local Construction and Maintenance
	Local Traffic Operations Center
	Local Traffic Operations Center Personnel
	Local Traffic Operations Center Roadside Equipment
Local Transit Agency	Enforcement Agency
	Transit Driver
	Transit Fleet Manager
	Transit Maintenance Personnel
	Transit Management Center
	Transit Management Center_Kiosks
	Transit Remote Traveler Support
	Transit System Operators
	Transit Vehicles
Map Provider	Map Update Provider
Multimodal Service Provider	Multimodal Service Provider
Other Public Works	Other Local TOC
Parking Manager	Parking Management
State of Tennessee	Tennessee Emergency Management Agency (TEMA) EOC
TDOT	HELP Vehicle
	Region 3 Maintenance
	Regional Traffic Management Center
	StatewideTraffic Management Center
	TDOT RTMC Personnel

	TDOT RTMC_Roadside Equipment
Tennessee Department of Safety	Commercial Vehicle Administration (CVAS)
Weather Information Provider	Weather Service

APPENDIX B

Performance Measures

Traffic performance measures were generated to help identify areas of high traffic demand and congestion within the Nashville region. The performance measures used were average daily traffic volume and average daily traffic volume per lane. These measures were produced for all freeways in the region, as well as key arterial roadways. Key arterial roadways were defined as those that have average daily traffic volumes exceeding 10,000 vehicles per day, provide continuity in the roadway network or are situated parallel to a freeway.

Freeway performance assessment included all roadways that are fully access controlled. Average daily traffic volumes for 1997 (latest available at the time the performance measures were produced) and number of lanes data were obtained from the Tennessee Roadway Information Management System (TRIMS) database. An average 3 percent per year growth rate was used to adjust traffic volumes from 1997 to 1999.

Developing performance measures for key arterial roadways was a more complex process, leading to less confidence in the performance measurements. One difficulty is the lack of complete traffic volume data, as traffic counts are made at point locations along arterial roadways, but the actual traffic volume changes at each cross street and driveway. Daily traffic volumes for arterial roadways were determined from the best available traffic count locations.

How well traffic flows on an arterial roadway is influenced by the spacing of traffic signals, the volume of traffic on cross streets at the signalized intersections and by the level of access control. No attempt was made to account for the effect of traffic signals on arterial roadways. The daily volume per lane performance measure for arterial roadways provides a relative comparison of traffic flow, but caution must be used when comparing specific roadways. As the number of traffic signals, cross street traffic volumes and number of driveways increase, there will be a lower level of traffic flow efficiency, resulting in more congestion.

It is recommended that, in future updates of the Nashville Regional ITS Architecture, forecast daily traffic volumes should be used along with existing traffic counts to develop performance measures. Current Year 2025 forecast traffic volumes were not available for consideration in this study.

APPENDIX C

ITS User Services Translation to ITS Market Packages

The selection of ITS User Services relevant to the Nashville region provides a high-level inventory of transportation services that will fulfill transportation system and user needs. To refine this description of how user needs can be met, ITS Market Packages were identified that work to provide the selected ITS User Service. The stakeholders then considered the resulting subset of ITS Market Packages.

The process used to identify system and user needs utilized previous ITS planning documents, notably the *TDOT ITS Strategic Plan* and the *Nashville Area Intelligent Transportation Systems Early Deployment Study*. The *TDOT ITS Strategic Plan* is a statewide strategic plan for ITS that is updated annually by an ITS Coordinating Committee within TDOT. The *Nashville Area Intelligent Transportation Systems Early Deployment Study* was conducted from 1995 to 1997 under the direction of the Nashville Area Metropolitan Planning Organization. Both planning efforts developed a list of applicable ITS User Services for the Nashville area.

The ITS User Services are tools provided in the National ITS Architecture that are defined as follows:

> *User services document what ITS should do from the user's perspective. A broad range of users is considered, including the traveling public as well as many different types of system operators. The concept of user services allows system or project definition to begin by establishing the high level services that will be provided to address identified problems and needs.*

Along with the ITS User Services identified in the two planning efforts, Nashville ITS stakeholders were asked to select ITS User Services they felt were applicable to the Nashville region (see Table C-1). Since the two ITS planning efforts were completed, one new ITS User Service (Archive Data User Service) has also been added to the National ITS Architecture.

In the Plan development process, only ITS Market Packages that helped provide ITS User Services selected as relevant to the Nashville region were reviewed for inclusion in the Plan. The structure of the National ITS Architecture provides a direct link between ITS User Services and ITS Market Packages. The link is a many-to-many relationship. An ITS User Service can have many ITS Market Packages that work to provide the desired service to a user; conversely, an ITS Market Package can work to provide many different ITS User Services.

Table C-1. Nashville Area User Service Matrix

User Service Bundles/User Services	Early Deploy-ment Study	TDOT ITS Strategic Plan		Stake-holder Priorities
		Lead	Support	
Travel and Traffic Management				
1.1 Pre-trip Travel Information	✓	✓	✓	✓
1.2 En-route Driver Information	✓①	✓		✓
1.3 Route Guidance	✓①			
1.4 Ride Matching and Reservation			✓	✓
1.5 Traveler Services Information				
1.6 Traffic Control	✓	✓②	✓③	✓
1.7 Incident Management	✓	✓②	✓③	✓

Table C-1. Nashville Area User Service Matrix

User Service Bundles/User Services	Early Deploy-ment Study	TDOT ITS Strategic Plan		Stake-holder Priorities
		Lead	Support	
1.8 Travel Demand Management ④	✓	✓	✓	✓
1.9 Emissions Testing and Mitigation				
1.10 Highway-rail Intersection	✓	✓		✓
Public Transportation Management				
2.1 Public Transportation Management	✓		✓	
2.2 En-route Transit Information	✓		✓	
2.3 Personalized Public Transit	✓		✓	
2.4 Public Travel Security	✓			
Electronic Payment				
3.1 Electronic Payment Services	✓			
Commercial Vehicle Operations				
4.1 Commercial Vehicle Electronic Clearance			✓	
4.2 Automated Roadside Safety Inspection				
4.3 On-board Safety Monitoring				
4.4 Commercial Vehicle Admin. Processes		✓		
4.5 Hazardous Material Incident Response	✓			
4.6 Commercial Fleet Management	✓			
Emergency Management				
5.1 Emergency Notification & Personal Security	✓			
5.2 Emergency Vehicle Management	✓		✓	
Advanced Vehicle Safety Systems				
6.1 Longitudinal Collision Avoidance				
6.2 Lateral Collision Avoidance				
6.3 Intersection Collision Avoidance	✓			
6.4 Vision Enhancement For Crash Avoidance				
6.5 Safety Readiness				
6.6 Pre-crash Restraint Deployment				
6.7 Automated Vehicle Operation				
Advanced Vehicle Safety Systems				
7.1 Archive Data				✓

① Parking management falls within en-route driver information and route guidance.
② Lead in traffic control and incident management on freeways and at freeway/surface street interfaces.
③ Support in traffic control and incident management on surface streets.
④ TDOT will lead on HOV lanes and support parking systems.

Figure C-1 shows the relationship between ITS User Services and ITS Market Packages in a matrix format. This matrix is a refined version of a similar matrix provided in the *ITS Implementation Strategy*[7] document produced in the National ITS Architecture development process. The matrix in Figure C-1 includes only ITS User Services considered relevant in the Nashville region and only the ITS Market Packages that are designed to provide those relevant

[7] Lockheed Martin Federal Systems and Odetics Intelligent Transportation Systems Division. ITS Implementation Strategy. Federal Highway Administration, US Department of Transportation. Washington, D. C. September 1998.

ITS User Services. Several of the newer ITS User Services and ITS Market Packages that were not originally in the National ITS Architecture are also added to the refined matrix. All of the ITS Market Packages included in the matrix were evaluated by the stakeholders for inclusion in the Plan.

The ITS stakeholders reviewed each ITS Market Package in the subset (see Table C-2) and discussed its relevance to the Nashville region in the next 20 years. Through the review and discussion process, a list of relevant ITS Market Packages was developed. Table C-2 lists each of these ITS Market Packages along with a brief description.

Figure C-1. ITS User Service to ITS Market Package Relationship

ITS Market Package / ITS User Service	1.1 Pre-Trip Traveler Information	1.2 En-route Driver Information	1.3 Route Guidance	1.4 Ride Matching And Reservation	1.6 Traffic Control	1.7 Incident Management	1.8 Travel Demand Management	1.10 Highway-rail Intersection	2.1 Public Transportation Management	2.2 En-route Transit Information	2.3 Personalized Public Transit	2.4 Public Travel Security	3.1 Electronic Payment Services	4.1 Commercial Vehicle Electronic Clearance	4.4 Commercial Vehicle Administrative Processes	4.5 Hazardous Material Incident Response	5.1 Emergency Notification and Personal Security	5.2 Emergency Vehicle Management	6.3 Intersection Collision Avoidance	7.1 Archive Data
Transit Vehicle Tracking									◆	◆	◆	◆								
Transit Fixed-Route Operations									◆	◆										
Demand Response Transit Operations									◆	◆	◆									
Transit Passenger and Fare Management										◆			◆							
Transit Security									◆			◆								
Transit Maintenance									◆											
Multi-modal Coordination					◆		◆		◆											
Transit Traveler Information									◆	◆			◆							
Broadcast Traveler Information	◆	◆								◆										
Interactive Traveler Information	◆	◆		◆						◆	◆		◆							
Autonomous Route Guidance		◆	◆																	
Dynamic Route Guidance		◆	◆			◆				◆										
ISP Based Route Guidance	◆	◆	◆										◆							
Integrated Transport Mgt./Route Guidance		◆	◆										◆							
Yellow Pages and Reservation	◆	◆		◆						◆			◆							
Dynamic Ridesharing	◆	◆	◆	◆			◆			◆	◆		◆							
In Vehicle Signing		◆			◆			◆												
Network Surveillance					◆															
Probe Surveillance					◆															
Surface Street Control					◆	◆		◆												
Freeway Control					◆	◆	◆													
HOV Lane Management					◆		◆													
Traffic Information Dissemination					◆			◆												
Regional Traffic Control					◆															
Incident Management System						◆														
Traffic Prediction and Demand Management					◆		◆													
Electronic Toll Collection							◆						◆							
Virtual TMC and Smart Probe Data		◆			◆	◆														
Standard Railroad Grade Crossing								◆												
Advanced Railroad Grade Crossing								◆												
Railroad Operations Coordination								◆												
Parking Facility Management							◆						◆							
Reversible Lane Management					◆	◆														
Road Weather Information System		◆			◆	◆														
Regional Parking Management							◆						◆							
Intersection Safety Warning								◆											◆	
Intersection Collision Avoidance								◆											◆	
Freight Administration																◆				
Electronic Clearance														◆	◆					
CV Administrative Processes														◆	◆					
International Border Electronic Clearance														◆	◆					
Weigh-In-Motion														◆						
HAZMAT Management						◆										◆				
Emergency Response																	◆	◆		
Emergency Routing					◆													◆		
Mayday Support																	◆	◆		
ITS Data Mart																				◆
ITS Data Warehouse																				◆
ITS Virtual Data Warehouse																				◆

Source: *Market Packages: A Tool for Viewing, Accessing and Utilizing the National ITS Architecture*, December 1999.

Table C-2. ITS Market Packages Considered

Name	Description
Network Surveillance (atms01)	This market package includes traffic detectors, environmental sensors, other surveillance equipment, the supporting field equipment, and wireline communications to transmit the collected data back to a transportation management or traffic operations center.
Probe Surveillance (atms02)	This market package provides an alternative approach for surveillance of the roadway network. Two general implementation paths are supported by this market package: 1) wide-area wireless communications between the vehicle and Information Service Provider is used to communicate current vehicle location and status, and 2) dedicated short range communications between the vehicle and roadside is used to provide equivalent information back to the Traffic Management Subsystem.
Surface Street Control (atms03)	This market package provides the central control and monitoring equipment, communication links, and the signal control equipment that support local surface street control and/or arterial traffic management.
Freeway Control (atms04)	This market package provides the communications and roadside equipment to support ramp control, lane controls, and interchange control for freeways.
HOV Lane Management (atms05)	This market package manages HOV lanes by coordinating freeway ramp meters and connector signals with HOV lane usage signals.
Traffic Information Dissemination (atms06)	This market package allows traffic information to be disseminated to drivers and vehicles using roadway equipment such as dynamic message signs or highway advisory radio.
Regional Traffic Control (atms07)	This market package advances the Surface Street Control and Freeway Control Market Packages by adding the communications links and integrated control strategies that enable integrated interjurisdictional traffic control.
Incident Management System (atms08)	This market package manages both predicted and unexpected incidents so that the impact to the transportation network and traveler safety is minimized.
Traffic Forecast and Demand Management (atms09)	This market package includes advanced algorithms, processing, and mass storage capabilities that support historical evaluation, real-time assessment, and forecast of the roadway network performance.
Electronic Toll Collection (atms10)	This market package provides toll operators with the ability to collect tolls electronically and detect and process violators.
Virtual TMC and Smart Probe Data (atms12)	This market package provides for special requirements of rural road systems. Instead of a central TMC, the traffic management is distributed over a very wide area (e.g., a whole state or collection of states).
Standard Railroad Grade Crossing (atms13)	This market package manages highway traffic at highway-rail intersections where operational requirements do not dictate more advanced features (e.g., where rail operational speeds are less than 80 miles per hour). Both passive and active warning systems are supported.
Advanced Railroad Grade Crossing (atms14)	This market package manages highway traffic at highway-rail intersections (HRIs) where operational requirements demand advanced features (e.g., where rail operational speeds are greater than 80 miles per hour).
Railroad Operations Coordination (atms15)	This market package provides an additional level of strategic coordination between rail operations and traffic operations centers. Rail operations provide train schedules, maintenance schedules, and any other forecast events that will result in highway-rail intersection closures.
Parking Facility Management (atms16)	This market package provides enhanced monitoring and management of a parking facility. The included equipment assists in the management of parking operations, coordinates with transportation authorities, and supports electronic collection of parking fees.
Reversible Lane Management (atms17)	This market package provides for the management of reversible lane facilities.

Table C-2. ITS Market Packages Considered

Name	Description
Road Weather Information System (atms18)	This market package monitors current and forecast road and weather conditions using a combination of weather service information and data collected from environmental sensors deployed on and about the roadway.
Electronic Clearance (cvo03)	This market package provides for automated clearance at roadside check facilities.
CV Administrative Processes (cvo04)	This market package provides for electronic application, processing, fee collection, issuance, and distribution of CVO credential and tax filing.
Weigh-In-Motion (cvo6)	This market package provides for high speed weigh-in-motion with or without AVI attachment.
HAZMAT Management (cvo10)	This market package integrates incident management capabilities with commercial vehicle tracking to assure effective treatment of HAZMAT material and incidents.
ITS Data Mart (ad1)	This market package provides a focused archive that houses data collected and owned by a single agency, district, private sector provider, research institution, or other organization.
ITS Data Warehouse (ad2)	This market package includes all the data collection and management capabilities provided by the ITS Data Mart, and adds the functionality and interface definitions that allow collection of data from multiple agencies and data sources spanning across modal and jurisdictional boundaries.
ITS Virtual Data Warehouse (ad3)	This market package provides broad access to multimodal, multidimensional data from varied data sources using enhanced interoperability between physically distributed ITS archives that are each locally managed.
Transit Vehicle Tracking (apts1)	This market package provides for an Automated Vehicle Location System to track the transit vehicle's real time schedule adherence and updates the transit system's schedule in real-time.
Transit Fixed-Route Operations (apts2)	This market package performs automatic driver assignment and monitoring, as well as vehicle routing and scheduling for fixed-route services.
Demand Response Transit Operations (apts3)	This market package performs automatic driver assignment and monitoring as well as vehicle routing and scheduling for demand response transit services.
Transit Passenger and Fare Management (apts4)	This market package allows for the management of passenger loading and fare payments on-board vehicles using electronic means.
Transit Security (apts5)	This market package provides for the physical security of transit passengers. An on-board security system is deployed to perform surveillance and warn of potentially hazardous situations. Public areas (e.g. stops, park and ride lots, stations) are also monitored.
Transit Maintenance (apts6)	This market package supports automatic maintenance scheduling and monitoring. On-board condition sensors monitor critical system status and transmit critical status information to the Transit Management Subsystem.
Multi-modal Coordination (apts7)	This market package establishes two-way communications between multiple transit and traffic agencies to improve service coordination.
Transit Traveler Information (apts8)	This market package provides transit users at transit stops and on-board transit vehicles with ready access to transit information.
Emergency Response (em1)	This market package provides the computer-aided dispatch systems, emergency vehicle equipment, and wireless communications that enable safe and rapid deployment of appropriate resources to an emergency.
Emergency Routing (em2)	This market package supports dynamic routing of emergency vehicles and coordination with the Traffic Management Subsystem for special priority on the selected route(s).

Table C-2. ITS Market Packages Considered

Name	Description
Mayday Support (em3)	This package allows the user (driver or non-driver) to initiate a request for emergency assistance and enables the Emergency Management Subsystem to locate the user and determine the appropriate response.
Broadcast Traveler Information (atis1)	This market package provides the user with a basic set of advanced traveler information services (ATIS). It involves the collection of traffic conditions, advisories, general public transportation and parking information and the near real time dissemination of this information over a wide area through existing infrastructures and low cost equipment (e.g., FM subcarrier, cellular data broadcast).
Interactive Traveler Information (atis2)	This market package provides tailored information in response to a traveler request. Both real-time interactive request/response systems and information systems that "push" a tailored stream of information to the traveler based on a submitted profile are supported.
Autonomous Route Guidance (atis3)	This market package relies on in-vehicle sensory, location determination, computational, map database, and interactive driver interface equipment to enable route planning and detailed route guidance based on static, stored information.
Dynamic Route Guidance (atis4)	This market package offers the user advanced route planning and guidance that is responsive to current conditions.
ISP Based Route Guidance (atis5)	This market package offers the user advanced route planning and guidance that is responsive to current conditions. Different than the Dynamic Route Guidance Market Package, this market package moves the route planning function from the user device to the information service provider.
Integrated Transportation Management/Route Guidance (atis6)	This market package allows a traffic management center to continuously optimize the traffic control strategy based on near-real time information on intended routes for a proportion of the vehicles within their network while offering the user advanced route planning and guidance which is responsive to current conditions.
Yellow Pages and Reservation (atis7)	This market package enhances the Interactive Traveler Information package by adding infrastructure provided yellow pages and reservation capabilities to tailored requests for information regarding traffic conditions, transit services, traveler services, ride share/ride match, parking management, and pricing information.
Dynamic Ridesharing (atis8)	This market package enhances the Interactive Traveler Information package by adding infrastructure provided dynamic ridesharing capability to tailored requests for information regarding traffic conditions, transit services, traveler services, ride share/ride match, parking management, and pricing information.
In-Vehicle Signing (atis9)	This market package supports distribution of traffic and travel advisory information to drivers through in-vehicle devices.
Intersection Safety Warning (avss05)	This market package will determine the probability of a collision in an equipped intersection (either highway-highway or highway-rail) and provide timely warnings to drivers in response to hazardous conditions.
Intersection Collision Avoidance (avss10)	This market package will determine the probability of an intersection collision and provide timely warnings to approaching vehicles so that avoidance actions can be taken.

APPENDIX D

ITS Deployment Scenarios

Deployment scenarios were developed for each selected ITS Market Package. The deployment scenarios clarify what ITS Market Packages are expected to include when deployed in the Nashville region. The ITS Market Packages identify what transportation services are to be provided and the deployment scenarios identify how those services will be provided in the Nashville region.

Network Surveillance

The *Network Surveillance* ITS Market Package is provided by several ITS equipment packages. The Freeway Surveillance ITS equipment package provides network surveillance on the freeway portion of the transportation network. The *Surface Street Control and Surveillance* ITS equipment package provides surveillance on the arterial roadway portion of the transportation network.

The *Freeway Surveillance* ITS equipment package reflects the functional design developed in planning for ITS on the I-65 North and I-24 East freeways in Nashville[8]. Freeway surveillance will include non-intrusive vehicle detection (e.g., microwave radar detectors), continuous coverage full monition video and the communications network required to transit the data and video to the regional transportation management center.

The *Surface Street Control and Surveillance* ITS equipment packages reflect several levels of deployment. The low-level ITS equipment package is limited to collection of information by individual signalized intersection detectors on an ad hoc basis. The medium-level ITS equipment package includes placement of system detectors along arterial roadways. This system detection data would be transmitted to the local traffic operations center on a near real-time basis. The high-level ITS equipment package provides the system detection from the medium-level along with continuous coverage full motion video surveillance.

Surface Street Control

The *Surface Street Control* ITS Market Package is provided through the three *Surface Street Control and Surveillance* ITS equipment packages. The ability to adjust signal timing plans in real-time from a traffic operations center is provided under all three ITS equipment packages. The difference between ITS equipment packages relates to the level of network surveillance provided, as discussed above. All three ITS equipment packages assume that the basic traffic signal equipment exists at an intersection.

Freeway Control

The *Freeway Control* ITS Market Package considered appropriate for the Nashville region includes only ramp metering. The stakeholders also decided that ramp metering would likely not be implemented within the 20-year planning period. Although ramp meters are not expected to be implemented in the near future, the regional ITS architecture should be developed to allow ramp meters to be added when necessary.

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[8] Gresham, Smith and Partners and PB Farradyne. I-65 North & I-24 East Intelligent Transportation System Technology Review and Functional Plan Development. Tennessee Department of Transportation. 1999.

Traffic Information Dissemination

The primary method of providing the *Traffic Information Dissemination* ITS Market Package is expected to be dynamic message signs. The dynamic message signs would be implemented at key decision points along freeway corridors being equipped with ITS. The dynamic message signs are considered an integral part of a freeway management system along with the *Network Surveillance* ITS Market Package components. Highway advisory radio may also be used to provide traveler information along a roadway corridor, but dynamic message signs would be the primary means. The dynamic message signs are included in the network surveillance ITS equipment package.

Regional Traffic Control

The *Regional Traffic Control* ITS Market Package involves sharing transportation network status information among transportation management and traffic operating agencies. The sharing of information will allow regional traffic control strategies to be developed and implemented on an ad hoc non-automated basis. A primary example is a local traffic operation center adjusting traffic signal timings in response to an incident on a freeway based on the sharing of information from the regional transportation management center. The sharing of network status information is a first step in regional traffic control. The *Regional Traffic Control* ITS equipment package includes additional software and staffing in the transportation management center to facilitate the sharing of information.

Incident Management System

The ability to provide the *Incident Management System* ITS Market Package is dependent on the ITS Market Packages discussed to this point. The ability to collect information on incidents and implement coordinated responses is predicated on other ITS Market Packages. The *Incident Management System* ITS Market Package processes the collected information and develops the appropriate response. The *Freeway Service Patrol* equipment package is a part of the providing the *Incident Management System* ITS Market Package and is consistent with the existing freeway service patrol program operating in Nashville.

Traffic Forecast and Demand Management

The *Traffic Forecast and Demand Management* ITS Market Package is envisioned to be implemented in the latter years of the planning period. The equipment package would consist of relatively high-power computers capable of processing the advanced algorithms required for real-time traffic demand forecasting. A traffic analyst will also be required to calibrate and monitor the process. The processing unit and required staff are expected to be located in the regional transportation management center.

Standard Railroad Grade Crossing

The deployment scenario for the *Standard Railroad Grade Crossing* ITS Market Package provides equipment at the highway-railroad grade crossing for monitoring of grade crossing status. This includes monitoring of the active warning device status and of roadway vehicles trapped or blocking a crossing. This monitoring information would be transmitted to local traffic operation centers. The actual highway-railroad grade crossing warning device is not included in

this ITS equipment package. The type of warning device appropriate for a given highway-railroad grade crossing is outside of the purview of the ITS program.

Railroad Operations Coordination

To provide the *Railroad Operations Coordination* ITS Market Package, the deployment scenario includes equipment at the local traffic operation center to monitor highway-railroad grade crossings as discussed for the *Standard Railroad Grade Crossing* ITS Market Package.

Parking Facility Management

The *Parking Facility Management* ITS Market Package deployment reflects the Traffic and Parking Guidance System being considered by Metro for downtown Nashville. Available spaces are tracked in major parking garages and the information is provided to the public via dynamic message signs.

Reversible Lane Management

The ITS equipment package for the *Reversible Lane Management* ITS Market Package is limited to providing centralized control of existing reversible lane control equipment. Since the reversible lanes are on limited sections of arterial roadways, wrong-way detection is not considered a relevant function. The only jurisdiction that currently has or expects to have reversible lanes is Metro.

Road Weather Information System

Equipment used to collect *Road Weather Information* will be deployed at strategic locations in the Nashville region. The road weather information systems collect ambient weather information and pavement temperatures that are transmitted to the transportation management center. Strategic locations will likely be major roadway structures.

Electronic Clearance

Deployment of the *Electronic Clearance* ITS Market Package is not directly included in the Plan. Electronic clearance for commercial vehicles is a statewide system currently in place. The benefits of integrating the electronic clearance system with the regional ITS system are limited at this time.

CV Administrative Processes

Deployment of the *CV Administrative Processes* ITS Market Package is not directly included in the Plan. The administrative processing for commercial vehicles is conducted on a statewide basis. The benefits of integrating the commercial vehicle administrative processing system with the regional ITS system are limited at this time.

Weigh-In-Motion

The *Weigh-In-Motion* ITS Market Package supports the *Electronic Clearance* ITS Market Package, thus it is not directly included in the Plan. The benefits of integrating the weigh-in-motion system with the regional ITS system are limited at this time.

HAZMAT Management

The *HAZMAT Management* ITS Market Package would be implemented through improved communication between transportation management centers and emergency management centers.

ITS Data Mart

A distributed system for *Archiving ITS Data* would be used in the Nashville region. Each agency would be responsible for data collection, verification, processing, storage and maintenance of archive data from their system. Computer equipment is required along with some type of mass storage device. Staffing to administer the data archiving process is also included in the ITS equipment package.

ITS Virtual Data Warehouse

Instead of having a comprehensive region-wide data warehouse for archiving all ITS data at one location, a *Virtual Data Warehouse* would be developed by providing access to each agency's data mart. The deployment scenario provides for archived ITS data to be accessed via the Internet.

Transit Vehicle Tracking

The *Transit Vehicle Tracking* ITS Market Package is provided through equipment onboard transit vehicles and in transit management centers. Equipment in the transit vehicle includes a global position system (GPS), an onboard computer managing data and a communications unit capable of transmitting data to the transit management center. Hardware and software in the transit management center would receive the tracking data transmitted by the transit vehicle and would manage the information.

Transit Fixed-Route Operations

The transit management center ITS equipment package provides the hardware, software and staff time necessary to provide the *Transit Fixed-Route Operations* ITS Market Package. The building that houses the transit management center is also included.

Demand Response Transit Operations

The ITS equipment package for the *Demand Response Transit Operations* ITS Market Package is similar to the deployment scenario for the *Transit Fixed-Route Operations* ITS Market Package. Hardware, software, staff time and the transit management center are included.

Transit Passenger and Fare Management

The *Transit Passenger and Fare Management* ITS Market Package ITS equipment package for the Nashville region includes equipment to implement a "smart card" system for fare payment. Electronic fare box equipment is installed on each transit vehicle. At the transit management center, hardware and software is required to process data from the electronic fare boxes.

Transit Maintenance

The ITS equipment package to provide the *Transit Maintenance* ITS Market Package is limited to hardware and software at the transit management center that automates the administrative portion of the maintenance task.

Multi-Modal Coordination

The *Multi-Modal Coordination* ITS Market Package is provided through a communication link between the transit management center and the regional transportation management center. The exchange of system status information between the management centers allows for coordination to take place between the modal agencies.

Transit Traveler Information

The ITS equipment package for providing the *Transit Traveler Information* ITS Market Package includes kiosks placed at major transit centers, such as transfer centers, park-and-ride lots and commuter rail stations. The kiosks would provide general static information and real-time transit vehicle arrival and departure times.

Emergency Response

The *Emergency Response* ITS Market Package is provided through a computer aided dispatch (CAD) system. Equipment is available within each emergency vehicle that allows data and voice communications with the emergency management center. At the emergency management center, hardware and software are provided to communicate and manage the communications with the emergency vehicles. Equipment at the emergency management center will also be provided to view video obtained from the regional transportation management center to assist in assessing the appropriate response to incidents. To allow the sharing of video, a communications link with significant bandwidth is required. Additional staffing is not required to provide this ITS Market Package, since it should improve the efficiency of the existing dispatch function.

Emergency Routing

The deployment scenario that facilitates the *Emergency Routing* ITS Market Package includes hardware and software to assist dispatchers in determining the most efficient routing to incidents requiring emergency services. The determination of most efficient routing will be based on real-time traffic flow information, so communications between the emergency management center and the regional traffic operations center is also required. In the time frame of this plan, implementing special ad hoc timing plans to facilitate emergency vehicle travel to incidents is not included. A traffic signal preemption ITS equipment package is also included in the *Emergency Routing* ITS Market Package.

Broadcast Traveler Information

The *Broadcast Traveler Information* ITS Market Package would be provided mainly through private entities, such as the existing media and traffic reporting services. Broadcast traveler information from the transportation management center would be limited to information provided on an Internet site. To facilitate the distribution of traveler information through private entities, the traffic operations center would provide access to network status data and video images.

Interactive Traveler Information

The deployment scenario for the *Interactive Traveler Information* ITS Market Package relies on private entities similar to the *Broadcast Traveler Information* ITS Market Package. Private entities would take the basic traveler information data and repackage the information customized for individual transportation system users.

APPENDIX E

ITS Plan Phasing

As with any major infrastructure or system implementation, to be successful, ITS deployment must be implemented incrementally. Moreover the rate of deployment is limited by available funding. The phasing proposed herein assumes that the most critical problem areas should be addressed first.

Implementation of the 20-year plan is divided into three periods: 0 to 5-years, 5 to 10-years and 10 to 20-years. Figures 5-2 and 5-3 illustrate the level of ITS deployment at the end of 0 to 5-year and 5 to 10-year periods, respectively. Figure 5-2a shows the 0 to 5-year plan for the entire study area and Figure 5-2b provides an enlarged view of the 0 to 5-year plan in central Davidson County, Franklin and Murfreesboro. The phasing of each ITS equipment package is discussed below.

Freeway Surveillance

Coverage of the 20-year freeway surveillance plan was prioritized into eight groups, based on applying the following criteria:

Has an Alternative Route - The two major functions of a freeway surveillance system are to facilitate enhanced incident management and to provide improved traveler information. Improved traveler information allows transportation system users to make better travel decisions. If no reasonable alternative routes are available, then a decision to take an alternative route is not viable. For the purpose of this evaluation, an alternative route is defined from the perspective of a typical Nashville commuter. The amount of out-of-direction travel and the type of roadway facility (e.g., freeway or surface street) affect the acceptability of an alternative route. In the evaluation of alternative routes, those that use freeways are considered superior to surface street alternative routes.

Is an Alternative Route - If a roadway is the primary alternative route for another freeway route that is equipped for surveillance, then surveillance of the roadway is requisite to ensure that traffic flow on the alternative route can be assessed. The utility of using an alternative route is affected by how well traffic is flowing on that alternative route. The ability to assess traffic flow on primary and alternative routes in real-time is key to an advanced traveler information system. Thus, freeway routes that serve as primary alternative routes for freeway routes being instrumented for surveillance are strong candidates for surveillance deployment.

High Volume-to-Capacity (LOS E/F) - One of the primary benefits of freeway surveillance systems is the ability to enhance incident management. Traffic related incidents are detected quicker, verified and more efficiently handled as a result of information that a freeway surveillance system provides. The objective is to resolve the incident as quickly as possible to reduce the impact on traffic flow. The impact on traffic flow is related to the ratio of traffic volume to capacity (V/C ratio). An incident reduces capacity, resulting in a higher V/C ratio. The level of service on a freeway degrades as the volume to capacity ratio increases and can become unstable, resulting in congestion as the reduced capacity nears the traffic volume being served. The closer a roadway is to capacity (high V/C ratio), the greater are the chances that an incident will cause a reduction in capacity significant enough to cause traffic congestion.

High Existing Volume - As route volumes increase, a greater number of users will experience the benefits of enhanced incident management and available traveler information. If the freeway surveillance system allows an incident to be removed sooner, resulting in a reduction in travel time, the reduction in delay will be experienced by each user passing the incident during the time while the reduced delay is experienced. A higher volume roadway will have a greater number of users passing the incident location in the same period of time. The higher the volume, the larger the number of motorists that can benefit from traveler information that is provided.

The freeways in the Nashville region were divided into segments to apply these criteria. The break points for freeway segments were at all system interchanges and at some service interchange locations along sections of freeway where the spacing between system interchanges exceeds 5 miles.

Figure E-1 summarizes the assignment of priority rankings to routes using the characteristics discussed above. The "Has An Alternative Route" criteria rating reflects the quality of the best alternative route. Freeway segments with alternative freeway routes were considered superior. The rating for serving as an alternative route is based on the number of situations in which a freeway segment would serve as an alternative route. In order to differentiate freeway segments based on traffic volumes, freeway segments were ranked from highest to lowest daily volume and subdivided into quartiles.

Figure E-1. Freeway Segment Prioritization

Freeway Segment Description	Has an Alternative Route	Is an Alternative Route	Per Lane Volume in the LOS E or F Range	High Existing Volume	Priority
I-265 -- I-40 to I-65/24	Good	◆	◆	2	1
I-65/24 -- I-265 to I-40	Good	◆	◆	1	1
I-65/40 -- I-40 to I-65	Good	◆	◆	1	1
I-40 -- I-65 to I-265	Good	◆	◆	1	1
I-40 -- I-265 to I-440	Good	◇	◆	2	2
I-440 -- I-40 to I-65	Good	◇	◆	2	2
I-440 -- I-65 to I-24	Good	◇	◆	2	1 ①
I-65 -- I-40 to I-440	Good	◆	◆	1	1
I-40/24 -- I-65 to Split	Good	◆	◆	1	1
I-24 -- I-40 to I-440	Good	◇	◆	1	1 ①
I-40 East -- I-24 to Briley Pkwy.	Average	◇	◆	1	3
I-40 West -- I-440 to Briley Pkwy	Average	◇	◆	1	3
I-65/24 -- I-265 to Split	Good	◆	◆	1	1
I-24 -- I-65 to Briley Pkwy.	Good	◆	◆	3	1 ①
I-65 -- I-24 to Briley Pkwy.	Good	◆	◆	1	1
Briley Pkwy. -- I-40 East to I-24	Good	◇		4	3 ①
Briley Pkwy. -- I-24 to I-65	Good	◇		3	1 ①
Briley Pkwy. -- I-65 to Ellington Pkwy.	Good	◇		3	1 ①
Briley Pkwy. -- Ellington Pkwy. to I-40	Good	◇		3	3 ①
Ellington Pkwy.	Good	◆		4	1 ①

Figure E-1. Freeway Segment Prioritization

Freeway Segment Description	Has an Alternative Route	Is an Alternative Route	Per Lane Volume in the LOS E or F Range	High Existing Volume	Priority
I-40 W -- Briley Pkwy. to US 70	Poor			3	6
I-40 W -- US 70 to Kingston Springs Rd.	Poor			4	7
I-40 W -- Kingston Springs Rd. to SR 96	Poor			4	7
I-40 W -- SR 96 to SR 840	Poor			4	7
I-65 S -- I-440 to Harding Pl.	Poor		◆	1	4
I-65 S -- Harding Pl. to Old Hickory Rd.	Poor			2	5
I-65 S -- Old Hickory Rd. to SR 96	Poor			2	5
I-65 S -- SR 96 to SR 840	Poor			3	6
I-65 S -- SR 840 to Exit 53	Poor			4	7
I-24 E -- I-440 to Briley Pkwy.	Poor		◆	1	4
I-24 E -- Briley Pkwy. to Harding Pl.	Poor		◆	1	4
I-24 E -- Harding Pl. to Sam Ridley Pkwy.	Poor			2	5
I-24 E -- Sam Ridley Pkwy. to US 231	Poor			3	6
I-40 E --Briley Pkwy. to Donelson Pk.	Poor		◆	1	4
I-40 E -- Donelson Pk. to Old Hickory Blvd.	Poor			2	5
I-40 E -- Old Hickory to SR 840	Poor			3	6
I-40 E -- SR 840 to SR 266	Poor			3	6
I-65 N -- Briley Pkwy. to Vietnam Veterans	Poor		◆	1	1 ②
I-65 N -- Vietnam Veterans to SR 76	Poor			3	6
I-65 N -- SR 76 to Kentucky State Line	Poor			4	7
I-24 W -- Briley Pkwy. to Whites Creek Pk.	Poor			3	6
I-24 W -- Whites Creek Pk. to SR 256	Poor			3	6
Vietnam Veterans Pkwy.	Poor			3	6
SR 840 -- I-40 E to I-65 S	Poor			--	8
SR 840 -- I-65 S to I-24 E	Poor			--	8
SR 840 -- I-24 E to I-40 E	Poor			4	8
SR 840 -- I-40 E to I-65 N	Poor			--	8

◆ - Fully meets criteria, ◇ - Partially meets criteria, ① Alternative route, ② Currently under design

The following summary explains the assignment of freeway segments to each priority group:

Priority 1 - The highest priority freeway segments have alternative routes that are freeways, act as an alternative route for a significant number (> 3) of other freeways segments, have an existing planning analysis LOS of E or F and fall in the upper-half of total volume ranking. In order to maximize the benefits accruing from deployment of surveillance on these highest priority freeway segments, freeway segments that act as alternative routes for these segments are also included as Priority 1. The portion of the I-65 North ITS Project north of the downtown loop is included in Priority 1 since it is a programmed project.

Priority 2 includes the remaining freeway segments that have good alternative freeway routes.

Priority 3 includes the remaining freeway segments that have alternative freeway routes that are not as advantageous to all users. Some longer distance travelers will use the alternative freeway routes, but many local commuters will use surface streets as alternative routes because of the amount of out-of-direction travel required using the alternative freeway route.

Priority 4 includes freeway segments without reasonable alternative freeway routes that have an existing planning analysis LOS of E or F and fall in the upper quartile of total volume rankings.

Priority 5 includes the remaining freeway segments in the upper-half of the daily volume rankings.

Priority 6 freeway segments are those that fall in the second to the lowest quartile of the daily volume rankings.

Priority 7 freeway segments are in the lowest quartile of total volume rankings and serve commuter traffic.

Priority 8 freeway segments are in the lowest quartile of total volume rankings and serve primarily traffic bypassing Nashville.

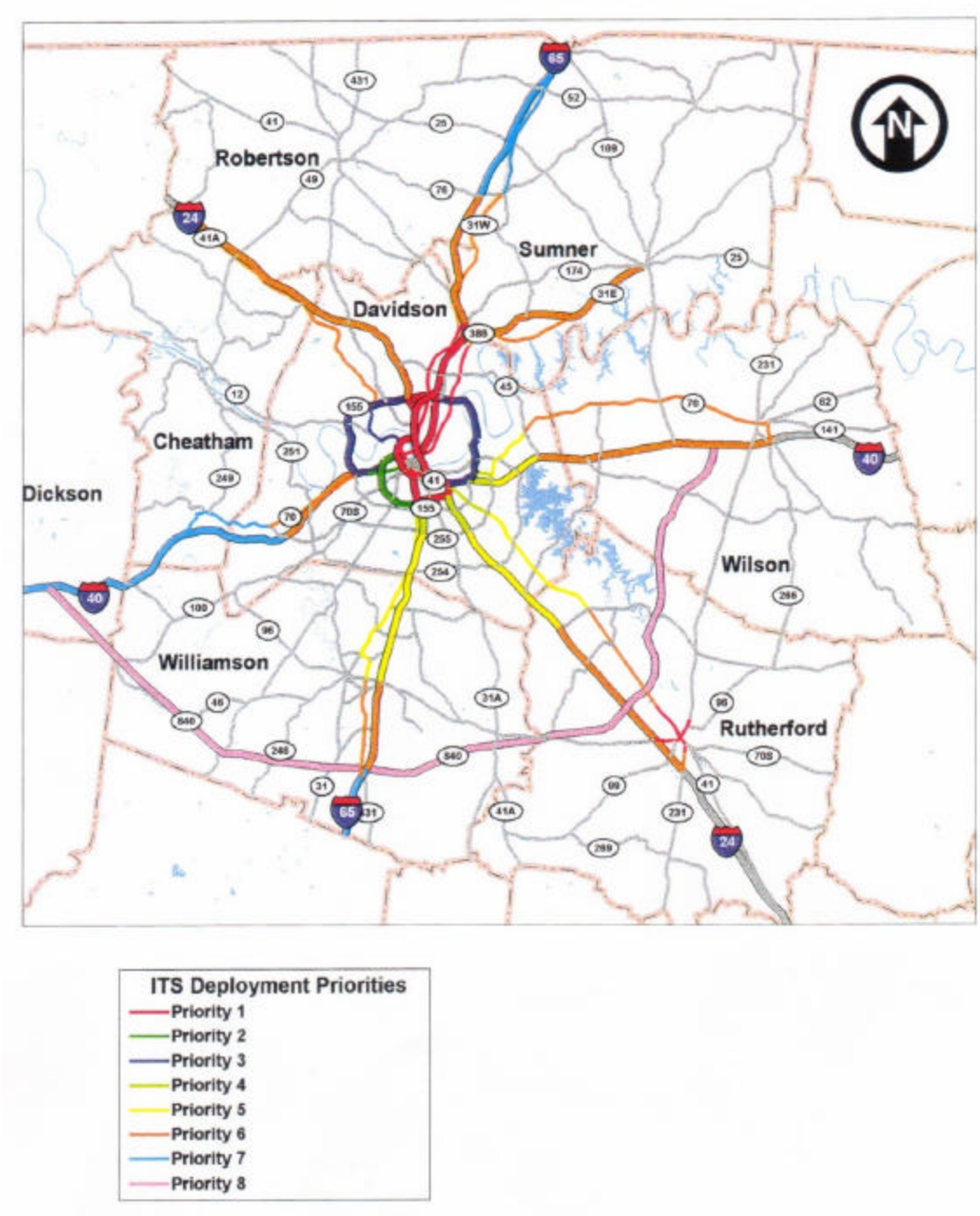
Figure E-2 illustrates the resulting priority groupings of freeway and primary arterial roadway segments on a regional map.

The stakeholders agreed to assign priority groups 1 and 2 to the first five years of the plan and priority groups 3, 4 and 5 to the next five years of the plan. The remaining priority groups (6, 7 and 8) are to be considered for implementation in years 10 through 20 of the plan.

Surface Street Control and Surveillance

Phasing for surface street control and surveillance depended on the phasing of freeway segments when the arterial roadway serves as an alternative route or on the plans of the local jurisdiction. An arterial roadway that serves as a primary alternative route would have medium-level surface street control and surveillance applied when the adjacent freeway is equipped with surveillance. A local jurisdiction's plans to provide high-level surveillance or medium-level surveillance to an arterial roadway that does not serve as a primary alternative route for a freeway dictates other deployment phasing. Figure E-2 shows the phasing of arterial roadways that serve as primary alternative routes for freeways.

Figure E-2. 20-Year Network Surveillance Plan Prioritization



Incident Management

The primary incident management ITS component, freeway service patrols, would be deployed as freeway sections are equipped for surveillance. Deploying the freeway service patrols to the freeway segments with surveillance will maximize the benefits from reduced nonrecurring congestion that result from enhanced incident detection, verification and response. Existing freeway service patrol coverage will not be reduced. Other incident management components would be deployed in the transportation management center.

Transportation Management/Traffic Operations Centers

The regional transportation management center would be built as part of the first freeway surveillance project. Local traffic operations centers would be implemented when local jurisdictions have them planned or as surface street control and surveillance is planned on arterial roadways in a jurisdiction. In the 0 to 5-year period, Metro and Franklin would implement enhanced or new traffic operations centers. In the 5 to 10-year period Brentwood and the Nashville Airport would implement traffic operation centers and in the 10 to 20-year period Gallatin, Hendersonville, LaVergne and Symrna would implement centers. The City of Murfreesboro has an existing traffic operations center.

Transit Vehicle Equipment

The transit vehicle equipment consists of two ITS equipment packages. The first package facilitates electronic fare payment and management, while the other provides the components for automated vehicle location. In the 0 to 5-year time frame, the MTA fleet (140 fixed route buses and 33 para-transit vehicles) would be equipped with electronic fare boxes. Also in the 0 to 5-year time frame, MTA's para-transit fleet (33 vehicles) would be equipped with automated vehicle location components. In the 5 to 10-year time frame, the MTA fixed route buses (140 vehicles) would be equipped for automatic vehicle location. In the 10 to 20-year time frame, the para-transit fleet (66 vehicles) providing service to the outlying counties would be equipped with electronic fare boxes and automatic vehicle location equipment. It is assumed that when the transit fleet is increased, new vehicles will be equipped with the required packages.

Transit Management Center

Enhancement of MTA's current dispatch center to create a transit management center is anticipated in the 5 to 10-year period. Along with the required equipment, software and staffing for the transit center, a 500 square foot building expansion is included. Creation of a transit management center for para-transit outside of Davidson County is planned for the 10 to 20-year time frame.

Transit Traveler Information

Deployment of transit traveler information kiosks is planned for the 5 to 10-year and the 10 to 20-year time frames. In the 5 to 10-year period a kiosk will be placed at the Petway Transit center, the Clement Landport and five commuter rail stations. In the 10 to 20-year period, kiosks will be located at twelve park-and-ride lots.

Broadcast and Interactive Traveler Information

The limited broadcast traveler information equipment that will be provided by public agencies will be implemented when each respective transportation management or traffic operations center is developed.

Regional Traffic Control

Since regional traffic control consists primarily of integrated communications between transportation management and traffic operations centers, this package would be phased-in as the number of traffic operations centers increases. It is assumed that 50 percent of the cost would be incurred in the 0 to 5-year period, 25 percent in the 5 to 10 year period and the final 25 percent in the 10 to 20-year period.

Railroad-Highway Grade Crossings

Railroad-highway grade crossing improvements would be implemented as the arterial roadways that are affected are covered by surface street control and surveillance.

Roadside Weather Stations

Roadside weather stations would be implemented when a freeway segment is equipped for surveillance.

Emergency Response/Routing

Implementation of emergency vehicle and emergency management center equipment is not within the scope of this plan. Once the transportation management and traffic operations centers are functioning, the benefits from coordination will be available along with the data required to enhance emergency response and routing.

Traffic Signal Preemption

Traffic signal preemption near hospitals in Davidson County would be implemented in the 0 to 5-year period, as planned by Metro.

Archive Data Function

The data marts would be implemented concurrent with the regional transportation management center and each local traffic operations center. The virtual data warehouse would be deployed incrementally as each transportation management or traffic operation center data mart is implemented.

Traffic Forecast and Demand Management

The ability to effectively implement the traffic forecast and demand management transportation service is limited at this time. Traffic forecast and demand management algorithms and procedures are currently in a national research and development phase. For this reason, implementation of the Traffic Forecast and Demand Management Market Package is deferred to the 10 to 20-year time frame.

Parking Facilities Management

The Downtown Parking and Guidance System will be implemented in the 0 to 5-year period, as planned by Metro.

Reversible Lane Management

The ability to communicate with the existing reversible lane control signals will be implemented as part of the Metro traffic operations center enhancement, which is planned for the 0 to 5-year time frame.

APPENDIX F

Cost Estimates

The primary source of unit cost information was the *ITS Unit Costs Database*[9] that is maintained by the Federal Highway Administration. When a more relevant cost estimate was available, it was used. For example, the cost per mile for the I-24 East ITS function design was used to estimate the cost for the freeway surveillance ITS equipment package (including roadside information dissemination). The resulting unit costs were increased by 20 percent to account for miscellaneous costs not specifically detailed, by 10 percent for contingencies and by 10 percent for engineering when it is required.

The remainder of this appendix includes the following cost estimate summaries:

Regional Architecture Cost Estimate Summaries

- Cost Estimate Discounting Worksheet
- 20-Year Total Cost Estimate
- Years 0 to 5 Cost Estimate
- Years 5 to 10 Cost Estimate
- Years 10 to 20 Cost Estimate
- Unit Cost Summary

[9] http://www.mitretek.org/its/benecost.nsf/CostHome

Cost Discounting Worksheet

May 1, 2001

Cost Estimate In Constant 1999 Dollars

Period	Capital	Annual O&M	Capital Re-placement
0-5	$50.10	$7.30	$0.00
5-10	$49.96	$4.97	$0.00
10-20	$159.49	$14.52	$100.06
Total	$259.55	$26.80	$100.06

Discount Table

Discount Rate = 7.00%

	Constant 1999 Dollars				Discounted to 1999 Dollars			
Year	Capital (1)	O & M (2)	Capital Re-placement (3)	Discount Factor (4)	Capital	O & M	Capital Replacement	Total
1	$10.02	$0.73	$0.00	0.967	$9.69	$0.71	$0.00	$10.39
2	$10.02	$2.19	$0.00	0.903	$9.05	$1.98	$0.00	$11.03
3	$10.02	$3.65	$0.00	0.844	$8.46	$3.08	$0.00	$11.54
4	$10.02	$5.11	$0.00	0.789	$7.91	$4.03	$0.00	$11.94
5	$10.02	$6.57	$0.00	0.738	$7.39	$4.85	$0.00	$12.24
6	$9.99	$7.80	$0.00	0.689	$6.89	$5.38	$0.00	$12.26
7	$9.99	$8.80	$0.00	0.644	$6.44	$5.67	$0.00	$12.10
8	$9.99	$9.79	$0.00	0.602	$6.02	$5.89	$0.00	$11.91
9	$9.99	$10.78	$0.00	0.563	$5.62	$6.07	$0.00	$11.69
10	$9.99	$11.78	$0.00	0.526	$5.25	$6.19	$0.00	$11.45
11	$15.95	$13.00	$10.02	0.491	$7.84	$6.39	$4.92	$19.15
12	$15.95	$14.45	$10.02	0.459	$7.33	$6.64	$4.60	$18.57
13	$15.95	$15.91	$10.02	0.429	$6.85	$6.83	$4.30	$17.97
14	$15.95	$17.36	$10.02	0.401	$6.40	$6.96	$4.02	$17.38
15	$15.95	$18.81	$10.02	0.375	$5.98	$7.05	$3.76	$16.79
16	$15.95	$20.26	$9.99	0.350	$5.59	$7.10	$3.50	$16.19
17	$15.95	$21.71	$9.99	0.327	$5.22	$7.11	$3.27	$15.61
18	$15.95	$23.17	$9.99	0.306	$4.88	$7.09	$3.06	$15.03
19	$15.95	$24.62	$9.99	0.286	$4.56	$7.04	$2.86	$14.46
20	$15.95	$26.07	$9.99	0.267	$4.26	$6.97	$2.67	$13.90
Total	$259.55	$262.57	$100.06		$131.62	$113.03	$36.96	$281.61

(1) Capital costs are assumed to be expended equally through the planning period (e.i., 0 to 5-years, 5 to 10-years and 10 to 20 years)
(2) O&M costs accrue evenly over a planning period and are incurred every year thereafter.
(3) An average functional life of 10-years is used to estimate capital replacement costs.
(4) A mid-year discount factor is used.

Discounted Cost Estimate Summary

	Discounted to 1999 Dollars			
Period	Capital	O & M	Capital Re-placement	Total
0-5	$42.49	$14.65	$0.00	$57.14
5-10	$30.22	$29.20	$0.00	$59.42
10-20	$58.91	$69.18	$36.96	$165.05
Total	$131.62	$113.03	$36.96	$281.61

Years 0 to 5 Cost Estimate

May 1, 2001

Nashville Regional ITS Architecture
0 to 5-Year Plan Cost Estimate

(all costs are in current year dollars)	Unit	Functl. Life	Unit Costs Capital	Unit Costs O&M	0 to 5-Year Plan Quantity	0 to 5-Year Plan Capital	0 to 5-Year Plan Annual O & M
Freeway Surveillance							
Low Level - Speed/Occupancy detection and direct connection comms	mile	10	$55,000	$18,000	0.0	$0	$0
Medium Level - Speed/Occupancy detection and wireline comms	mile	10	$299,000	$5,000	0.0	$0	$0
High Level - CCTV, Speed/Occupancy detection and Leased comms*	mile	10	$665,000	$42,000	42.7	$28,395,500	$1,793,400
Subtotal					42.7	$28,395,500	$1,793,400
Surface Street Control and Surveillance							
Low Level - New Technology Signal Improvements	mile	10	---	5.0%	---	$4,240,063	$212,003
Medium Level - Speed/Occupancy Detectors - Davidson Co.	mile	10	$25,000	$4,000	50.3	$1,257,500	$201,200
Medium Level - Speed/Occupancy Detectors - Other	mile	10	$31,000	$5,000	0.0	$0	$0
High Level - CCTV and Speed/Occupancy Detectors - Davidson Co.	mile	10	$86,000	$12,000	39.6	$3,405,600	$475,200
High Level - CCTV and Speed/Occupancy Detectors - Other	mile	10	$94,000	$14,000	13.0	$1,222,000	$182,000
Subtotal					102.9	$10,125,163	$1,070,403
Information Dissemination (Roadside)							
Medium Level - Isolated VMSs Contacted Through Dial-up Phone	each	10	$241,000	$12,000	0.0	$0	$0
High Level - VMS costs included in high level freeway surveillance	--	10	--	--	--	--	--
Subtotal					0.0	$0	$0
Incident Management							
Medium Level - Freeway Service Patrols - Existing	mile	10	$0	$10,000	36.4	$0	$364,000
Medium Level - Freeway Service Patrols - New	mile	10	$8,000	$10,000	12.7	$101,600	$127,000
High Level - Costs in Freeway Management TOC	--	0	--	--	--	--	--
Subtotal					49.1	$101,600	$491,000
Traffic Management/Operations Centers							
RTMC - Freeway Management	each	10	$1,303,000	$1,353,000	1	$1,303,000	$1,353,000
RTMC - Freeway Management Building	each	20	$1,995,000	$100,000	1	$1,995,000	$100,000
TOC - Metro (Hardware, software, integration and staffing)	each	10	$1,236,000	$938,000	1	$1,236,000	$938,000
TOC - Metro (Building)	each	20	$1,893,000	$189,000	1	$1,893,000	$189,000
TOC - Surface Street Control**	each	10	$338,000	$329,000	2	$676,000	$658,000
Subtotal						$7,103,000	$3,238,000
Transit							
Transit Vehicle Equipment - Electronic Farebox	each	10	$3,000	$200	173	$519,000	$34,600
Transit Vehicle Equipment - Vehicle Tracking and Management	each	10	$5,500	$300	33	$181,500	$9,900
Transit Management Center Hardware, Software, Staffing and Integratior	each	10	$1,824,000	$193,000	0	$0	$0
Transit Management Center Building Expansion	each	20	$98,000	$10,000	0	$0	$0
Transit Stop ATIS	each	10	$21,000	$3,000	0	$0	$0
Subtotal						$700,500	$44,500

Years 0 to 5 Cost Estimate

May 1, 2001

Nashville Regional ITS Architecture
0 to 5-Year Plan Cost Estimate

(all costs are in current year dollars)	Unit	Functl. Life	Unit Costs Capital	Unit Costs O&M	0 to 5-Year Plan Quantity	0 to 5-Year Plan Capital	0 to 5-Year Plan Annual O & M
Traveler Information Service							
Broadcast Service	Cost will be incurred by private providers. Cost to provide access to information is in the RTMC cost.						
Interactive Service	Cost will be incurred by private sector providers.						
Subtotal						$0	$0
Regional Traffic Control							
Hardware, software, integration and labor	each	10	$520,000	$286,000	0.50	$260,000	$143,000
Railroad-Highway Grade Crossings							
Standard Grade Crossing (4-quad gates & trapped vehicle sensing)	each	10	$47,000	$1,000	7	$329,000	$7,000
Standard Grade Crossing (4-quad gates & trapped vehicle sensing)	each	20	$24,000	$2,000	7	$168,000	$14,000
Railroad Operations Coordination - TOC Upgrades	each	10	$156,000	$9,000	2	$312,000	$18,000
Subtotal						$809,000	$39,000
Roadside Weather Information System							
Roadside Weather Information System Station	each	10	$65,000	$2,000	3	$195,000	$6,000
Emergency Response/Routing							
Emergency Response Center	each	10	$372,000	$213,000		Costs incurred by EM agencies.	
Emergency Vehicle Communications Unit	each	10	$1,500	$30		Costs incurred by EM agencies.	
Traffic Signal Preemption (Metro - around hospitals)	each	10	$460,000	$23,000	1	$460,000	$23,000
Subtotal						$460,000	$23,000
Archived Data Function							
ITS Data Mart - RTMC	each	10	$694,000	$165,000	1	$694,000	$165,000
ITS Data Mart - TOC	each	10	$232,000	$77,000	3	$696,000	$231,000
ITS Virtual Data Warehouse	each	10	$139,000	$15,000	4	$556,000	$60,000
Subtotal						$1,946,000	$456,000
Traffic Forecast and Demand Management							
Traffic Forecast and Demand Management	each	10	$1,071,000	$704,000	0	$0	$0
Parking Facility Management							
Downtown Parking and Traffic Guidance System	each	10	$0	$0	0	$0	$0
Reversible Lane Management							
Reversible Lane Management - Metro	The cost to communicate to existing field equipment is included in the TOC item.						
					Subtotals	$50,095,763	$7,304,303

* Includes variable message signs and leased communications (With TDOT owned fiber the per mile cost increases to $1.1 million).

** Assumes that TOC will use existing public agency space.

Years 5 to 10 Cost Estimate

May 1, 2001

Nashville Regional ITS Architecture
5 to 10-Year Plan Cost Estimate

(all costs are in current year dollars)	Unit	Functl. Life	Unit Costs Capital	Unit Costs O&M	5 to 10-Year Plan Quantity	5 to 10-Year Plan Capital	5 to 10-Year Plan Annual O & M
Freeway Surveillance							
Low Level - Speed/Occupancy detection and direct connection comms	mile	10	$55,000	$18,000	0.0	$0	$0
Medium Level - Speed/Occupancy detection and wireline comms	mile	10	$299,000	$5,000	0.0	$0	$0
High Level - CCTV, Speed/Occupancy detection and Leased comms*	mile	10	$665,000	$42,000	58.1	$38,636,500	$2,440,200
Subtotal					58.1	$38,636,500	$2,440,200
Surface Street Control and Surveillance							
Low Level - New Technology Signal Improvements	mile	10	---	5.0%	---	$0	$0
Medium Level - Speed/Occupancy Detectors - Davidson Co.	mile	10	$25,000	$4,000	41.2	$1,030,000	$164,800
Medium Level - Speed/Occupancy Detectors - Other	mile	10	$31,000	$5,000	33.0	$1,023,000	$165,000
High Level - CCTV and Speed/Occupancy Detectors - Davidson Co.	mile	10	$86,000	$12,000	29.20	$2,511,200	$350,400
High Level - CCTV and Speed/Occupancy Detectors - Other	mile	10	$94,000	$14,000	0.0	$0	$0
Subtotal					103.4	$4,564,200	$680,200
Information Dissemination (Roadside)							
Medium Level - Isolated VMSs Contacted Through Dial-up Phone	each	10	$241,000	$12,000	0.0	$0	$0
High Level - VMS costs included in high level freeway surveillance	--	10	--	--	--	--	--
Subtotal					0.0	$0	$0
Incident Management							
Medium Level - Freeway Service Patrols - Existing	mile	10	$0	$10,000	0.0	$0	$0
Medium Level - Freeway Service Patrols - New	mile	10	$8,000	$10,000	50.6	$404,800	$506,000
High Level - Costs in Freeway Management TOC	--	0	--	--	--	--	--
Subtotal					50.6	$404,800	$506,000
Traffic Management/Operations Centers							
RTMC - Freeway Management	each	10	$1,303,000	$1,353,000	0	$0	$0
RTMC - Freeway Management Building	each	20	$1,995,000	$100,000	0	$0	$0
TOC - Metro (Hardware, software, integration and staffing)	each	10	$1,236,000	$938,000	0	$0	$0
TOC - Metro (Building)	each	20	$1,893,000	$189,000	0	$0	$0
TOC - Surface Street Control**	each	10	$338,000	$329,000	2	$676,000	$658,000
Subtotal						$676,000	$658,000
Transit							
Transit Vehicle Equipment - Electronic Farebox	each	10	$3,000	$200	0	$0	$0
Transit Vehicle Equipment - Vehicle Tracking and Management	each	10	$5,500	$300	140	$770,000	$42,000
Transit Management Center Hardware, Software, Staffing and Integratior	each	10	$1,824,000	$193,000	1	$1,824,000	$193,000
Transit Management Center Building Expansion	each	20	$98,000	$10,000	1	$98,000	$10,000
Transit Stop ATIS	each	10	$21,000	$3,000	7	$147,000	$21,000
Subtotal						$2,839,000	$266,000

Years 5 to 10 Cost Estimate

May 1, 2001

Nashville Regional ITS Architecture
5 to 10-Year Plan Cost Estimate

(all costs are in current year dollars)	Unit	Functl. Life	Unit Costs Capital	Unit Costs O&M	5 to 10-Year Plan Quantity	5 to 10-Year Plan Capital	5 to 10-Year Plan Annual O & M
Traveler Information Service							
Broadcast Service	Cost will be incurred by private providers. Cost to provide access to information is in the RTMC cost.						
Interactive Service	Cost will be incurred by private sector providers.						
Subtotal						$0	$0
Regional Traffic Control							
Hardware, software, integration and labor	each	10	$520,000	$286,000	0.25	$130,000	$71,500
Railroad-Highway Grade Crossings							
Standard Grade Crossing (4-quad gates & trapped vehicle sensing)	each	10	$47,000	$1,000	15	$705,000	$15,000
Standard Grade Crossing (4-quad gates & trapped vehicle sensing)	each	20	$24,000	$2,000	15	$360,000	$30,000
Railroad Operations Coordination - TMC/TOC Upgrades	each	10	$156,000	$9,000	3	$468,000	$27,000
Subtotal						$1,533,000	$72,000
Roadside Weather Information System							
Roadside Weather Information System Station	each	10	$65,000	$2,000	1	$65,000	$2,000
Emergency Response/Routing							
Emergency Response Center	each	10	$372,000	$213,000		Costs incurred by EM agencies.	
Emergency Vehicle Communications Unit	each	10	$1,500	$30		Costs incurred by EM agencies.	
Traffic Signal Preemption (Metro - around hospitals)	each	10	$460,000	$23,000	0	$0	$0
Subtotal						$0	$0
Archived Data Function							
ITS Data Mart - RTMC	each	10	$694,000	$165,000	0	$0	$0
ITS Data Mart - TOC	each	10	$232,000	$77,000	3	$696,000	$231,000
ITS Virtual Data Warehouse	each	10	$139,000	$15,000	3	$417,000	$45,000
Subtotal						$1,113,000	$276,000
Traffic Forecast and Demand Management							
Traffic Forecast and Demand Management	each	10	$1,071,000	$704,000	0	$0	$0
Parking Facility Management							
Downtown Parking and Traffic Guidance System	each	10	$0	$0	0	$0	$0
Reversible Lane Management							
Reversible Lane Management - Metro	The cost to communicate to existing field equipment is included in the TOC item.						
					Subtotals	$49,961,500	$4,971,900

* Includes variable message signs and leased communications (With TDOT owned fiber the per mile cost increases to $1.1 million).

** Assumes that TOC will use existing public agency space.

Years 10 to 20 Cost Estimate

May 1, 2001

Nashville Regional ITS Architecture
10 to 20-Year Plan Cost Estimate

(all costs are in current year dollars)	Unit	Functl. Life	Unit Costs Capital	Unit Costs O&M	10 to 20-Year Plan Quantity	10 to 20-Year Plan Capital	10 to 20-Year Plan Annual O & M
Freeway Surveillance							
Low Level - Speed/Occupancy detection and direct connection comms	mile	10	$55,000	$18,000	0.0	$0	$0
Medium Level - Speed/Occupancy detection and wireline comms	mile	10	$299,000	$5,000	0.0	$0	$0
High Level - CCTV, Speed/Occupancy detection and Leased comms*	mile	10	$665,000	$42,000	219.0	$145,635,000	$9,198,000
Subtotal					219.0	$145,635,000	$9,198,000
Surface Street Control and Surveillance							
Low Level - New Technology Signal Improvements	mile	10	---	5.0%	---	$0	$0
Medium Level - Speed/Occupancy Detectors - Davidson Co.	mile	10	$25,000	$4,000	29.2	$730,000	$116,800
Medium Level - Speed/Occupancy Detectors - Other	mile	10	$31,000	$5,000	107.0	$3,317,000	$535,000
High Level - CCTV and Speed/Occupancy Detectors - Davidson Co.	mile	10	$86,000	$12,000	0.00	$0	$0
High Level - CCTV and Speed/Occupancy Detectors - Other	mile	10	$94,000	$14,000	0.0	$0	$0
Subtotal					136.2	$4,047,000	$651,800
Information Dissemination (Roadside)							
Medium Level - Isolated VMSs Contacted Through Dial-up Phone	each	10	$241,000	$12,000	0.0	$0	$0
High Level - VMS costs included in high level freeway surveillance	--	10	--	--	--	--	--
Subtotal					0.0	$0	$0
Incident Management							
Medium Level - Freeway Service Patrols - Existing	mile	10	$0	$10,000	0.0	$0	$0
Medium Level - Freeway Service Patrols - New	mile	10	$8,000	$10,000	220.1	$1,760,800	$2,201,000
High Level - Costs in Freeway Management TOC	--	0	--	--	--	--	--
Subtotal					220.1	$1,760,800	$2,201,000
Traffic Management/Operations Centers							
RTMC - Freeway Management	each	10	$1,303,000	$1,353,000	0	$0	$0
RTMC - Freeway Management Building	each	20	$1,995,000	$100,000	0	$0	$0
TOC - Metro (Hardware, software, integration and staffing)	each	10	$1,236,000	$938,000	0	$0	$0
TOC - Metro (Building)	each	20	$1,893,000	$189,000	0	$0	$0
TOC - Surface Street Control**	each	10	$338,000	$329,000	3	$1,014,000	$987,000
Subtotal						$1,014,000	$987,000
Transit							
Transit Vehicle Equipment - Electronic Farebox	each	10	$3,000	$200	66	$198,000	$13,200
Transit Vehicle Equipment - Vehicle Tracking and Management	each	10	$5,500	$300	66	$363,000	$19,800
Transit Management Center Hardware, Software, Staffing and Integratior	each	10	$1,824,000	$193,000	1	$1,824,000	$193,000
Transit Management Center Building Expansion	each	20	$98,000	$10,000	0	$0	$0
Transit Stop ATIS	each	10	$21,000	$3,000	12	$252,000	$36,000
Subtotal						$2,637,000	$262,000

Years 10 to 20 Cost Estimate

May 1, 2001

Nashville Regional ITS Architecture
10 to 20-Year Plan Cost Estimate

(all costs are in current year dollars)	Unit	Functl. Life	Unit Costs Capital	Unit Costs O&M	10 to 20-Year Plan Quantity	10 to 20-Year Plan Capital	10 to 20-Year Plan Annual O & M
Traveler Information Service							
Broadcast Service	Cost will be incurred by private providers. Cost to provide access to information is in the RTMC cost.						
Interactive Service	Cost will be incurred by private sector providers.						
Subtotal						$0	$0
Regional Traffic Control							
Hardware, software, integration and labor	each	10	$520,000	$286,000	0.25	$130,000	$71,500
Railroad-Highway Grade Crossings							
Standard Grade Crossing (4-quad gates & trapped vehicle sensing)	each	10	$47,000	$1,000	13	$611,000	$13,000
Standard Grade Crossing (4-quad gates & trapped vehicle sensing)	each	20	$24,000	$2,000	13	$312,000	$26,000
Railroad Operations Coordination - TMC/TOC Upgrades	each	10	$156,000	$9,000	3	$468,000	$27,000
Subtotal						$1,391,000	$66,000
Roadside Weather Information System							
Roadside Weather Information System Station	each	10	$65,000	$2,000	5	$325,000	$10,000
Emergency Response/Routing							
Emergency Response Center	each	10	$372,000	$213,000		Costs incurred by EM agencies.	
Emergency Vehicle Communications Unit	each	10	$1,500	$30		Costs incurred by EM agencies.	
Traffic Signal Preemption (Metro - around hospitals)	each	10	$460,000	$23,000	0	$0	$0
Subtotal						$0	$0
Archived Data Function							
ITS Data Mart - RTMC	each	10	$694,000	$165,000	0	$0	$0
ITS Data Mart - TOC	each	10	$232,000	$77,000	4	$928,000	$308,000
ITS Virtual Data Warehouse	each	10	$139,000	$15,000	4	$556,000	$60,000
Subtotal						$1,484,000	$368,000
Traffic Forecast and Demand Management							
Traffic Forecast and Demand Management	each	10	$1,071,000	$704,000	1	$1,071,000	$704,000
Parking Facility Management							
Downtown Parking and Traffic Guidance System	each	10	$0	$0	0	$0	$0
Reversible Lane Management							
Reversible Lane Management - Metro	The cost to communicate to existing field equipment is included in the TOC item.						
					Subtotals	$159,494,800	$14,519,300

* Includes variable message signs and leased communications (With TDOT owned fiber the per mile cost increases to $1.1 million).

** Assumes that TOC will use existing public agency space.

Unit Cost Summary

May 1, 2001

Nashville Regional ITS Architecture Unit Costs

	Unit	Unit Costs		Functional Life		
		Capital	Annual O&M		Rounding -3	
Freeway Surveillance						
Low Level - Speed/Occupancy detection and spread spectrum comms	mile	$55,000	$18,000	10	$55,373	$17,997
Medium Level - Speed/Occupancy detection and wireline comms	mile	$299,000	$5,000	10	$298,891	$5,374
High Level - CCTV, Speed/Occupancy detection and Leased comms	mile	$665,000	$42,000	10	$665,210	$41,806
Surface Street Control and Surveillance						
Low Level - New Technology Signal Improvements	Lump Sum	---	5.0%	10	---	5.0%
Medium Level - Speed/Occupancy Detectors - Davidson Co.	mile	$25,000	$4,000	10	$25,038	$3,755
Medium Level - Speed/Occupancy Detectors - Other	mile	$31,000	$5,000	10	$30,660	$4,861
High Level - CCTV and Speed/Occupancy Detectors - Davidson Co.	mile	$86,000	$12,000	10	$86,380	$11,630
High Level - CCTV and Speed/Occupancy Detectors - Other	mile	$94,000	$14,000	10	$93,800	$13,660
Information Dissemination (Roadside)						
Medium Level - Isolated VMSs Contacted Through Dial-up Phone	each	$241,000	$12,000	10	$241,130	$12,464
High Level - VMS costs included in high level freeway surveillance	--	--	--	10	--	--
Incident Management						
Medium Level - Freeway Service Patrols (HELP)	mile	$8,000	$10,000	10	$8,411	$10,195
High Level - Costs in Freeway Management TOC	--	--	--	10	--	--
Traffic Management/Operations Centers						
RTMC - Freeway Management	each	$1,303,000	$1,353,000	10	$1,303,120	$1,353,001
RTMC - Freeway Management Building	each	$1,995,000	$100,000	20	$1,995,000	$99,750
TOC - Metro (Hardware, software, integration and staffing)	each	$1,236,000	$938,000	10	$1,236,394	$937,825
TOC - Metro (Building)	each	$1,893,000	$189,000	20	$1,892,846	$189,285
TOC - Surface Street Control*	each	$338,000	$329,000	10	$338,130	$328,712
Freeway Control						
Ramp Meter	each	$52,000	$3,000	10	$52,000	$3,250
Lane Control Signal	each	$9,000	$1,000	10	$9,100	$910
TMC Equipment and Labor	each	$622,000	$486,000	10	$622,050	$486,103
Transit						
Transit Vehicle Equipment - Electronic Farebox	each	$3,000	$200	10	$3,025	$151
Transit Vehicle Equipment - Vehicle Tracking and Management	each	$5,500	$300	10	$5,460	$273
Transit Management Center Hardware, Software, Staffing and Integration	each	$1,824,000	$193,000	10	$1,823,900	$192,985
Transit Management Center Building Expansion	each	$98,000	$10,000	20	$97,500	$9,750
Transit Stop ATIS	each	$21,000	$3,000	10	$20,800	$2,535

Unit Cost Summary

May 1, 2001

Nashville Regional ITS Architecture Unit Costs

	Unit	Unit Costs Capital	Unit Costs Annual O&M	Functional Life	Rounding -3	
Traveler Information Service						
Broadcast Service - Software, Hardware, Staffing and Integration.	each	$754,000	$538,000	10	$754,000	$538,233
Broadcast Service - Building	each	$293,000	$29,000	20	$292,500	$29,250
Interactive Service Upgrade - Software, hardware, staffing & integration.	each	$515,000	$187,000	10	$514,800	$187,421
Interactive Service Upgrade - Building	each	$146,000	$15,000	20	$146,250	$14,625
Regional Traffic Control						
Hardware, software, integration and labor	each	$520,000	$286,000	10	$520,000	$286,000
Railroad-Highway Grade Crossings						
Standard Grade Crossing (4-quad gates & trapped vehicle sensing)	each	$47,000	$1,000	10	$47,450	$1,170
Standard Grade Crossing (4-quad gates & trapped vehicle sensing)	each	$24,000	$2,000	20	$24,375	$2,373
Railroad Operations Coordination - TMC/TOC Upgrades	each	$156,000	$9,000	10	$156,000	$9,100
Roadside Weather Information System						
Roadside Weather Information System Station	each	$65,000	$2,000	10	$65,000	$2,470
Emergency Response/Routing						
Emergency Response Center	each	$372,000	$213,000	10	$372,450	$212,940
Emergency Vehicle Communications Unit	each	$1,500	$30	10	$1,495	$26
Archived Data Function						
ITS Data Mart - RTMC	each	$694,000	$165,000	10	$694,200	$164,710
ITS Data Mart - TOC	each	$232,000	$77,000	10	$231,725	$76,586
ITS Virtual Data Warehouse	each	$139,000	$15,000	10	$139,035	$15,483
Traffic Forecast and Demand Management						
Traffic Forecast and Demand Management	each	$1,071,000	$704,000	10	$1,070,550	$703,528

Note:

Unit costs were developed from the I-65 North ITS Functional Plans, the ITS Cost Data Repository, discussions with equipment vendors and discussions with Bell South.

* Assumes that TOC will use existing public agency space.

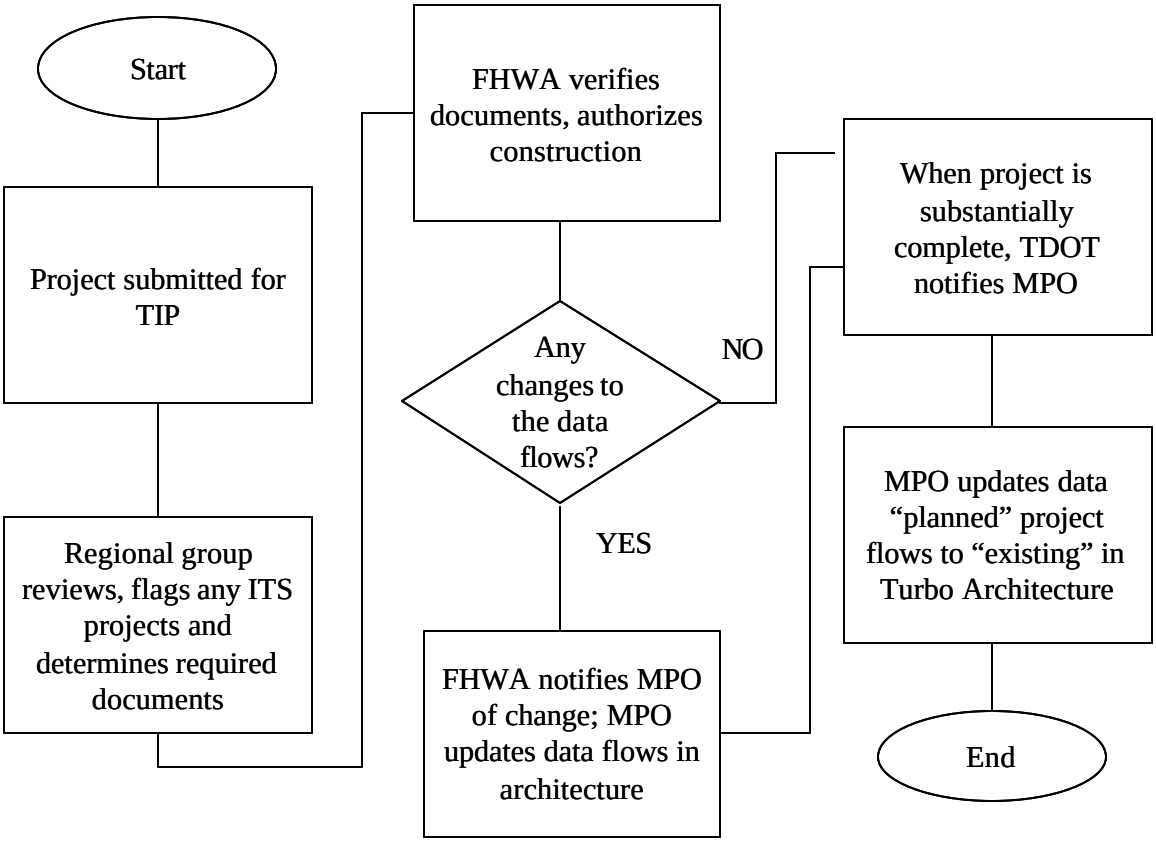
APPENDIX G

Additional ITS Project Descriptions & Regional ITS Architecture Revisions

APPENDIX H

ITS Project Implementation Process Flow Chart & Forms

Figure H-1. Flowchart for Revising the Regional Architecture.



Tennessee ITS Project
Regional ITS Architecture Revision Form

Completed by State/Local Agency
DRAFT Revised 04/23/01

Project Name:

Project Description:

Date of Revision:

New ITS Market Packages:

1. _____
2. _____
3. _____
4. _____

New Subsystems:

1. _____
2. _____
3. _____
4. _____

New Terminators:

1. _____
2. _____
3. _____
4. _____

Architecture Flow Status Change From Planned to Existing (Flow name/From/To)

1. _____
2. _____
3. _____
4. _____

New Architecture Flows (Flow name/From/To)

1. _____ Planned or Existing
2. _____ Planned or Existing
3. _____ Planned or Existing
4. _____ Planned or Existing

APPENDIX I

Interagency Agreements

As mentioned in Section 9 of the regional architecture document, this appendix contains interagency agreements. The format and nature of the agreements will depend on the significance of the interaction between agencies that is being addressed in the agreement.

Any agreements (existing or new) required for operations, including at a minimum those affecting ITS project interoperability, utilization of ITS related standards, and the operation of the projects identified in the regional ITS architecture are required in FHWA Rule 940.9(d)4 and FTA National ITS Architecture Policy Section 5.d.4.[10]

The following agreements are included:

Name	**Modified**	**Added**
TDOT Public Agency Access to Live Video	01-15-2003	04-22-2003
TDOT Private Agency Access to Live Video	01-29-2003	04-22-2003

[10] FHWA National ITS Architecture Team, USDOT, FHWA, and FTA. "Regional ITS Architecture Guidance." Washington, DC. 2001.

Tennessee Department of Transportation

TRAFFIC OPERATIONS PROGRAM POLICY

Effective Date:

Title: Access to Live Video

POLICY

> The Tennessee Department of Transportation (TDOT) will make live video of traffic conditions from Closed Circuit Television (CCTV) available to the public. CCTV images will be supplied from the Nashville Regional Transportation Management Center (RTMC) at TDOT Region 3 Complex. The video images provided would be those selected by the RTMC Operators from the images on the traffic surveillance monitors within the RTMC and that are consistent with the objectives of traffic management.

Live video images will generally be made available upon request to other government and public agencies to better coordinate traffic management strategies on incidents and crashes, and to private news media and other companies for their use in providing traffic information to the public or their customers.

A non-exclusive access agreement is required in order for governmental and private interests to receive direct access to live video. Costs for the access connection will be determined by TDOT and paid for by the USER.

BACKGROUND

In order to gather real-time traffic condition information, TDOT is building a RTMC at the Region 3 Complex on Centennial Boulevard. The RTMC is being developed into the central collection point for freeway condition information. The RTMC support systems are being developed in ways to gather and disseminate traffic information using the latest technologies.

CCTV has proven to be a significant management and delay-reduction tool for the identification and verification of incidents and crashes, thereby enabling a proper and timely response. The sharing of video information enhances the communication of current traffic conditions, thereby aiding travelers in planning their trip times, routes, and travel mode using the latest available information. TDOT will operate and maintain the CCTV system for the purpose of enhancing response to traffic incidents on the Nashville regional freeway system. TDOT wishes to share that traffic information with other transportation operating agencies, incident response agencies and the public.

Live CCTV Video Access Agreement Between

Tennessee Department of Transportation

And

Governmental Agency Users

Tennessee Department of Transportation And Governmental Agency Users

ACCESS AGREEMENT FOR LIVE VIDEO

This Access Agreement for Live Video (Agreement), is an agreement between the Tennessee Department of Transportation (TDOT) and _____hereafter referred to as the "USER."

The effective date of this Agreement is _____.

The "Access to Live Video" is that video provided by a Closed Circuit Television (CCTV) system developed for traffic management and provided by the Nashville Regional Transportation Management Center (RTMC) which is operated by TDOT. The CCTV images will show live traffic conditions, including crashes, stalled vehicles, road hazards, weather conditions, traffic congestion, and maintenance and repair work locations.

The purpose of providing the USER with Access to Live Video is to disseminate real-time traffic information to motorists and to help improve incident management response times. The following provisions of this Agreement are provided to ensure that the CCTV system is accessed and its information used for this purpose, and this purpose alone.

The USER hereby acknowledges that other matters not addressed in this Agreement may arise after the RTMC begins operating the system. Therefore, TDOT reserves the right to make changes in this Agreement, by adding provisions, deleting provisions, and/or changing existing provisions when in TDOT's opinion circumstances require such changes be effectuated.

GENERAL INFORMATION:

1. TDOT will operate and maintain the CCTV system as a traffic management tool and, consistent with this purpose, TDOT agrees to provide the USER with Access to Live Video. TDOT does not guarantee the continuity of this access, and TDOT does not warrant the quality of any video image or the accuracy of any image or information provided. Any reliance on such images or information is at the risk of the USER.

2. TDOT will not record video images except for staff training purposes, and no videotapes will be made available to the USER under this Agreement.

3. TDOT will maintain exclusive control of the information and images released from the CCTV system to the USER, including but not limited to determining whether and when to provide a CCTV system feed, from what location, and for what duration. No feed shall focus on vehicle license plates, drivers, or other personal identification of

individuals involved in any traffic-related incident. No image shall focus on any property or person outside the TDOT right-of-way. Access via feed will not be provided for events that are not, in the opinion of TDOT personnel, traffic-related. The decision whether to activate, and upon activation to terminate the access, is exclusively at the discretion of TDOT personnel.

4. Each USER will receive the same video feed from the CCTV system as any other USER participating in this Agreement. This Agreement in no way limits or restricts TDOT from providing video information to any other potential USER.

5. TDOT reserves the right to terminate this video access program at its discretion or change the areas, times, or levels of access within the RTMC at any time.

USER'S RESPONSIBILITIES:

6. USER, through this agreement, may be allowed to control the pan, tilt and zoom capabilities of selected CCTV cameras. TDOT will maintain an override capability of these functions.

7. USER agrees not to focus on vehicle license plates, drivers, or other personal identification of individuals involved in any traffic-related incident, nor focus on any property or person outside the TDOT right-of-way. USER further agrees to access the feed only for traffic-related or emergency response activities.

8. USER may install necessary equipment at the RTMC in order to obtain the video feed; the USER is exclusively responsible for any costs related to the purchase and installation of the equipment. TDOT personnel shall determine at what location within the RTMC the equipment is to be placed, and TDOT reserves the right to inspect all installation of equipment. Under no circumstances shall the placement and installation of this equipment interfere with RTMC equipment or activities of RTMC personnel. The responsibility for the service, maintenance, and upkeep of the installed equipment is exclusively that of the USER. The USER must give RTMC personnel reasonable advance notice of any maintenance/repair visits, and RTMC personnel reserve the right to schedule such visits at a time and in such a manner so as to not interrupt or otherwise obstruct RTMC operations. USER assumes any and all liability for the cost of repair and/or other damages to TDOT's CCTV system caused in any manner by the installation, servicing or maintenance of the USER equipment or by the equipment once installed. USER staff at the RTMC shall be under the general direction of the RTMC Manager for routine conduct, privileges, and protocols within the RTMC.

9. USER shall maintain the security and integrity of the CCTV system by limiting use of the system to trained and authorized individuals, and by insuring that the system is used for the specific purpose stated in this Agreement.

10. USER agrees to move or alter, at its own expense, any of its equipment, hardware, or software, as TDOT deems necessary to accommodate future alterations, improvements, or other changes to the RTMC equipment or facilities.

11. USER accepts all risks inherent with the live video feeds, including, but not limited to, interruptions in the video feed, downtime for maintenance, or unannounced adjustments to the camera displays.

12. USER agrees to provide TDOT with a technical contact person and with a list of all USER'S owned and supplied equipment connected to the RTMC, including the basic operational capabilities of such equipment. USER shall limit calls to the RTMC for monitoring, diagnosing problems or otherwise performing any minor service on USER owned and supplied equipment.

13. USER agrees that video feed will not be used for automated traffic enforcement purposes unless it is specifically allowed by legislation.

LIABILILTY AND INDEMNITY PROVISIONS:

14. The USER agrees to defend, indemnify, and hold TDOT harmless from and against any and all liability and expense, including defense costs and legal fees, caused by the negligent or wrongful act or omission of the USER, or its agents, officers, and employees, in the use, possession, or dissemination of information made available from the CCTV system to the extent that such liability may be imposed upon TDOT, including but not limited to, personal injury, bodily injury, death, property damage, and/or injury to privacy or reputation.

15. The liability obligations assumed by the USER pursuant to this Agreement shall survive the termination of the Agreement, as to any and all claims, inclusive without limitation liability for any damages to TDOT property or for personal injury, bodily injury, death, property damage, or injury to personal reputation or privacy occurring as a proximate result of information made available from the CCTV system.

TERMINATION:

16. TDOT or USER may terminate this Agreement any time for any reason by providing written notice of termination. Instances that may warrant such termination shall be determined at the sole discretion of TDOT. Examples of actions that could warrant termination could include but not be limited to such actions as using the zoom capabilities to focus on vehicle license plates, drivers, or other personal identification of individuals involved in any traffic-related incidents, or focusing on any property or person outside the TDOT right-of-way.

17. Upon termination of this Agreement by either party, the USER shall promptly remove its equipment from the RTMC as directed by TDOT.

State of Tennessee
Department of Transportation

Approved as to Form:

By:_____ _____
GERALD F. NICELY MARY MOODY
Commissioner General Counsel

Date:_____

USER AGENCY_____

By_____

(Print Name)_____

(Title)_____

Date:_____

Approved by Legal Counsel for USER AGENCY

By_____

(Print Name)_____

(Title)_____

Date:_____

Tennessee Department of Transportation

TRAFFIC OPERATIONS PROGRAM POLICY

Effective Date:

Title: Access to Live Video

POLICY

> The Tennessee Department of Transportation (TDOT) will make live video of traffic conditions from Closed Circuit Television (CCTV) available to the public. CCTV images will be supplied from Nashville Regional Transportation Management Center (RTMC) at TDOT Region 3 Complex. The video images provided would be those selected by the RTMC Operators from the images on the traffic surveillance monitors within the RTMC and that are consistent with the objectives of traffic management.

Live video images will generally be made available upon request to other government and public agencies to better coordinate traffic management strategies on incidents and crashes, and to private news media and other companies for their use in providing traffic information to the public or their customers.

A non-exclusive access agreement is required in order for governmental and private interests to receive direct access to live video. Costs for the access connection will be determined by TDOT and paid for by the USER.

BACKGROUND

In order to gather real-time traffic condition information, TDOT is building a RTMC at the Region 3 Complex on Centennial Boulevard. The RTMC is being developed into the central collection point for freeway condition information. The RTMC support systems are being developed in ways to gather and disseminate traffic information using the latest technologies.

CCTV has proven to be a significant management and delay-reduction tool for the identification and verification of incidents and crashes, thereby enabling a proper and timely response. The sharing of video information enhances the communication of current traffic conditions, thereby aiding travelers in planning their trip times, routes, and travel mode using the latest available information. TDOT will operate and maintain the CCTV system for the purpose of enhancing traffic incident response on the Nashville regional freeway system. TDOT wishes to share that traffic information with other transportation operating agencies, incident response agencies and the public.

Live CCTV Video Access Agreement Between

Tennessee Department of Transportation

And

Private Entity Users

Tennessee Department of Transportation And Private Entity Users

ACCESS AGREEMENT FOR LIVE VIDEO

This Access Agreement for Live Video (Agreement), is an agreement between the Tennessee Department of Transportation (TDOT) and _____hereafter referred to as the "USER."

The effective date of this Agreement is _____.

The "Access to Live Video" is that video provided by a Closed Circuit Television (CCTV) system developed for traffic management and provided by the Nashville Regional Transportation Management Center (RTMC) which is operated by TDOT. The CCTV images will show live traffic conditions including crashes, stalled vehicles, road hazards, weather conditions, traffic congestion, and maintenance and repair work locations.

The purpose of providing the USER with Access to Live Video is to disseminate real-time traffic information to motorists. The following provisions of this Agreement are intended to ensure that the CCTV system is accessed and its information used for this purpose, and this purpose alone.

The USER hereby acknowledges that other matters not addressed in this Agreement may arise after the RTMC begins operating the CCTV system. Therefore, TDOT reserves the right to make changes in this Agreement, by adding provisions, deleting provisions, and/or changing existing provisions when in TDOT's opinion circumstances require such changes.

GENERAL INFORMATION:

1. TDOT will operate and maintain the CCTV system as a traffic management tool and, consistent with this purpose, TDOT agrees to provide the USER with Access to Live Video. TDOT does not guarantee the continuity of this access, and TDOT does not warrant the quality of any video image or the accuracy of any image or information provided. Any reliance on such images or information is at the risk of the USER.

2. TDOT will not record video images except for staff training purposes, and no videotapes will be made available to the USER under this Agreement.

3. TDOT will maintain exclusive control of the information and images released from the CCTV system to the USER, including but not limited to determining whether and when to provide a CCTV system feed, from what location, and for what duration. No feed will deploy the cameras' zoom capabilities, and no image will focus on vehicle license plates, drivers, or other personal identification of individuals involved in any traffic-related incident. No image will focus on any property or person outside the TDOT right-of-way. Access via feed will not be provided for events that are not, in the opinion

of TDOT personnel, traffic-related. The decision whether to activate, and upon activation to terminate the access, is exclusively at the discretion of TDOT personnel.

4. RTMC personnel will not accept requests that specific CCTV cameras be operated or that cameras be repositioned.

5. Each USER will receive the same video feed from the CCTV system as any other USER participating in this Agreement. This Agreement in no way limits or restricts TDOT from providing video information to any other potential USER.

6. TDOT reserves the right to terminate this video access program or to change the areas, times, or levels of access within the RTMC at any time.

USER'S RESPONSIBILITIES:

7. USER may install necessary equipment at the RTMC in order to obtain the video feed; the USER is exclusively responsible for any costs related to the purchase and installation of the equipment. TDOT personnel shall determine at what location within the RTMC the equipment is to be placed, and TDOT reserves the right to inspect all installation of equipment. Under no circumstances shall the placement and installation of USER's equipment interfere with RTMC equipment or activities of RTMC personnel. The responsibility for the service, maintenance, and upkeep of the installed equipment is exclusively that of the USER. USER must give RTMC personnel reasonable advance notice of any maintenance/repair visits, and RTMC personnel reserves the right to schedule such visits at a time and in such a manner so as to not interrupt or otherwise obstruct RTMC operations. USER assumes any and all liability for the cost of any repair and/or other damages to TDOT's CCTV system caused in any manner by the installation, servicing or maintenance of the USER's equipment or by the equipment once installed. USER staff at the RTMC shall be under the general direction of the RTMC Manager for routine conduct, privileges, and protocols within the RTMC.

8. USER shall maintain the security and integrity of the CCTV system by limiting use of the system to trained and authorized individuals, and by insuring the system is used for the specific purpose stated in this Agreement. No feed shall be purposely broadcast live or rebroadcast that is zoomed in on an accident where individuals or license numbers are recognizable.

9. USER agrees to move or alter, at its own expense, any of its equipment, hardware, or software, as TDOT deems necessary to accommodate future alterations, improvements, or other changes to the RTMC equipment or facilities.

10. USER accepts all risks inherent with the live video feeds, including, but not limited to, interruptions in the video feed, downtime for maintenance, or unannounced adjustments to the camera displays. TDOT is providing the video feeds as a convenience to the private media company and agrees to provide a good faith effort to maintain the video feed from TDOT equipment. The USER agrees to hold TDOT harmless, including

TDOT employees and TDOT-designated agents, from any damages caused by loss of a video signal due to equipment failure or any unintentional act on their part.

11. USER agrees to provide TDOT with a technical contact person and with a list of all USER's owned and supplied equipment connected to the RTMC, including the basic operational capabilities of such equipment. USER shall limit calls to the RTMC for monitoring, diagnosing problems or otherwise performing any minor service on USER owned and supplied equipment.

12. The User agrees to acknowledge the video images are provided by the Tennessee Department of Transportation.

LIABILITY AND INDEMNITY PROVISIONS:

13. The USER agrees to defend, indemnify, and hold TDOT harmless from and against any and all liability and expense, including defense costs and legal fees, caused by any negligent or wrongful act or omission of the USER, or its agents, officers, and employees, in the use, possession, or dissemination of information made available from the CCTV system to the extent that such expenses or liability may be incurred by TDOT, including but not limited to, personal injury, bodily injury, death, property damage, and/or injury to privacy or reputation.

14. The liability obligations assumed by the USER pursuant to this Agreement shall survive the termination of the Agreement, as to any and all claims including without limitation liability for any damages to TDOT property or for injury, death, property damage, or injury to personal reputation or privacy occurring as a proximate result of information made available from the CCTV system.

TERMINATION:

15. TDOT or USER may terminate this Agreement at any time for any reason by providing notice of termination.

16. Upon termination of this Agreement by either party, the USER shall promptly remove its equipment from the RTMC as directed by TDOT.

State of Tennessee
Department of Transportation

Approved as to Form:

By:_____ _____
GERALD F. NICELY
Commissioner General Counsel

Date:_____

USER AGENCY_____

By_____

(Print Name)_____

(Title)_____

Date:_____

Approved by Legal Counsel for USER AGENCY

By_____

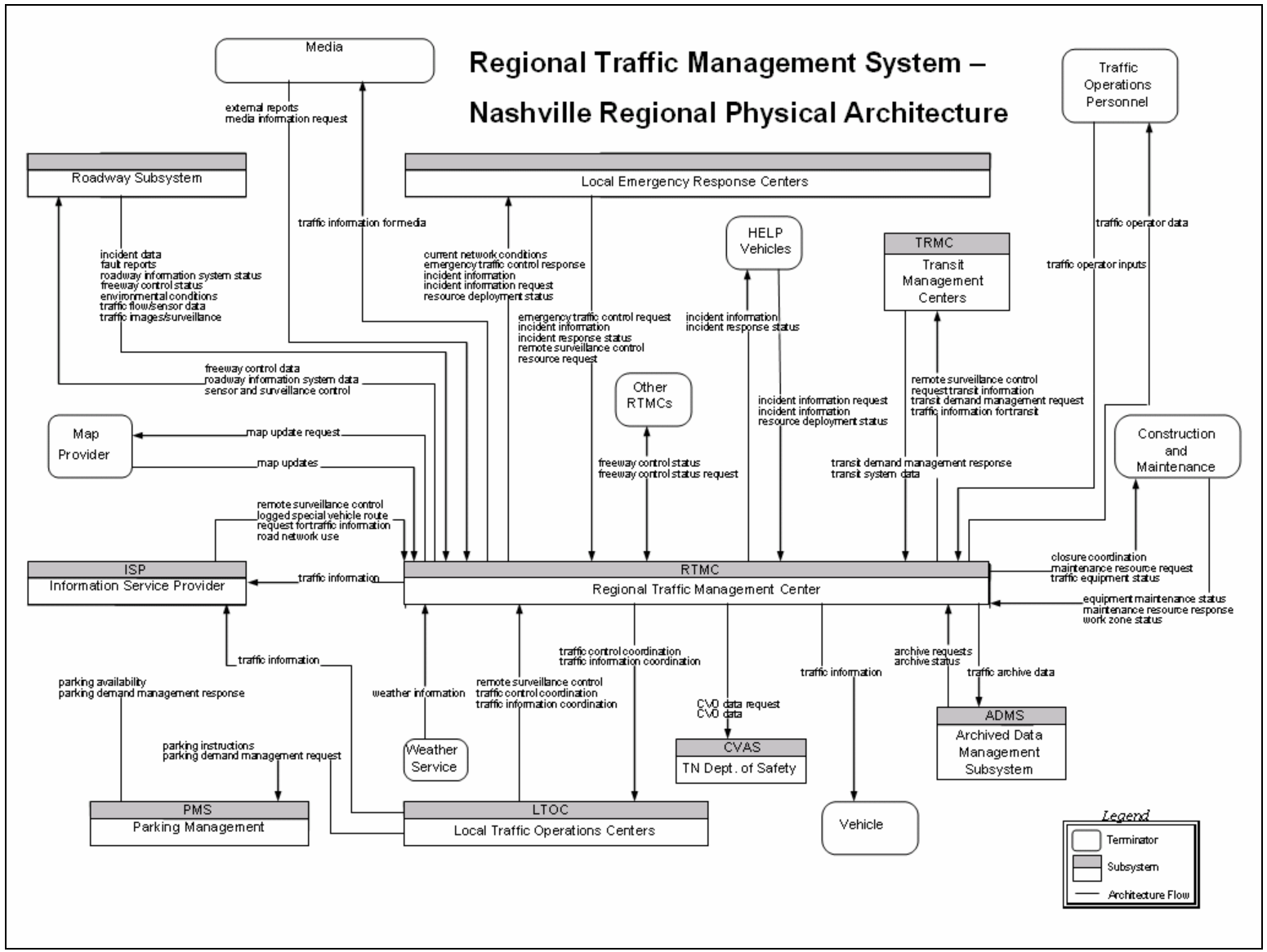
(Print Name)_____

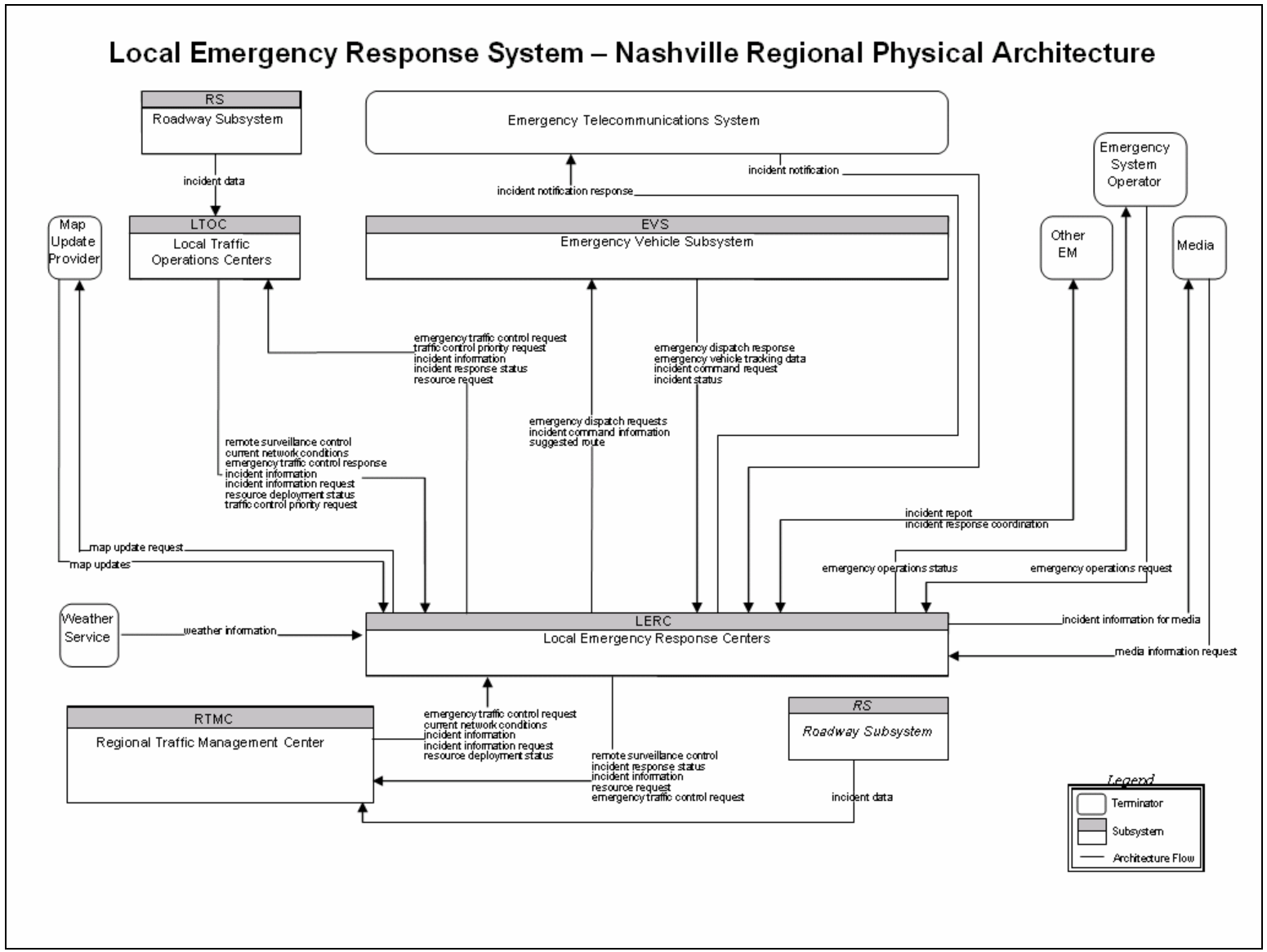
(Title)_____

Date:_____

APPENDIX J

Architecture Diagrams, Information Flows and Standards


Regional Traffic Management System –
Nashville Regional Physical Architecture
Media
external reports
media information request
traffic information formedia
Traffic Operations Personnel
traffic operator data
traffic operator inputs
Roadway Subsystem
incident data
fault reports
roadway information system status
freeway control status
environmental conditions
traffic flow/sensor data
traffic images/surveillance
Local Emergency Response Centers
current network conditions
emergency traffic control response
incident information
incident information request
resource deployment status
HELP Vehicles
incident information
incident response status
TRMC
Transit Management Centers
emergency traffic control request
incident information
incident response status
remote surveillance control
resource request
freeway control data
roadway information system data
sensor and surveillance control
Other RTMCs
incident information request
incident information
resource deployment status
remote surveillance control
request transit information
transit demand management request
traffic information fortransit
Map Provider
map update request
map updates
freeway control status
freeway control status request
transit demand management response
transit system data
Construction and Maintenance
remote surveillance control
logged special vehicle route
request fortraffic information
road network use
ISP
Information Service Provider
traffic information
RTMC
Regional Traffic Management Center
closure coordination
maintenance resource request
traffic equipment status
equipment maintenance status
maintenance resource response
work zone status
traffic information
parking availability
parking demand management response
weather information
remote surveillance control
traffic control coordination
traffic information coordination
traffic control coordination
traffic information coordination
CVO data request
CVO data
traffic information
archive requests
archive status
traffic archive data
ADMS
Archived Data Management Subsystem
parking instructions
parking demand management request
Weather Service
CVAS
TN Dept. of Safety
PMS
Parking Management
LTOC
Local Traffic Operations Centers
Vehicle
Legend
Terminator
Subsystem
Architecture Flow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Roadway Subsystem
Emergency Telecommunications System
Emergency System Operator
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Map Update Provider
LTOC
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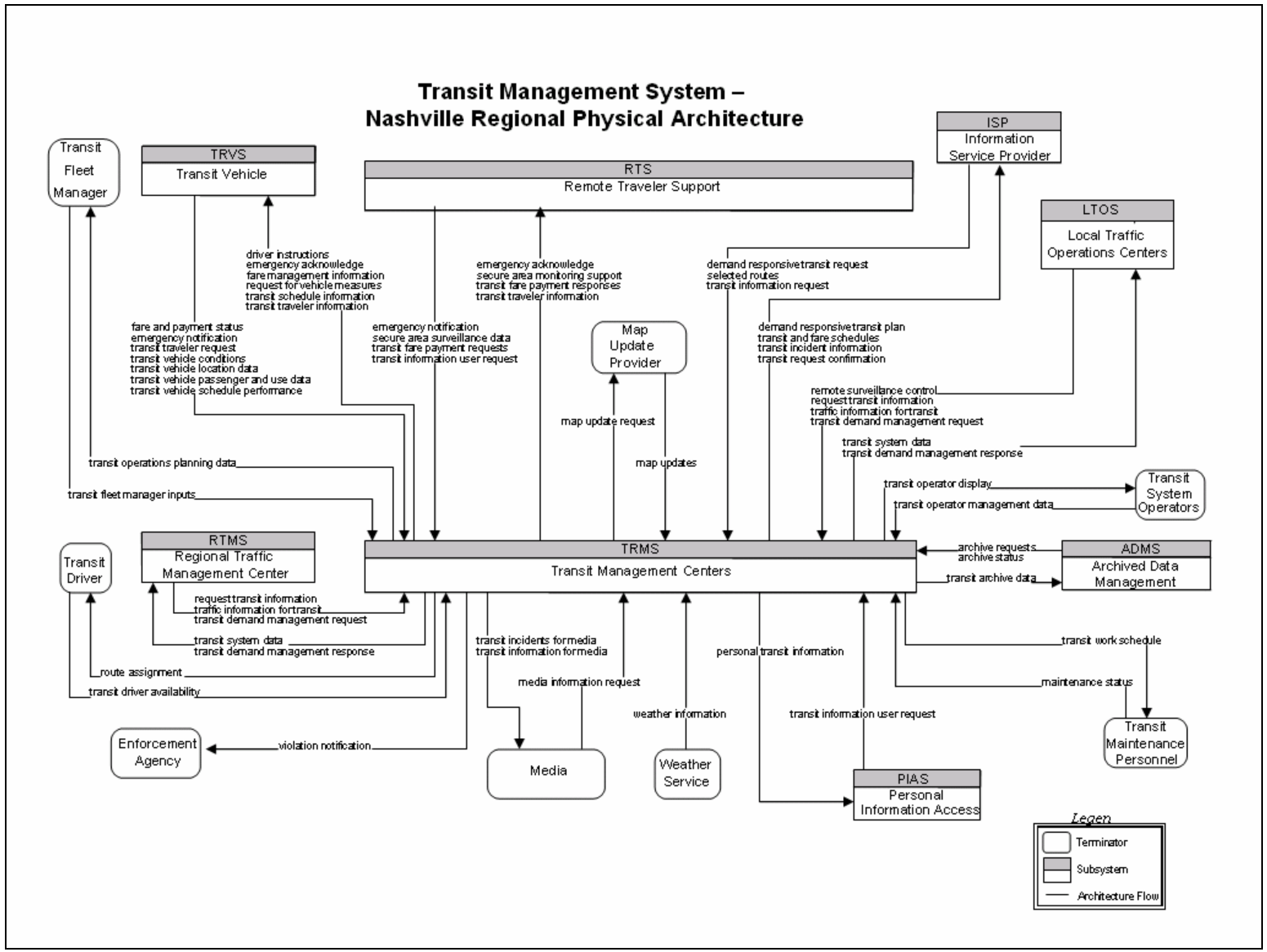
Terminator
Subsystem
Architecture Flow


Transit Management System –
Nashville Regional Physical Architecture
Transit Fleet Manager
TRVS
Transit Vehicle
RTS
Remote Traveler Support
ISP
Information Service Provider
LTOS
Local Traffic Operations Centers
Map Update Provider
Transit System Operators
RTMS
Regional Traffic Management Center
TRMS
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ADMS
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Transit Driver
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PIAS
Personal Information Access
Transit Maintenance Personnel
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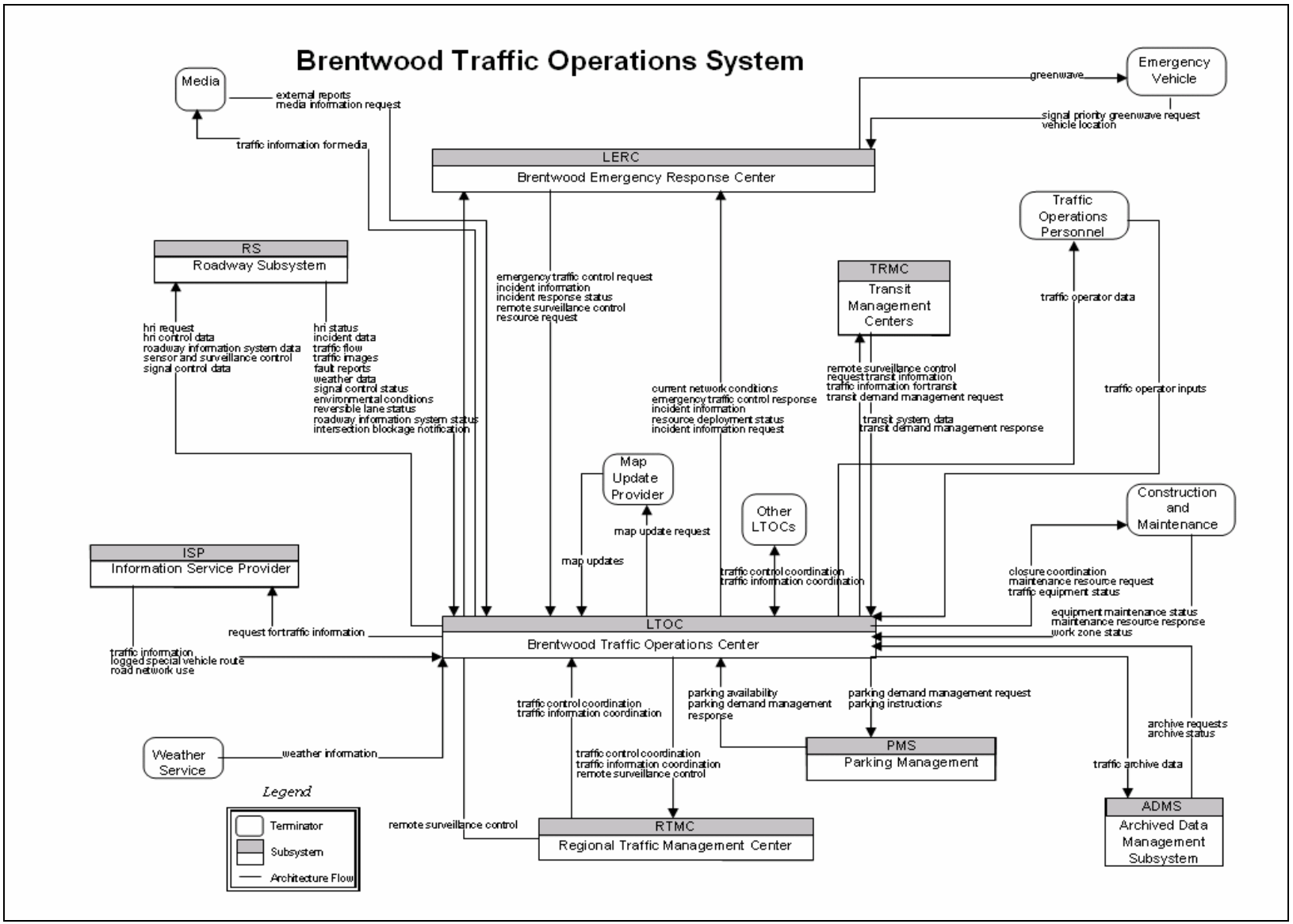
Architecture Flow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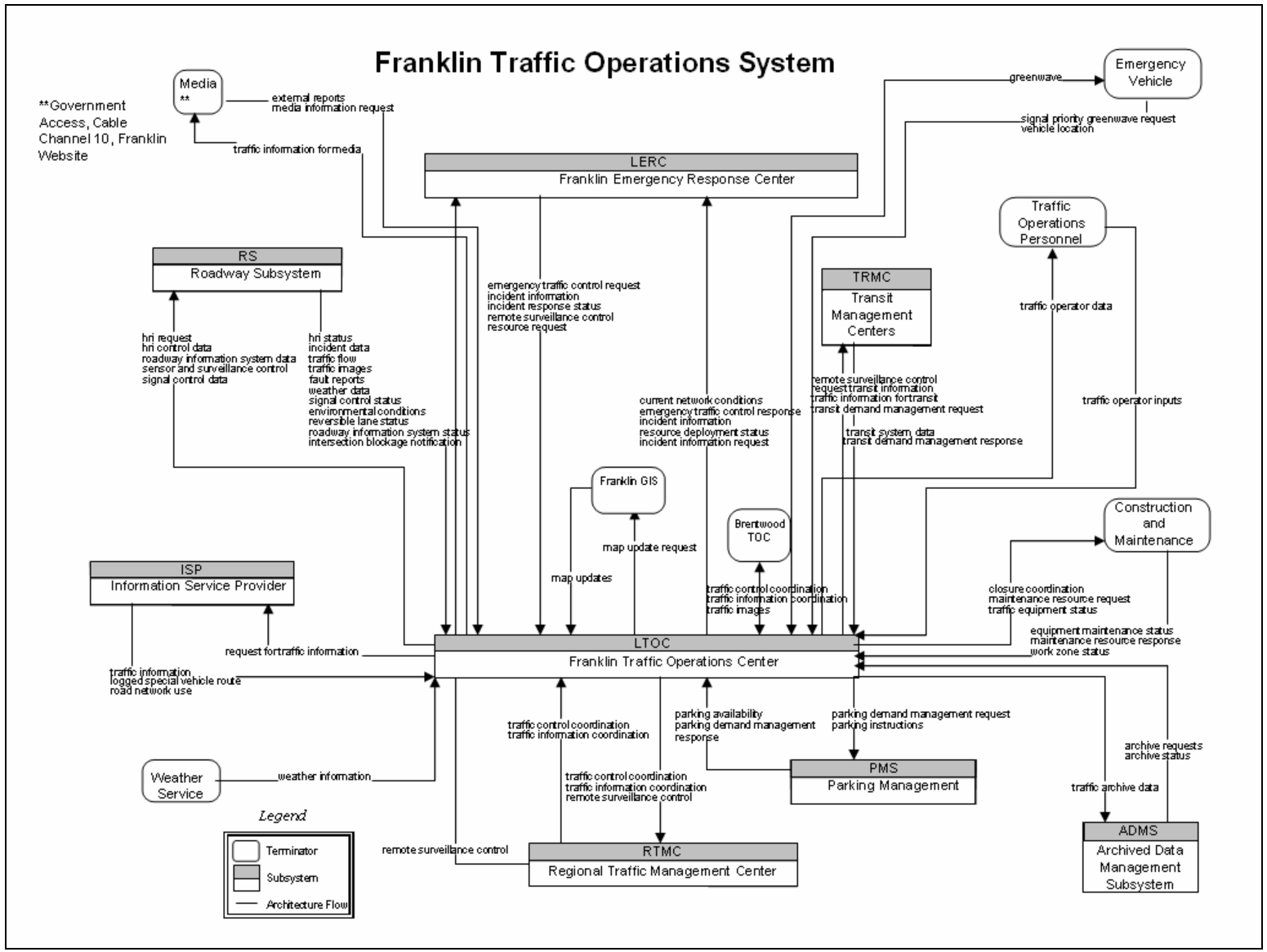
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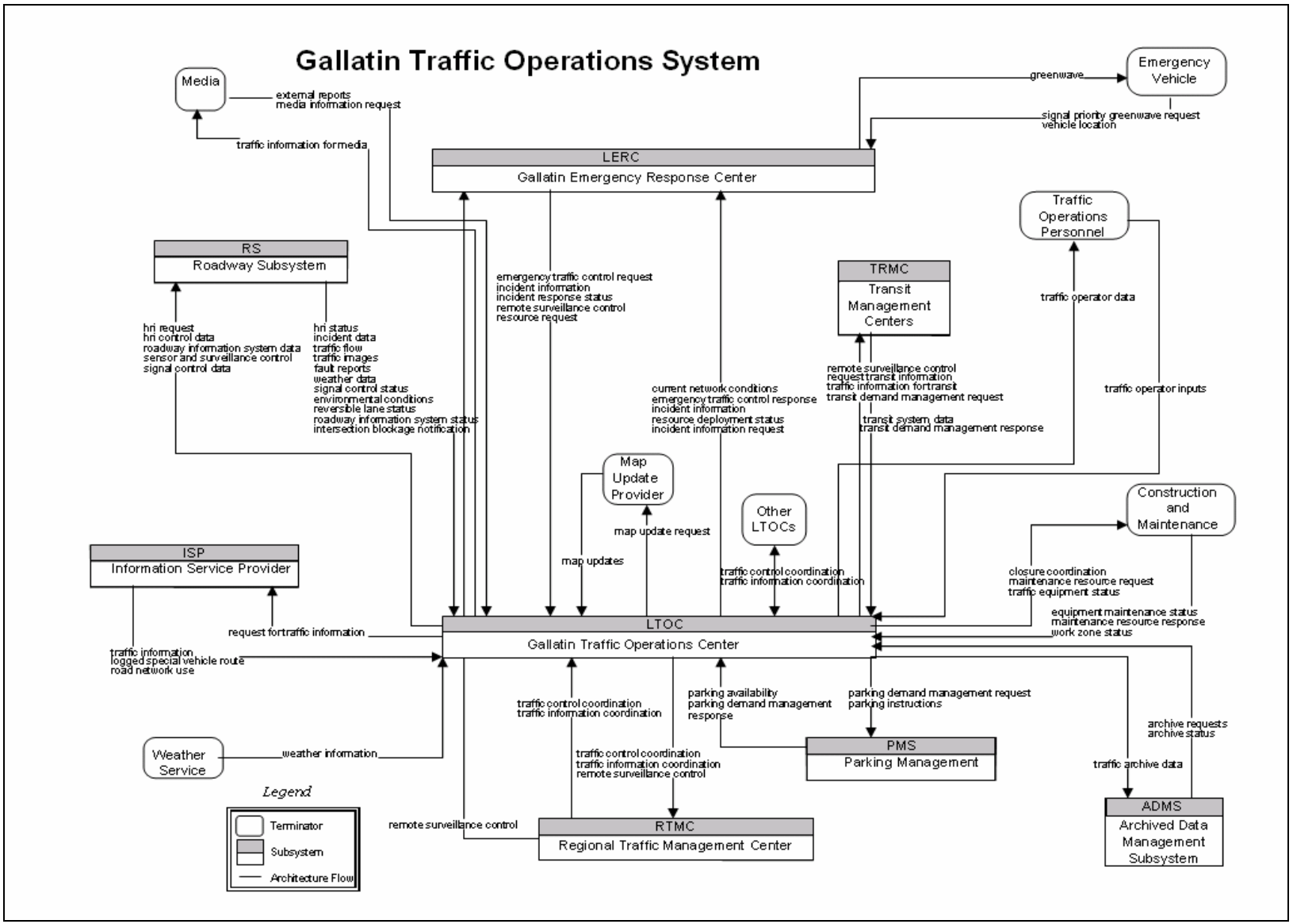
Gallatin Traffic Operations System
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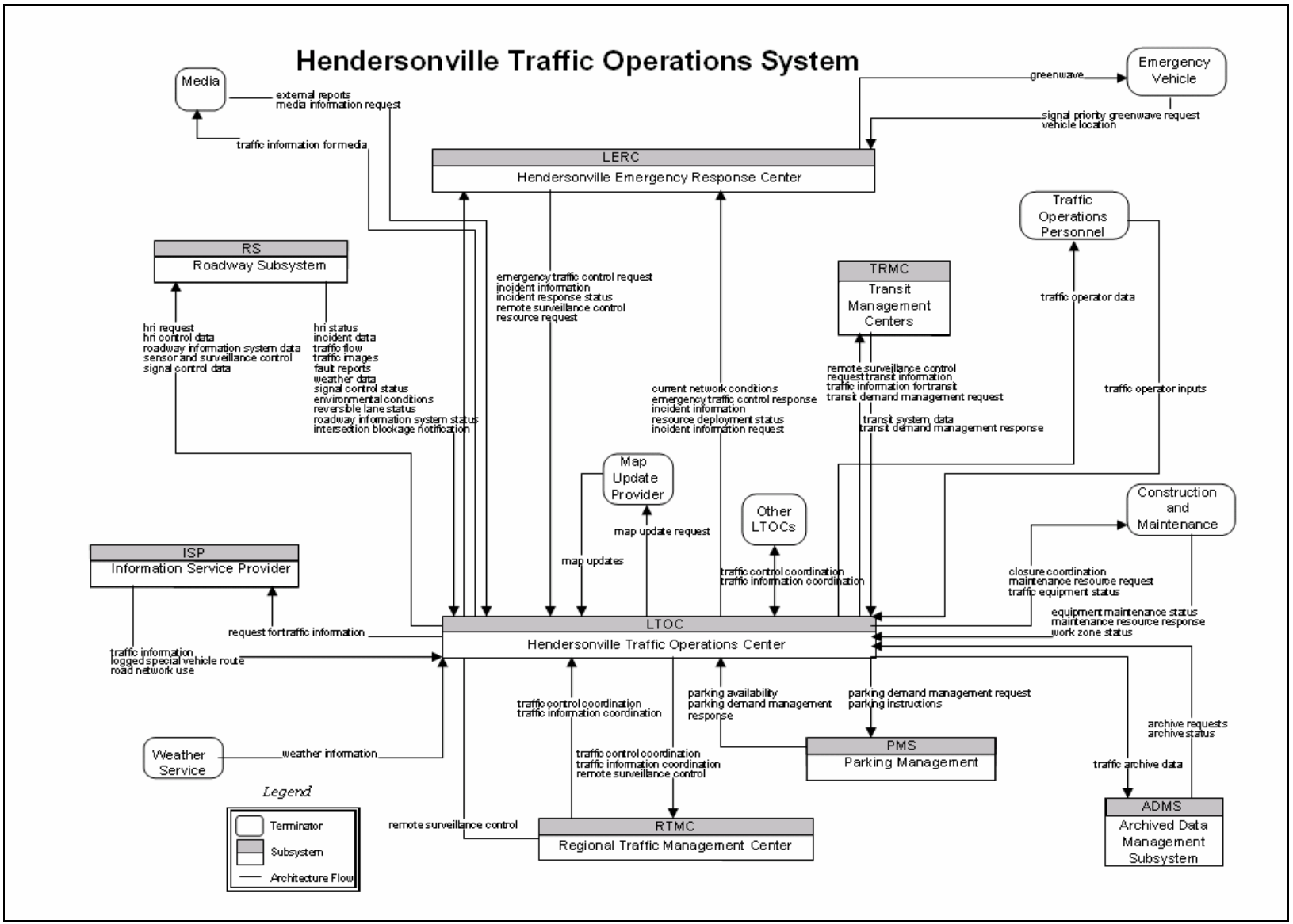
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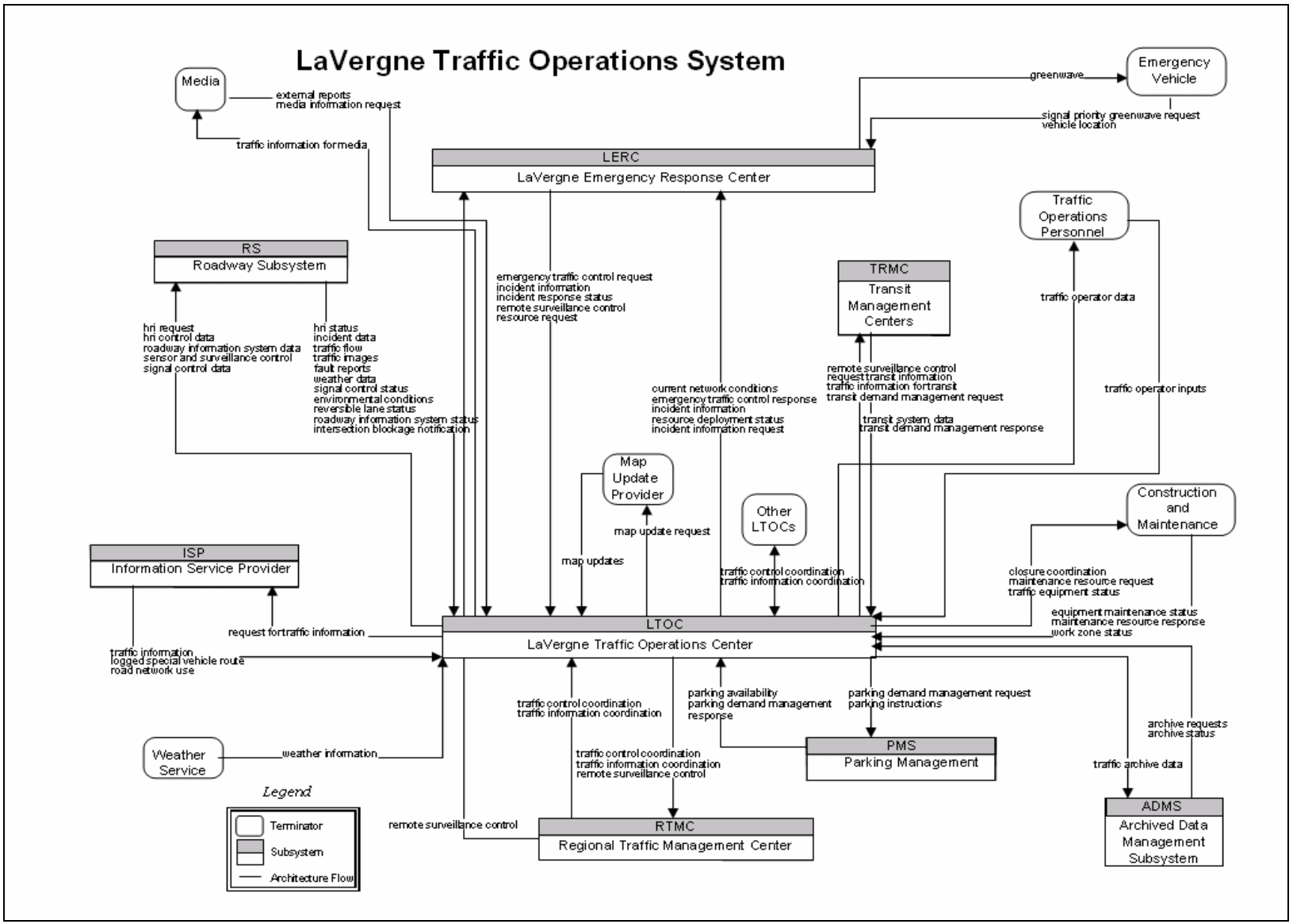
ADMS
Archived Data Management Subsystem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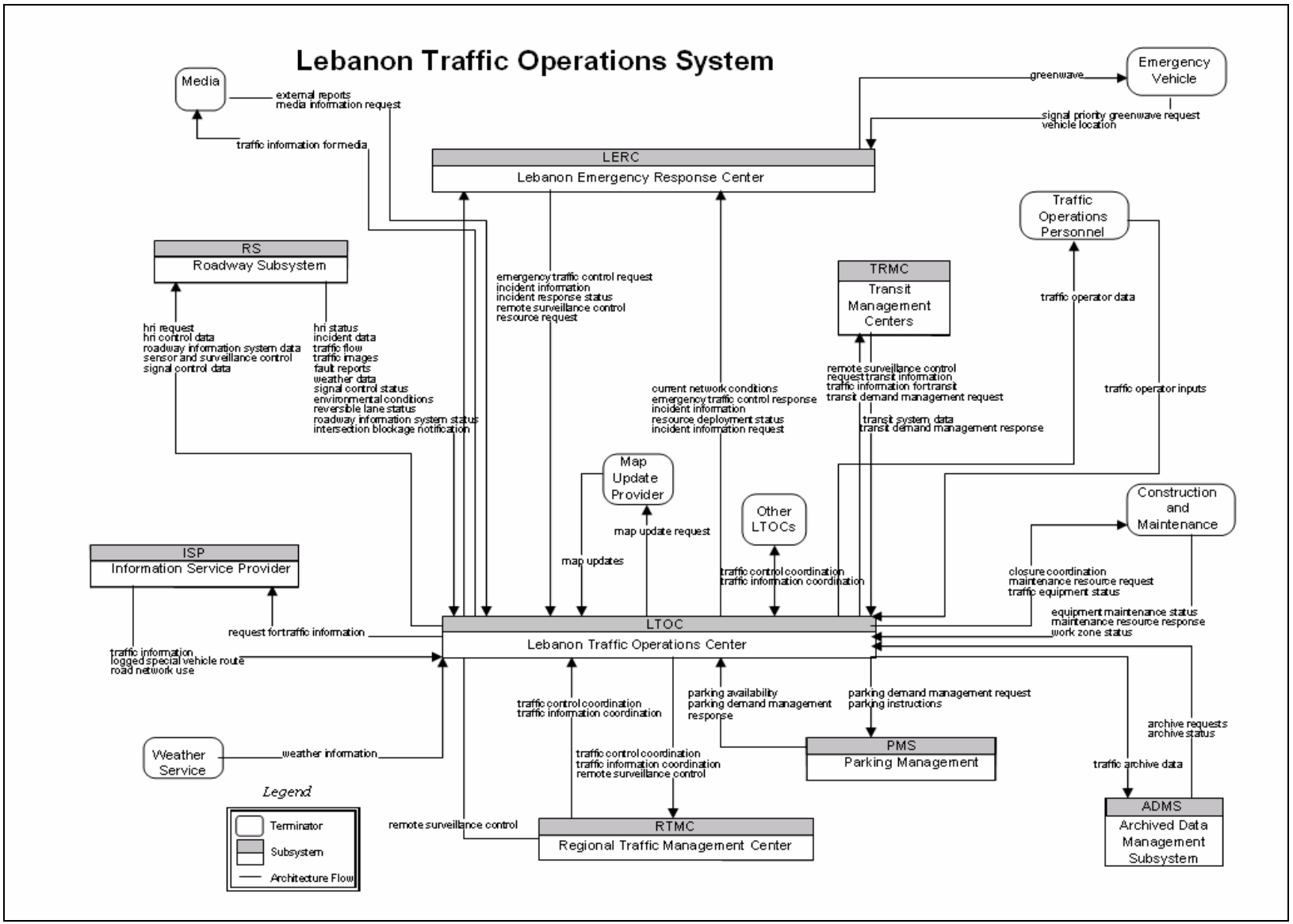
Lebanon Traffic Operations System
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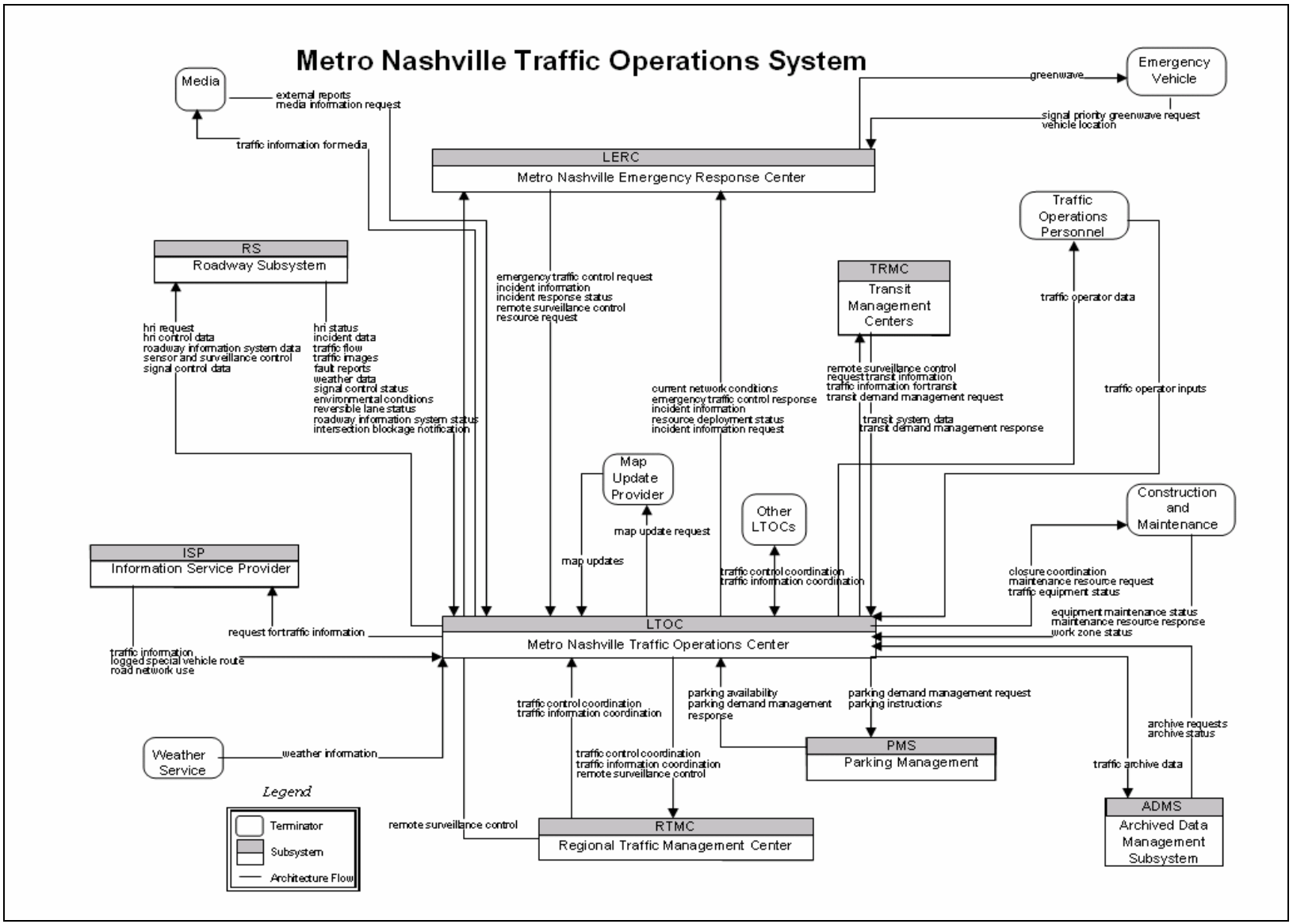
RTMC
Regional Traffic Management Center
ADMS
Archived Data Management Subsystem


Metro Nashville Traffic Operations System
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Roadway Subsystem
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Legend
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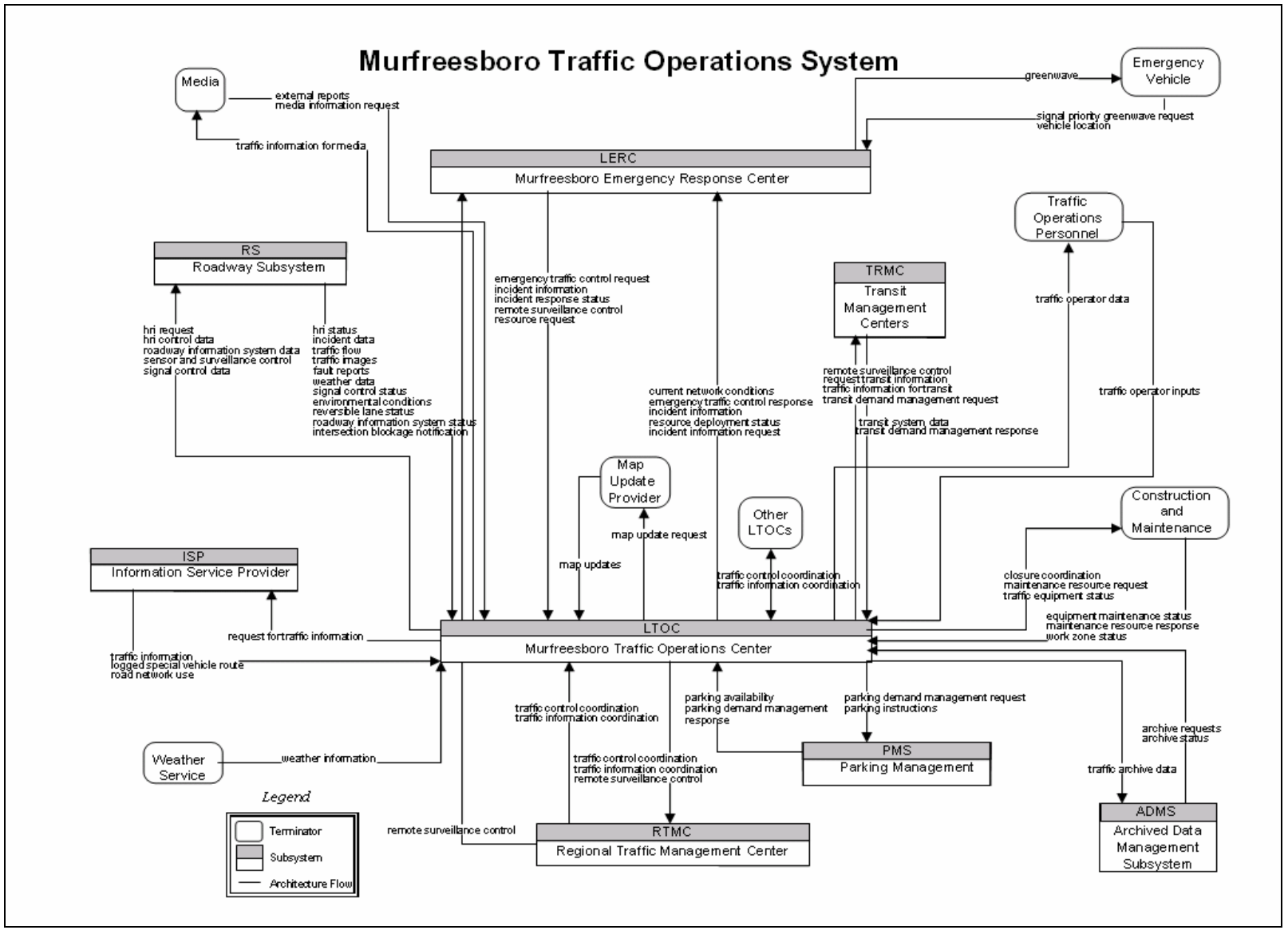
Subsystem
Architecture Flow
remote surveillance control
RTMC
Regional Traffic Management Center
ADMS
Archived Data Management Subsystem


Murfreesboro Traffic Operations System
Media
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Emergency Vehicle
greenwave
signal priority greenwave request
vehicle location
LERC
Murfreesboro Emergency Response Center
Traffic Operations Personnel
RS
Roadway Subsystem
TRMC
Transit Management Centers
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environmental conditions
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Information Service Provider
traffic control coordination
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LTOC
Murfreesboro Traffic Operations Center
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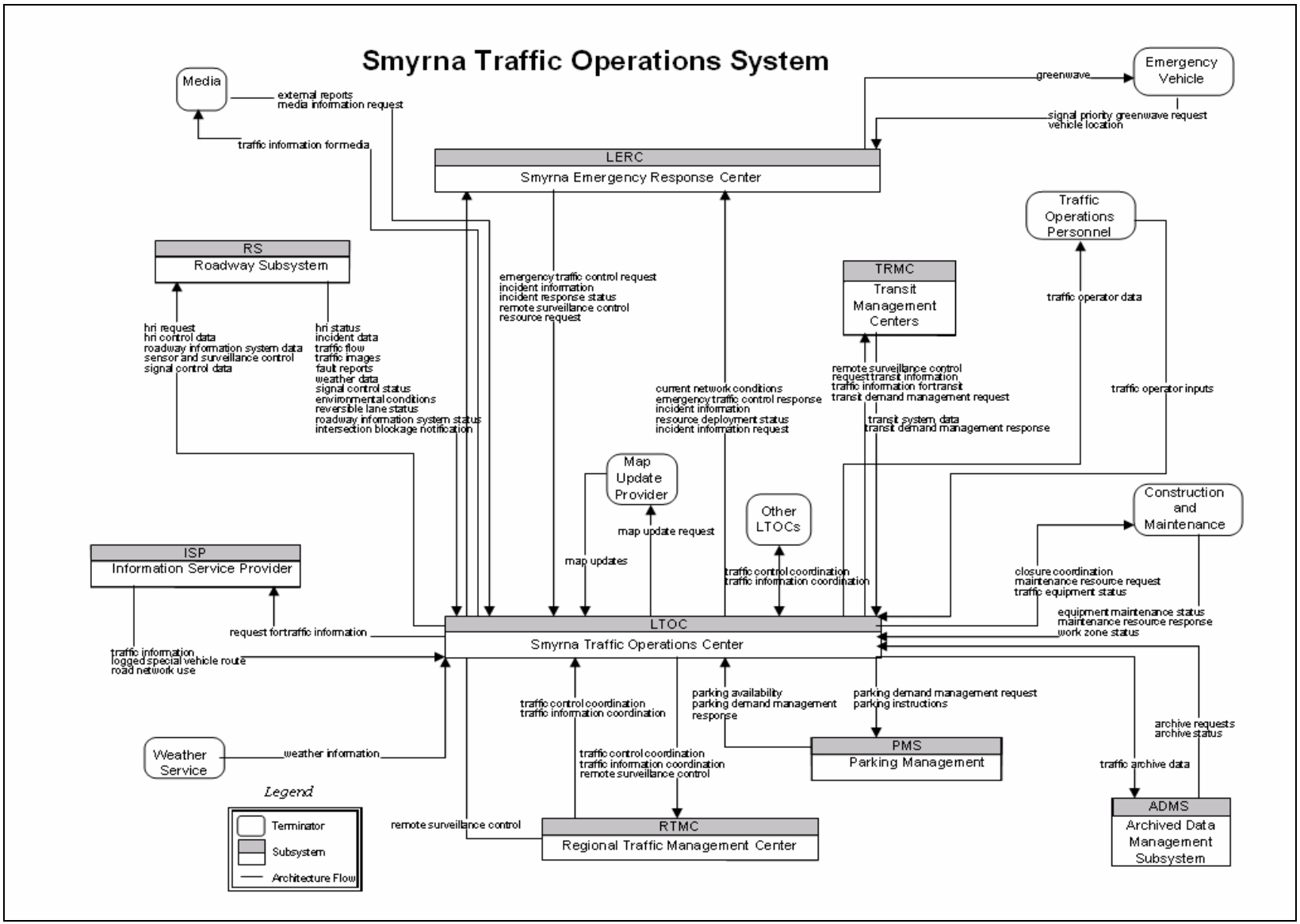
Archived Data Management Subsystem


Smyrna Traffic Operations System
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Emergency Vehicle
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Regional Traffic Management Center
ADMS
Archived Data Management Subsystem

The following table lists each of the data flows included in the Nashville Regional physical architecture and describes the interfaces that will occur at the initiating and receiving ends of that data flow. The interface is described by a frequency of information interchange and the requirements for a standard protocol to conduct that interchange of data.

The protocol requirements are based on the message type and frequency. Any system command or control will occur in real time and a stable protocol will be required. US DOT is recommending any appropriate standards federally funded for ITS deployment such as the National Transportation Communications for ITS Protocol (NTCIP). Therefore, all five systems in the Nashville Region will be designed for NTCIP (or an equivalent federally adopted standard) compliance of individual elements, based on the maturity of specifications.

There are numerous additional messages that communicate information among the terminators within a subsystem in real time. NTCIP is recommended, although not required, for these communications. There are other messages that are sent with subsystems that will not occur in real time. NTCIP is optional for these non-real time messages. There are other messages to be sent via basic communications media such as telephone, pager, fax, Internet, radio broadcast or television broadcast. These communications do not need any transportation-related protocols.

In general, when a standard is required, this generally means that real-time control is involved, such as surveillance. Life safety may be at stake therefore the standard is categorized as being required.

A recommended standard indicates that data is passed between agencies and those receiving the data should have a common base for understanding its meaning. This is not a control standard, nor is it an issue of life safety.

Standards listed as optional relinquish the decision to those establishing the architecture flow. Communication may be easier with the local standard but it is not necessarily in real-time. Lastly, if no protocol category is listed, no standard currently available is applicable or needed.

There are three types of exchange frequency used in the interface descriptions.

System command/control – Information transfer is between a terminator and a subsystem.

Daily periodic in real time – Information transfer occurs regularly in actual time

Daily periodic not real time – Information transfer occurs regularly but not necessarily relayed immediately.

In all cases, the protocol suggested is currently in development and adoption phases of the ITS Standards process. Therefore it is possible that a local standard may need to be adopted in the early stages of the Nashville ITS development and a migration plan be implemented to use the National or International Standard when it is in place. In a migration plan, standards suggested in this section may change as they become standards adopted by the USDOT. The suggested standards will need to be updated to correspond with those regulations. The Intelligent Transportation Systems (ITS) program has placed emphasis on developing national standards for communications. Several standards organizations have been tasked to develop the communications standards necessary to provide system interoperability and seamless communications between systems and subsystems.

- *National Transportation Communications for ITS Protocol (NTCIP)*
  NTCIP development began with the traffic control industry recognizing the need to extend existing standards to include systems interoperability and communications issues. The NTCIP effort is focused on developing communications protocols necessary to "command and control" various ITS devices (DMS, CCTV, traffic signal controllers, etc.).

- *Advanced Traffic Management Systems Data Dictionary (TMDD)*
  TMDD provides unique definition and description of the data elements used in "sharing" data between systems.

- *Advanced Traveler Information System (ATIS)*
  ATIS protocol development focuses on developing standardized message sets used in disseminating traveler information.

- *Transit Communications Interface Profiles (TCIP)*
  TCIP focuses on developing standards for transit communications to various systems.

- *Commercial Vehicle Information Systems and Networks (CVISN)*
  CVISN refers to a collection of information systems and communications networks to support commercial vehicle operations (CVO). The FHWA CVISN program focuses on creating new ways for existing and newly designed systems to exchange information. A component of the CVO part of the National ITS Architecture, CVISN includes standards for communications technologies.

Nashville Regional RTMC Interface Descriptions				
Regional Traffic Management Center				
Initiating Subsystem/Terminator	**Receiving Subsystem/Terminator**	**Architecture Flow**	**Exchange Frequency**	**Protocol Categories**
Nashville RTMC	Commercial Vehicle Administration	CVO Data	Daily Periodic in Real Time	NTCIP Recommended
Nashville RTMC	Commercial Vehicle Administration	CVO Data Request	Daily Periodic in Real Time	NTCIP Recommended
Archived Data Management	Nashville RTMC	Archive Requests	Daily Periodic in Real Time	NTCIP Recommended
Archived Data Management	Nashville RTMC	Archive Status	Daily Periodic in Real Time	NTCIP Recommended
Nashville RTMC	Archived Data Management	Traffic Archive Data	Daily Periodic in Real Time	NTCIP Recommended
Construction & Maintenance	Nashville RTMC	Work Zone Status	Daily Periodic Not Real Time	NTCIP Optional
Construction & Maintenance	Nashville RTMC	Maintenance Resource Response	Daily Periodic in Real Time	NTCIP Recommended
Construction & Maintenance	Nashville RTMC	Equipment Maintenance Status	Daily Periodic in Real Time	NTCIP Recommended
Nashville RTMC	Construction & Maintenance	Closure Coordination	Daily Periodic in Real Time	NTCIP Recommended
Nashville RTMC	Construction & Maintenance	Maintenance Resource Request	Daily Periodic in Real Time	NTCIP Recommended

Nashville Regional RTMC Interface Descriptions				
Regional Traffic Management Center				
Initiating Subsystem/Terminator	**Receiving Subsystem/Terminator**	**Architecture Flow**	**Exchange Frequency**	**Protocol Categories**
Nashville RTMC	Construction & Maintenance	Traffic Equipment Status	Daily Periodic in Real Time	NTCIP Recommended
Traffic Operations Personnel	Nashville RTMC	Traffic Operator Inputs	Daily Periodic in Real Time	NTCIP Recommended
Nashville RTMC	Traffic Operations Personnel	Traffic Operator Data	Daily Periodic in Real Time	NTCIP Recommended
Transit Management Center	Nashville RTMC	Transit Demand Management Response	Daily Periodic in Real Time	TCIP Required
Transit Management Center	Nashville RTMC	Transit System Data	Daily Periodic in Real Time	TCIP Required
Nashville RTMC	Transit Management Center	Request Transit Information	Daily Periodic in Real Time	TCIP Required
Nashville RTMC	Transit Management Center	Traffic Information for Transit	Daily Periodic in Real Time	TCIP Required
Nashville RTMC	Transit Management Center	Transit Demand Management Request	Daily Periodic in Real Time	TCIP Required
Nashville RTMC	Transit Management Center	Remote Surveillance Control	System Command/Control	NTCIP Required
Emergency Management	Nashville RTMC	Emergency Traffic Control Request	Daily Periodic in Real Time	TMDD Recommended

Nashville Regional RTMC Interface Descriptions				
Regional Traffic Management Center				
Initiating Subsystem/Terminator	**Receiving Subsystem/Terminator**	**Architecture Flow**	**Exchange Frequency**	**Protocol Categories**
Emergency Management	Nashville RTMC	Incident Information	Daily Periodic in Real Time	TMDD Recommended
Emergency Management	Nashville RTMC	Incident Response Status	Daily Periodic in Real Time	TMDD Recommended
Emergency Management	Nashville RTMC	Remote Surveillance Control	Daily Periodic in Real Time	TMDD Recommended
Emergency Management	Nashville RTMC	Resource Request	Daily Periodic in Real Time	TMDD Recommended
Nashville RTMC	Emergency Management	Current Network Conditions	Daily Periodic in Real Time	TMDD Recommended
Nashville RTMC	Emergency Management	Emergency Traffic Control Response	Daily Periodic in Real Time	TMDD Recommended
Nashville RTMC	Emergency Management	Incident Information	Daily Periodic in Real Time	TMDD Recommended
Nashville RTMC	Emergency Management	Incident Information Request	Daily Periodic in Real Time	TMDD Recommended
Nashville RTMC	Emergency Management	Resource Deployment Status	Daily Periodic in Real Time	TMDD Recommended

Nashville Regional RTMC Interface Descriptions				
Regional Traffic Management Center				
Initiating Subsystem/Terminator	**Receiving Subsystem/Terminator**	**Architecture Flow**	**Exchange Frequency**	**Protocol Categories**
Nashville RTMC	Map Update Provider	Map Update Request	Daily Periodic in Real Time	Local Standard Recommended
Map Update Provider	Nashville RTMC	Map Updates	Daily Periodic in Real Time	Local Standard Recommended
Media	Nashville RTMC	External Reports	Daily Periodic in Real Time	NTCIP Recommended
Media	Nashville RTMC	Media Information Request	Daily Periodic in Real Time	NTCIP Recommended
Nashville RTMC	Media	Traffic Information for Media	Daily Periodic in Real Time	NTCIP Recommended
Nashville RTMC	Roadway Subsystem	Freeway Control Data	System Command/Control	NTCIP Required
Nashville RTMC	Roadway Subsystem	Roadway Information System Data	System Command/Control	NTCIP Required
Nashville RTMC	Roadway Subsystem	Sensor and Surveillance Control	System Command/Control	NTCIP Required
Roadway Subsystem	Nashville RTMC	Traffic Images/Surveillance Data	System Command/Control	NTCIP Required

Nashville Regional RTMC Interface Descriptions				
Regional Traffic Management Center				
Initiating Subsystem/Terminator	**Receiving Subsystem/Terminator**	**Architecture Flow**	**Exchange Frequency**	**Protocol Categories**
Roadway Subsystem	Nashville RTMC	Traffic Flow/Sensor Data	System Command/Control	NTCIP Required
Roadway Subsystem	Nashville RTMC	Environmental Conditions	System Command/Control	NTCIP Required
Roadway Subsystem	Nashville RTMC	Freeway Control Status	System Command/Control	NTCIP Required
Roadway Subsystem	Nashville RTMC	Roadway Information System Status	System Command/Control	NTCIP Required
Roadway Subsystem	Nashville RTMC	Fault Reports	System Command/Control	NTCIP Required
Roadway Subsystem	Nashville RTMC	Incident Data	System Command/Control	NTCIP Required
Parking Management	Nashville RTMC	Parking Availability	Daily Periodic in Real Time	NTCIP Recommended
Parking Management	Nashville RTMC	Parking Demand Management Response	Daily Periodic in Real Time	NTCIP Recommended
Nashville RTMC	Parking Management	Parking Demand Management Request	Daily Periodic in Real Time	NTCIP Recommended
Nashville RTMC	Parking Management	Parking Instructions	Daily Periodic in Real Time	NTCIP Recommended

Nashville Regional RTMC Interface Descriptions				
Regional Traffic Management Center				
Initiating Subsystem/Terminator	**Receiving Subsystem/Terminator**	**Architecture Flow**	**Exchange Frequency**	**Protocol Categories**
Information Service Provider	Nashville RTMC	Logged Special Vehicle Route	Daily Periodic in Real Time	ATIS & TMDD Recommended
Information Service Provider	Nashville RTMC	Request for Traffic Information	Daily Periodic in Real Time	ATIS & TMDD Recommended
Information Service Provider	Nashville RTMC	Remote Surveillance Control	System Command/Control	NTCIP Required
Information Service Provider	Nashville RTMC	Road Network Use	Daily Periodic in Real Time	ATIS & TMDD Recommended
Nashville RTMC	Information Service Provider	Traffic Information	Daily Periodic in Real Time	ATIS & TMDD Recommended
Weather Service	Nashville RTMC	Weather Information	Daily Periodic Not Real Time	None
Nashville RTMC	Other RTMC	Freeway Control Status Request	Daily Periodic in Real Time	TMDD Required
Nashville RTMC	Other RTMC	Freeway Control Status	Daily Periodic in Real Time	TMDD Required
Other RTMC	Nashville RTMC	Freeway Control Status Request	Daily Periodic in Real Time	TMDD Required
Other RTMC	Nashville RTMC	Freeway Control Status	Daily Periodic in Real Time	TMDD Required
LTOC	Nashville RTMC	Remote Surveillance Control	Daily Periodic in Real Time	NTCIP Recommended

Nashville Regional RTMC Interface Descriptions				
Regional Traffic Management Center				
Initiating Subsystem/Terminator	**Receiving Subsystem/Terminator**	**Architecture Flow**	**Exchange Frequency**	**Protocol Categories**
Nashville RTMC	LTOC	Traffic Information Coordination	Daily Periodic in Real Time	TMDD Required
Nashville RTMC	LTOC	Traffic Control Coordination	Daily Periodic in Real Time	TMDD Required
LTOC	Nashville RTMC	Traffic Information Coordination	Daily Periodic in Real Time	TMDD Required
LTOC	Nashville RTMC	Traffic Control Coordination	Daily Periodic in Real Time	TMDD Required

Nashville Regional LTOC Interface Descriptions				
Local Traffic Operations Center				
Initiating Subsystem/Terminator	**Receiving Subsystem/Terminator**	**Architecture Flow**	**Exchange Frequency**	**Protocol Categories**
LTOC	Archived Data Management	Traffic Archive Data	Daily Periodic in Real Time	NTCIP Recommended
Archived Data Management	LTOC	Archive Status	Daily Periodic in Real Time	NTCIP Recommended
Archived Data Management	LTOC	Archive Requests	Daily Periodic in Real Time	NTCIP Recommended
LTOC	Construction & Maintenance	Closure Coordination	Daily Periodic Not Real Time	TMDD Optional
LTOC	Construction & Maintenance	Maintenance Resource Request	Daily Periodic Not Real Time	TMDD Optional
LTOC	Construction & Maintenance	Traffic Equipment Status	Daily Periodic Not Real Time	TMDD Optional
Construction & Maintenance	LTOC	Equipment Maintenance Status	Daily Periodic Not Real Time	TMDD Optional
Construction & Maintenance	LTOC	Maintenance Resource Response	Daily Periodic Not Real Time	TMDD Optional
Construction & Maintenance	LTOC	Work Zone Status	Daily Periodic Not Real Time	TMDD Optional
LTOC	Traffic Operations Personnel	Traffic Operator Data	System Command/Control	NTCIP Required

Nashville Regional LTOC Interface Descriptions				
Local Traffic Operations Center				
Initiating Subsystem/Terminator	**Receiving Subsystem/Terminator**	**Architecture Flow**	**Exchange Frequency**	**Protocol Categories**
Traffic Operations Personnel	LTOC	Traffic Operator Inputs	System Command/Control	NTCIP Required
LTOC	Local Emergency Response Centers	Current Network Conditions	Daily Periodic in Real Time	NTCIP Recommended
LTOC	Local Emergency Response Centers	Emergency Traffic Control Response	Daily Periodic in Real Time	NTCIP Recommended
LTOC	Local Emergency Response Centers	Incident Information	Daily Periodic in Real Time	NTCIP Recommended
LTOC	Local Emergency Response Centers	Incident Information Request	Daily Periodic in Real Time	NTCIP Recommended
LTOC	Local Emergency Response Centers	Resource Deployment Status	Daily Periodic in Real Time	NTCIP Recommended
Local Emergency Response Centers	LTOC	Emergency Traffic Control Request	Daily Periodic in Real Time	NTCIP Recommended
Local Emergency Response Centers	LTOC	Incident Information	Daily Periodic in Real Time	NTCIP Recommended
Local Emergency Response Centers	LTOC	Incident Response Status	Daily Periodic in Real Time	NTCIP Recommended
LTOC	Local Emergency Response Centers	Remote Surveillance Control	Daily Periodic in Real Time	NTCIP Recommended

Nashville Regional LTOC Interface Descriptions				
Local Traffic Operations Center				
Initiating Subsystem/Terminator	**Receiving Subsystem/Terminator**	**Architecture Flow**	**Exchange Frequency**	**Protocol Categories**
Local Emergency Response Centers	LTOC	Resource Request	Daily Periodic in Real Time	NTCIP Recommended
Local Emergency Response Centers	Emergency Vehicle	Greenwave	Daily Periodic in Real Time	TMDD Recommended
Emergency Vehicle	Local Emergency Response Centers	Signal priority Greenwave Request	Daily Periodic in Real Time	TMDD Recommended
Emergency Vehicle	Local Emergency Response Centers	Vehicle Location	Daily Periodic in Real Time	TMDD Recommended
LTOC	Media	Traffic Information for Media	Daily Periodic in Real Time	NTCIP Recommended
Media	LTOC	External Reports	Daily Periodic in Real Time	NTCIP Recommended
Media	LTOC	Media Information Request	Daily Periodic in Real Time	NTCIP Recommended
LTOC	Roadway Subsystem	Roadway Information System Data	System Command/Control	NTCIP Required
LTOC	Roadway Subsystem	Sensor and Surveillance Control	System Command/Control	NTCIP Required
LTOC	Roadway Subsystem	HRI Control Data	System Command/Control	NTCIP & TCIP Required

Nashville Regional LTOC Interface Descriptions				
Local Traffic Operations Center				
Initiating Subsystem/Terminator	**Receiving Subsystem/Terminator**	**Architecture Flow**	**Exchange Frequency**	**Protocol Categories**
LTOC	Roadway Subsystem	HRI Request	System Command/Control	NTCIP & TCIP Required
LTOC	Roadway Subsystem	Signal Control Data	System Command/Control	NTCIP Required
Roadway Subsystem	LTOC	Weather Data	Daily Periodic in Real Time	None
Roadway Subsystem	LTOC	Environmental Conditions	System Command/Control	NTCIP Required
Roadway Subsystem	LTOC	Traffic Flow	System Command/Control	NTCIP Required
Roadway Subsystem	LTOC	Traffic Images	System Command/Control	NTCIP Required
Roadway Subsystem	LTOC	HRI Status	System Command/Control	NTCIP & TCIP Required
Roadway Subsystem	LTOC	Intersection Blockage Notification	System Command/Control	NTCIP & TCIP Required
Roadway Subsystem	LTOC	Reversible Lane Status	System Command/Control	NTCIP Required
Roadway Subsystem	LTOC	Signal Control Status	System Command/Control	NTCIP Required

Nashville Regional LTOC Interface Descriptions				
Local Traffic Operations Center				
Initiating Subsystem/Terminator	**Receiving Subsystem/Terminator**	**Architecture Flow**	**Exchange Frequency**	**Protocol Categories**
Roadway Subsystem	LTOC	Fault reports	System Command/Control	NTCIP Required
Roadway Subsystem	LTOC	Roadway Information System Status	System Command/Control	NTCIP Required
Roadway Subsystem	LTOC	Incident Data	System Command/Control	NTCIP Required
LTOC	Map Update Provider	Map Update Request	Daily Periodic in Real Time	Local Standard Recommended
Map Update Provider	LTOC	Map Updates	Daily Periodic in Real Time	Local Standard Recommended
LTOC	Information Service Provider	Traffic Information	Daily Periodic in Real Time	ATIS & TMDD Recommended
Information Service Provider	LTOC	Logged Special Vehicle Route	Daily Periodic in Real Time	ATIS & TMDD Recommended
Information Service Provider	LTOC	Request for Traffic Information	Daily Periodic in Real Time	ATIS & TMDD Recommended
Information Service Provider	LTOC	Road Network Use	Daily Periodic in Real Time	ATIS & TMDD Recommended
LTOC	Parking Management	Parking Demand Management Request	Daily Periodic in Real Time	NTCIP Recommended

Nashville Regional LTOC Interface Descriptions				
Local Traffic Operations Center				
Initiating Subsystem/Terminator	**Receiving Subsystem/Terminator**	**Architecture Flow**	**Exchange Frequency**	**Protocol Categories**
LTOC	Parking Management	Parking Instructions	Daily Periodic in Real Time	NTCIP Recommended
Parking Management	LTOC	Parking Availability	Daily Periodic in Real Time	NTCIP Recommended
Parking Management	LTOC	Parking Demand Management Response	Daily Periodic in Real Time	NTCIP Recommended
Weather Service	LTOC	Weather Information	Daily Periodic Not Real Time	None
LTOC	Other LTOCs	Traffic Control Coordination	Daily Periodic in Real Time	TMDD Required
LTOC	Other LTOCs	Traffic Information Coordination	Daily Periodic in Real Time	TMDD Required
Other LTOCs	LTOC	Traffic Control Coordination	Daily Periodic in Real Time	TMDD Required
Other LTOCs	LTOC	Traffic Information Coordination	Daily Periodic in Real Time	TMDD Required
LTOC	Nashville RTMC	Remote Surveillance Control	Daily Periodic in Real Time	NTCIP Recommended
LTOC	Nashville RTMC	Traffic Control Coordination	Daily Periodic in Real Time	TMDD Required

Nashville Regional LTOC Interface Descriptions				
Local Traffic Operations Center				
Initiating Subsystem/Terminator	**Receiving Subsystem/Terminator**	**Architecture Flow**	**Exchange Frequency**	**Protocol Categories**
LTOC	Nashville RTMC	Traffic Information Coordination	Daily Periodic in Real Time	TMDD Required
Nashville RTMC	LTOC	Traffic Control Coordination	Daily Periodic in Real Time	TMDD Required
Nashville RTMC	LTOC	Traffic Information Coordination	Daily Periodic in Real Time	TMDD Required
LTOC	TRMC	Remote Surveillance Control	Daily Periodic in Real Time	TCIP Required
LTOC	TRMC	Request Transit Information	Daily Periodic in Real Time	TCIP Required
LTOC	TRMC	Traffic Information for Transit	Daily Periodic in Real Time	TCIP Required
LTOC	TRMC	Traffic Demand Management Request	Daily Periodic in Real Time	TCIP Required
TRMC	LTOC	Transit Demand Management Response	Daily Periodic in Real Time	TCIP Required
TRMC	LTOC	Transit System Data	Daily Periodic in Real Time	TCIP Required

Nashville Regional LERS Interface Descriptions				
Local Emergency Response Center				
Initiating Subsystem/Terminator	**Receiving Subsystem/Terminator**	**Architecture Flow**	**Exchange Frequency**	**Protocol Categories**
LERS	Media	Incident Information for Media	Daily Periodic Not Real Time	None
Media	LERS	Media Information Request	Daily Periodic Not Real Time	None
Weather Service	LERS	Weather Information	Daily Periodic in Real Time	None
LERS	Other EM	Incident Report	Daily Periodic in Real Time	TMDD Recommended
LERS	Other EM	Incident Response Coordination	Daily Periodic in Real Time	TMDD Recommended
Other EM	LERS	Incident Report	Daily Periodic in Real Time	TMDD Recommended
LERS	Map Update Provider	Map Update Request	Daily Periodic in Real Time	Local Standard Recommended
Map Update Provider	LERS	Map Updates	Daily Periodic in Real Time	Local Standard Recommended
Other EM	LERS	Incident Response Coordination	Daily Periodic in Real Time	TMDD Recommended
LERS	Emergency System Operator	Emergency Operations Status	System Command/Control	NTCIP Optional
Emergency System Operator	LERS	Emergency Operations Request	System Command/Control	NTCIP Optional

Nashville Regional LERS Interface Descriptions				
Local Emergency Response Center				
Initiating Subsystem/Terminator	**Receiving Subsystem/Terminator**	**Architecture Flow**	**Exchange Frequency**	**Protocol Categories**
LERS	Emergency Telecommunications System	Incident Notification Response	Daily Periodic in Real Time	TMDD Recommended
Emergency Telecommunications System	LERS	Incident Notification	Daily Periodic in Real Time	TMDD Recommended
LERS	Emergency Vehicle	Suggested Route	Daily Periodic in Real Time	TMDD Optional
LERS	Emergency Vehicle	Incident Command Information	Daily Periodic in Real Time	TMDD Optional
LERS	Emergency Vehicle	Emergency Dispatch Requests	Daily Periodic in Real Time	TMDD Recommended
Emergency Vehicle	LERS	Emergency Dispatch Response	Daily Periodic in Real Time	TMDD Recommended
Emergency Vehicle	LERS	Emergency Vehicle Tracking Data	Daily Periodic in Real Time	TMDD Optional
Emergency Vehicle	LERS	Incident Command Request	Daily Periodic in Real Time	TMDD Recommended
Emergency Vehicle	LERS	Incident Status	Daily Periodic in Real Time	TMDD Recommended
LERS	LTOC	Emergency Traffic Control Request	Daily Periodic in Real Time	NTCIP Recommended

Nashville Regional LERS Interface Descriptions				
Local Emergency Response Center				
Initiating Subsystem/Terminator	**Receiving Subsystem/Terminator**	**Architecture Flow**	**Exchange Frequency**	**Protocol Categories**
LERS	LTOC	Incident Information	Daily Periodic in Real Time	NTCIP Recommended
LERS	LTOC	Incident Response Status	Daily Periodic in Real Time	NTCIP Recommended
LTOC	LERS	Remote Surveillance Control	Daily Periodic in Real Time	NTCIP Recommended
LERS	LTOC	Resource Request	Daily Periodic in Real Time	NTCIP Recommended
LTOC	LERS	Traffic Control Priority Request	Daily Periodic in Real Time	NTICP Required
LTOC	LERS	Current Network Conditions	Daily Periodic in Real Time	NTCIP Recommended
LTOC	LERS	Emergency Traffic Control Response	Daily Periodic in Real Time	TMDD Recommended
LTOC	LERS	Incident Information	Daily Periodic in Real Time	TMDD Recommended
LTOC	LERS	Incident Information Request	Daily Periodic in Real Time	Local Standard Recommended
LTOC	LERS	Resource Deployment Status	Daily Periodic in Real Time	Local Standard Recommended

Nashville Regional LERS Interface Descriptions				
Local Emergency Response Center				
Initiating Subsystem/Terminator	**Receiving Subsystem/Terminator**	**Architecture Flow**	**Exchange Frequency**	**Protocol Categories**
LTOC	LERS	Remote Surveillance Control	System Command/Control	NTCIP Required
LERS	Nashville RTMC	Resource Request	Daily Periodic in Real Time	NTCIP Recommended
Nashville RTMC	LERS	Remote Surveillance Control	Daily Periodic in Real Time	NTCIP Recommended
LERS	Nashville RTMC	Incident Response Status	Daily Periodic in Real Time	NTCIP Recommended
LERS	Nashville RTMC	Incident Information	Daily Periodic in Real Time	NTCIP Recommended
Nashville RTMC	LERS	Incident Information	Daily Periodic in Real Time	TMDD Recommended
Nashville RTMC	LERS	Current Network Conditions	Daily Periodic in Real Time	TMDD Recommended
Nashville RTMC	LERS	Resource Deployment Status	Daily Periodic in Real Time	NTCIP Recommended
Nashville RTMC	LERS	Incident Information Request	Daily Periodic in Real Time	NTCIP Recommended
Roadway	LTOS	Incident Data	System Command/Control	NTCIP Required

Nashville Regional TRMS Interface Descriptions				
Transit Management Center				
Initiating Subsystem/Terminator	**Receiving Subsystem/Terminator**	**Architecture Flow**	**Exchange Frequency**	**Protocol Categories**
TRMC	Archived Data Management	Transit Archive Data	Daily Periodic in Real Time	TCIP Recommended
Archived Data Management	TRMC	Archive Requests	Daily Periodic in Real Time	TCIP Recommended
Archived Data Management	TRMC	Archive Status	Daily Periodic in Real Time	TCIP Recommended
Weather Service	TRMC	Weather Information	Daily Periodic in Real Time	None
TRMC	Transit Maintenance Personnel	Transit Work Schedule	Daily Periodic Not Real Time	TMDD Optional
Transit Maintenance Personnel	TRMC	Maintenance Status	Daily Periodic Not Real Time	TMDD Optional
TRMC	Map Update Provider	Map Update Request	Daily Periodic in Real Time	Local Standard Recommended
Map Update Provider	TRMC	Map Updates	Daily Periodic in Real Time	Local Standard Recommended
TRMC	Transit System Operators	Transit Operator Display	System Command/Control	TCIP Optional
Transit System Operators	TRMC	Transit Operator Management Data	System Command/Control	TCIP Optional

Nashville Regional TRMS Interface Descriptions				
Transit Management Center				
Initiating Subsystem/Terminator	**Receiving Subsystem/Terminator**	**Architecture Flow**	**Exchange Frequency**	**Protocol Categories**
TRMC	Information Service Provider	Demand Responsive Transit Plan	Daily Periodic in Real Time	TMDD Recommended
TRMC	Information Service Provider	Transit and Fare Schedules	Daily Periodic in Real Time	TMDD Recommended
TRMC	Information Service Provider	Transit Incident Information	Daily Periodic in Real Time	TMDD Recommended
TRMC	Information Service Provider	Transit Request Confirmation	Daily Periodic in Real Time	TMDD Recommended
Information Service Provider	TRMC	Demand Responsive Transit Request	Daily Periodic in Real Time	TMDD Recommended
Information Service Provider	TRMC	Selected Routes	Daily Periodic in Real Time	TMDD Recommended
Information Service Provider	TRMC	Transit Information Request	Daily Periodic in Real Time	TMDD Recommended
TRMC	Remote Traveler Support	Emergency Acknowledge	Daily Periodic in Real Time	TCIP Recommended
TRMC	Remote Traveler Support	Secure Area Monitoring Support	Daily Periodic in Real Time	TCIP Recommended
TRMC	Remote Traveler Support	Transit Fare Payment Responses	Daily Periodic in Real Time	TCIP Recommended

Nashville Regional TRMS Interface Descriptions				
Transit Management Center				
Initiating Subsystem/Terminator	**Receiving Subsystem/Terminator**	**Architecture Flow**	**Exchange Frequency**	**Protocol Categories**
TRMC	Remote Traveler Support	Transit Traveler Information	Daily Periodic in Real Time	TCIP Recommended
Remote Traveler Support	TRMC	Emergency Notification	Daily Periodic in Real Time	TCIP Recommended
Remote Traveler Support	TRMC	Secure Area Surveillance Data	Daily Periodic in Real Time	TCIP Recommended
Remote Traveler Support	TRMC	Transit Fare Payment Requests	Daily Periodic in Real Time	TCIP Recommended
Remote Traveler Support	TRMC	Transit Information User Request	Daily Periodic in Real Time	TCIP Recommended
TRMC	Transit Vehicle	Driver Instructions	Daily Periodic in Real Time	TMDD Optional
TRMC	Transit Vehicle	Emergency Acknowledge	Daily Periodic in Real Time	TMDD Optional
TRMC	Transit Vehicle	Fare Management Information	Daily Periodic in Real Time	TMDD Optional
TRMC	Transit Vehicle	Request for Vehicle Measures	Daily Periodic in Real Time	TMDD Optional
TRMC	Transit Vehicle	Transit Schedule Information	Daily Periodic in Real Time	TMDD Optional

Nashville Regional TRMS Interface Descriptions				
Transit Management Center				
Initiating Subsystem/Terminator	**Receiving Subsystem/Terminator**	**Architecture Flow**	**Exchange Frequency**	**Protocol Categories**
TRMC	Transit Vehicle	Transit Traveler Information	Daily Periodic in Real Time	TMDD Recommended
Transit Vehicle	TRMC	Fare and Payment Status	Daily Periodic in Real Time	TMDD Optional
Transit Vehicle	TRMC	Emergency Notification	Daily Periodic in Real Time	TMDD Optional
Transit Vehicle	TRMC	Transit Traveler Request	Daily Periodic in Real Time	TMDD Recommended
Transit Vehicle	TRMC	Transit Vehicle Conditions	Daily Periodic in Real Time	TMDD Optional
Transit Vehicle	TRMC	Transit Vehicle Location Data	Daily Periodic in Real Time	TMDD Optional
Transit Vehicle	TRMC	Transit Vehicle Passenger and Use Data	Daily Periodic in Real Time	TMDD Optional
Transit Vehicle	TRMC	Transit Vehicle Schedule Performance	Daily Periodic in Real Time	TMDD Optional
TRMC	Transit Fleet Manager	Transit Operations Planning Data	System Command/Control	TCIP Optional
Transit Fleet Manager	TRMC	Transit Fleet Manager Inputs	System Command/Control	TCIP Optional

Nashville Regional TRMS Interface Descriptions				
Transit Management Center				
Initiating Subsystem/Terminator	**Receiving Subsystem/Terminator**	**Architecture Flow**	**Exchange Frequency**	**Protocol Categories**
TRMC	Nashville RTMC	Transit System Data	Daily Periodic in Real Time	TCIP Recommended
TRMC	Nashville RTMC	Transit Demand Management Response	Daily Periodic in Real Time	TCIP Recommended
Nashville RTMC	TRMC	Transit Demand Management Response	Daily Periodic in Real Time	TCIP Recommended
Nashville RTMC	TRMC	Request Transit Information	Daily Periodic in Real Time	TCIP Recommended
Nashville RTMC	TRMC	Traffic Information for Transit	Daily Periodic in Real Time	TCIP Recommended
TRMC	Transit Driver	Route Assignment	Daily Periodic in Real Time	TCIP Recommended
Transit Driver	TRMC	Transit Driver Availability	Daily Periodic in Real Time	TMDD Recommended
TRMC	Enforcement Agency	Violation Notification	Daily Periodic in Real Time	TMDD Recommended
TRMC	Media	Transit Incidents for Media	Daily Periodic Not Real Time	None

Nashville Regional TRMS Interface Descriptions				
Transit Management Center				
Initiating Subsystem/Terminator	**Receiving Subsystem/Terminator**	**Architecture Flow**	**Exchange Frequency**	**Protocol Categories**
TRMC	Media	Transit Information for Media	Daily Periodic Not Real Time	None
Media	TRMC	Media Information Request	Daily Periodic Not Real Time	None
LTOC	TRMC	Request Transit Information	Daily Periodic in Real Time	TCIP Recommended
LTOC	TRMC	Traffic Information for Transit	Daily Periodic in Real Time	TCIP Recommended
TRMC	LTOC	Transit System Data	Daily Periodic in Real Time	TCIP Recommended
TRMC	Personal Information Access	Personal Transit Information	Daily Periodic in Real Time	None
Personal Information Access	TRMC	Transit Information User Request	Daily Periodic in Real Time	None
LTOC	TRMC	Remote Surveillance Control	Daily Periodic in Real Time	TCIP Required
LTOC	TRMC	Request Transit Information	Daily Periodic in Real Time	TCIP Required
LTOC	TRMC	Traffic Information for Transit	Daily Periodic in Real Time	TCIP Required
LTOC	TRMC	Traffic Demand Management Request	Daily Periodic in Real Time	TCIP Required

Nashville Regional TRMS Interface Descriptions				
Transit Management Center				
Initiating Subsystem/Terminator	**Receiving Subsystem/Terminator**	**Architecture Flow**	**Exchange Frequency**	**Protocol Categories**
TRMC	LTOC	Transit Demand Management Response	Daily Periodic in Real Time	TCIP Required
TRMC	LTOC	Transit System Data	Daily Periodic in Real Time	TCIP Required

Nashville Regional ISP Interface Descriptions				
Information Service Provider				
Initiating Subsystem/Terminator	**Receiving Subsystem/Terminator**	**Architecture Flow**	**Exchange Frequency**	**Protocol Categories**
ISP	Archived Data Management	Traveler Archive Data	Daily Periodic in Real Time	NTCIP Recommended
Archived Data Management	ISP	Archive Status	Daily Periodic in Real Time	NTCIP Recommended
Archived Data Management	ISP	Archive Requests	Daily Periodic in Real Time	NTCIP Recommended
Weather Service	ISP	Weather Information	Daily Periodic in Real Time	None
ISP	ISP Operator	ISP Operating Parameters	Daily Periodic in Real Time	ATIS & TMDD Optional
ISP Operator	ISP	ISP Operating Parameter Updates	Daily Periodic in Real Time	ATIS & TMDD Optional
ISP	Map Update Provider	Map Update Request	Daily Periodic in Real Time	Local Standard Recommended
Map Update Provider	ISP	Map Updates	Daily Periodic in Real Time	Local Standard Recommended
ISP	Multimodal Transportation Service Provider	Multimodal Information Request	Daily Periodic in Real Time	NTCIP Recommended

Nashville Regional ISP Interface Descriptions				
Information Service Provider				
Initiating Subsystem/Terminator	**Receiving Subsystem/Terminator**	**Architecture Flow**	**Exchange Frequency**	**Protocol Categories**
Multimodal Transportation Service Provider	ISP	Multimodal Information	Daily Periodic in Real Time	NTCIP Recommended
ISP	Personal Information Access	Broadcast Information	Daily Periodic in Real Time	None
ISP	Personal Information Access	Traveler Information	Daily Periodic in Real Time	None
ISP	Personal Information Access	Trip Plan	Daily Periodic in Real Time	None
Personal Information Access	ISP	Traveler Profile	Daily Periodic in Real Time	None
Personal Information Access	ISP	Traveler Request	Daily Periodic in Real Time	None
Personal Information Access	ISP	Trip Confirmation	Daily Periodic in Real Time	None
Personal Information Access	ISP	Trip Request	Daily Periodic in Real Time	None
ISP	Remote Traveler Support	Broadcast Information	Daily Periodic in Real Time	None
ISP	Remote Traveler Support	Traveler Information	Daily Periodic in Real Time	ATIS & TMDD Optional

Nashville Regional ISP Interface Descriptions				
Information Service Provider				
Initiating Subsystem/Terminator	**Receiving Subsystem/Terminator**	**Architecture Flow**	**Exchange Frequency**	**Protocol Categories**
ISP	Remote Traveler Support	Trip Plan	Daily Periodic in Real Time	ATIS & TMDD Optional
Remote Traveler Support	ISP	Traveler Request	Daily Periodic in Real Time	ATIS & TMDD Optional
Remote Traveler Support	ISP	Trip Confirmation	Daily Periodic in Real Time	ATIS & TMDD Optional
Remote Traveler Support	ISP	Trip Request	Daily Periodic in Real Time	ATIS & TMDD Optional
ISP	LERS	Incident Information Request	Daily Periodic in Real Time	ATIS & TMDD Recommended
LERS	ISP	Incident Information	Daily Periodic in Real Time	ATIS & TMDD Recommended
ISP	Media	Traveler Information for Media	Daily Periodic Not Real Time	None
Media	ISP	External Reports	Daily Periodic Not Real Time	None
Media	ISP	Media Information Request	Daily Periodic Not Real Time	None
ISP	Vehicle	Broadcast Information	Daily Periodic in Real Time	ATIS Recommended

Nashville Regional ISP Interface Descriptions				
Information Service Provider				
Initiating Subsystem/Terminator	**Receiving Subsystem/Terminator**	**Architecture Flow**	**Exchange Frequency**	**Protocol Categories**
ISP	Vehicle	Traveler Information	Daily Periodic in Real Time	ATIS Recommended
ISP	Vehicle	Trip Plan	Daily Periodic in Real Time	ATIS Recommended
ISP	Vehicle	Traffic Information	Daily Periodic in Real Time	ATIS & TMDD Recommended
Vehicle	ISP	Traveler Profile	Daily Periodic in Real Time	NTCIP Recommended
Vehicle	ISP	Traveler Request	Daily Periodic in Real Time	NTCIP Recommended
Vehicle	ISP	Trip Confirmation	Daily Periodic in Real Time	NTCIP Recommended
Vehicle	ISP	Trip Request	Daily Periodic in Real Time	NTCIP Recommended
Vehicle	ISP	Vehicle Probe Data	Daily Periodic in Real Time	NTCIP Recommended
Vehicle	ISP	Traffic Information Request	Daily Periodic in Real Time	ATIS & TMDD Recommended
ISP	Transit Management	Demand Responsive Transit Request	Daily Periodic in Real Time	NTCIP Recommended

Nashville Regional ISP Interface Descriptions				
Information Service Provider				
Initiating Subsystem/Terminator	**Receiving Subsystem/Terminator**	**Architecture Flow**	**Exchange Frequency**	**Protocol Categories**
ISP	Transit Management	Selected Routes	Daily Periodic in Real Time	NTCIP Recommended
ISP	Transit Management	Transit Information Request	Daily Periodic in Real Time	NTCIP Recommended
Transit Management	ISP	Demand Responsive Transit Plan	Daily Periodic in Real Time	NTCIP Recommended
Transit Management	ISP	Transit and Fare Schedules	Daily Periodic in Real Time	NTCIP Recommended
Transit Management	ISP	Transit Incident Information	Daily Periodic in Real Time	NTCIP Recommended
Transit Management	ISP	Transit Request Confirmation	Daily Periodic in Real Time	NTCIP Recommended
ISP	Dept. of Safety	CVO Data Request	Daily Periodic in Real Time	NTCIP Recommended
Dept. of Safety	ISP	CVO Data	Daily Periodic in Real Time	NTCIP Recommended
ISP	Parking Management	Parking Lot Data Request	Daily Periodic in Real Time	NTCIP Recommended
ISP	Parking Management	Parking Reservations Request	Daily Periodic in Real Time	NTCIP Recommended

Nashville Regional ISP Interface Descriptions				
Information Service Provider				
Initiating Subsystem/Terminator	**Receiving Subsystem/Terminator**	**Architecture Flow**	**Exchange Frequency**	**Protocol Categories**
Parking Management	ISP	Parking Information	Daily Periodic in Real Time	NTCIP Recommended
Parking Management	ISP	Parking Lot Reservation Confirmation	Daily Periodic in Real Time	NTCIP Recommended
ISP	Other ISP	ISP Coordination	Daily Periodic in Real Time	NTCIP Recommended
Other ISP	ISP	ISP Coordination	Daily Periodic in Real Time	NTCIP Recommended
ISP	LTOC	Logged Special Vehicle Route	Daily Periodic in Real Time	ATIS & TMDD Recommended
ISP	LTOC	Request for Traffic Information	Daily Periodic in Real Time	ATIS & TMDD Recommended
ISP	LTOC	Road Network Use	Daily Periodic in Real Time	ATIS & TMDD Recommended
LTOC	ISP	Traffic Information	Daily Periodic in Real Time	ATIS & TMDD Recommended
ISP	RTMC	Logged Special Vehicle Route	Daily Periodic in Real Time	ATIS & TMDD Recommended
ISP	RTMC	Request for Traffic Information	Daily Periodic in Real Time	ATIS & TMDD Recommended

Nashville Regional ISP Interface Descriptions				
Information Service Provider				
Initiating Subsystem/Terminator	**Receiving Subsystem/Terminator**	**Architecture Flow**	**Exchange Frequency**	**Protocol Categories**
ISP	RTMC	Road Network Use	Daily Periodic in Real Time	ATIS & TMDD Recommended
RTMC	ISP	Traffic Information	Daily Periodic in Real Time	ATIS & TMDD Recommended