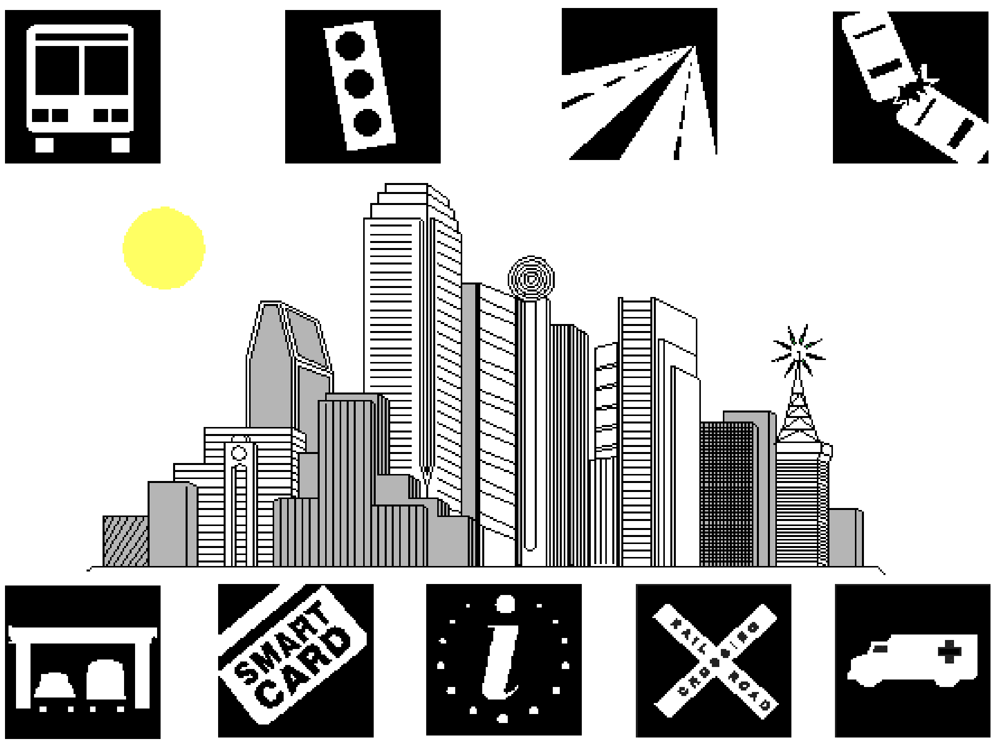
MEASURING ITS DEPLOYMENT AND INTEGRATION



Prepared for

ITS Joint Program Office
Federal Highway Administration
Washington, DC

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Version 2

Executive Summary

Over the past year, the ITS Joint Program Office sponsored a major data collection effort to track ITS deployment in the nation's largest metropolitan areas. As part of this effort, a consistent and simple methodology was developed to assess both the level of deployment of individual ITS elements and the level of integration between these elements. This method is based on the metropolitan ITS infrastructure, a blueprint defined by the U.S. DOT for the early deployment of ITS technologies in large cities. This infrastructure is made up of nine components used to group similarly functioning ITS elements. These components are Freeway Management, Incident Management, Traffic Signal Control, Transit Management, Electronic Toll Collection, Electronic Fare Payment, Highway Rail Intersections, Emergency Management Services, and Regional Multimodal Traveler Information.

To track the deployment and integration of ITS technologies, the methodology uses performance indicators, based on the functions and interactions of each of these nine infrastructure components. Since this metropolitan infrastructure is closely related to the National ITS Architecture, the metropolitan tracking methodology can serve as a starting point for more detailed ITS planning based on the National ITS Architecture. Although the methodology was originally designed for planning and monitoring in metropolitan areas, it can be used in non-metropolitan areas as well.

This three-part document provides sufficient background in the deployment tracking methodology for metropolitan transportation officials to use it in planning and monitoring ITS deployment. The sections of this document include:

Section I - "Integrating the Metropolitan ITS Infrastructure" – This section provides a concise description of the concept of integration based on the interactions between elements of the ITS infrastructure. Additionally, the relationship of the infrastructure to the National ITS Architecture is outlined. This outline shows that the two frameworks are sufficiently compatible that the infrastructure based methodology can be useful in the context of the National ITS Architecture.

Section II - "Describing the Metropolitan ITS Infrastructure" – This section provides a detailed explanation of the deployment tracking indicators and how they are calculated. Indicators for individual infrastructure deployment and integration are also described. Enough detail is provided that local transportation officials can employ the indicators to prepare an ITS deployment inventory. A short description of how to use the indicators in describing deployment goals is included

Section III - "Deployment Tracking Questionnaires" - This section contains the deployment tracking questionnaires to be used for gathering data to support local metropolitan deployment tracking.

Section I - “Integrating the Metropolitan Infrastructure”

INTEGRATING THE METROPOLITAN ITS INFRASTRUCTURE

Prepared for

ITS Joint Program Office
Federal Highway Administration
Washington, DC

FOREWORD

The nationwide deployment of an integrated, Intelligent Transportation Systems (ITS) infrastructure is a major goal of the recently enacted Transportation Equity Act for the 21st Century (TEA-21). Over the next decade, transportation planning and implementing agencies throughout the nation will be working toward this goal through a variety of federal, state, and local initiatives. This paper discusses ITS integration using a conceptual framework based on the component to component perspective that characterizes the metropolitan ITS infrastructure. The infrastructure, which is less detailed that the subsystem to subsystem approach laid out in the National ITS Architecture, is focused on metropolitan ITS deployments. However, the concepts developed for use in planning to meet the goals of ITS integration in metropolitan regions can also be usefully applied in the National ITS Architecture framework and the regional ITS architectures based on that framework.

This paper has been prepared under sponsorship of the ITS Joint Program Office for the purpose of information exchange. The information presented is intended to be a useful starting point for those agencies and individuals interested in learning more about ITS integration and the related technical and institutional considerations that must be included in the planning process. It is designed to help in understanding the basic elements of integration and to inform discussion and does not constitute a standard, specification, or regulation. The hope is that the information will aid officials planning for ITS purchases, so that new equipment will fit into the regional ITS architecture that will eventually be developed. Once available, the regional architecture will serve as the guide for all future ITS expenditures. Questions or comments concerning the material presented in this paper are encouraged and can be directed to:

Joseph I. Peters
ITS Program Assessment Coordinator
ITS Joint Program Office
Federal Highway Administration (HVH-1)
400 Seventh Street, SW
Washington, DC 20590
(202) 366-2202
E-mail: joe.peters@fhwa.dot.gov

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Tables and Figures

1. Background

The concept behind ITS integration is that linked technologies working together provide more power and versatility for a region's transportation management capability than individual systems working separately. This paper discusses ITS integration using the framework of the metropolitan ITS infrastructure, which is a blueprint defined by the U.S. DOT for the early deployment of ITS technologies in large cities. The infrastructure is comprised of nine components used to group similarly functioning ITS elements, including:

- Freeway Management
- Incident Management
- Traffic Signal Control
- Electronic Toll Collection
- Electronic Fare Payment
- Transit Management
- Highway Rail Intersections
- Emergency Management
- Regional Multimodal Traveler Information

This nine-component infrastructure provides an easily grasped framework for considering ITS deployment and integration. It also provides an introduction to the general integration concepts that are developed in greater detail in the National ITS Architecture.

The National ITS Architecture lays out a common approach for the design and implementation of integrated ITS. It is a detailed framework that defines the functions performed by ITS subsystems and the various ways in which these subsystems can be interconnected. The National ITS Architecture was developed in a collaborative process between the U.S. DOT and state and local stakeholders. It is an essential tool for ITS planning and project development activities, particularly in the area of integration.

The metropolitan ITS infrastructure is closely related to the National ITS Architecture. Table 1 shows that, although categorized differently, the National ITS Architecture subsystems include all of the same functions that are defined in the components of the metropolitan ITS infrastructure. For example, the functions of the Freeway Management infrastructure component are compatible with those provided by the Traffic Management Subsystem and Roadway Subsystem as defined in the National ITS Architecture. This paper should provide a starting point for those agencies and individuals interested in learning about ITS and in understanding the basic elements of ITS integration.[1]

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[1] Additional Resources: "The National Architecture for ITS: A Framework for Integrated Transportation into the 21st Century (Publication Number: FHWA-JPO-96-012)." U.S. Department of Transportation, Joint Program Office for Intelligent Transportation Systems, 400 Seventh St., SW (HVH-1), Washington, DC 20590, Phone: 202-366-9536, Fax: 202-366-3302, Web: http://www.its.dot.gov ITS America, 400 Virginia Ave., SW,

Table 1. Relationships Between Metropolitan ITS Infrastructure Elements and National ITS Architecture Subsystems*

Infrastructure Element	National ITS Architecture Subsystems	Functions
Freeway Management	-Traffic Management -Roadway	Monitors freeway conditions Identifies flow impediments Controls ramp metering and lane control Controls Highway Advisory Radios (HARs) and Variable Message Signs (VMS)
Incident Management	-Traffic Management	Incident detection/verification Incident response/clearance
Traffic Signal Control	-Traffic Management -Roadway	Monitor arterial network traffic Implement range of adaptive control strategies Manage area wide signal coordination
Transit Management	-Transit Management -Transit Vehicle	Monitor transit vehicle position Disseminate real-time schedules Provide computer aided dispatch Provide vehicle condition monitoring
Electronic Fare Payment	-Transit Management -Transit Vehicle	Provide payment at station/stop or in-vehicle
Electronic Toll Collection	-Toll Administration -Toll Collection -Vehicle	Provide payment at toll collection stop
Emergency Management	-Emergency Management -Emergency Vehicle	Monitor vehicle location Provide fleet mgt support
Highway Rail Intersection	-Roadway	Provide remote monitoring of highway rail intersections
Regional Multimodal Traveler Information	-Information Service Provider -Personal Information Access -Remote Traveler Support	Provide information distribution

*For example, the functions of the Freeway Management infrastructure element are compatible with those provided by the Traffic Management Subsystem and Roadway Subsystem defined in the National ITS Architecture.

2. Integration

Deploying integrated systems is inherently more complex and requires a higher level of coordination between different organizations, than deploying systems in isolation. Therefore, integrating ITS infrastructure components is likely to be a multiphase process, with each phase requiring progressively greater levels of technical and institutional coordination. This document identifies three progressively more complex phases of integration. They are: *shared infrastructure,* which is probably the simplest, *shared information*, and *coordinated control,* which requires substantial technical and institutional sharing between agencies. These definitions offer a means for transportation officials to assess the level of ITS integration in their region.

Shared Infrastructure: Sharing physical infrastructure refers to the joint use by different transportation agencies of the same equipment. For example, an area might share ITS infrastructure by constructing a regional communication spine to support interactions between ITS elements. The common communication link would eliminate the need to build numerous point-to-point links, each of which has an associated cost.

Sharing infrastructure requires technical coordination to make certain that the equipment can be integrated and adheres to applicable ITS standards. Sharing infrastructure also entails institutional coordination, as agencies must work together to create a technically sound system that addresses each individual agency's needs. Decision-makers planning such integration should understand both the technical and institutional barriers and benefits of integration to ensure the success of the project.[2]

Example: In San Antonio, TX, two agencies are sharing a single fiber-optic cable. The Travel Speed Database uses the cable to maintain a record of network speed information. Lifelink, an agency that equips ambulances with video conferencing capabilities, uses the same cable to allow emergency room doctors at the hospitals to remotely monitor patients' vital signs and interact with the paramedic personnel while the ambulance is in transit.

Shared Information: Sharing information refers to the transfer of data between agencies. The types of information that may be transferred include traffic conditions, incident information, incident response actions, traffic control actions, etc. For example, traffic management personnel may share incident information gleaned from video surveillance with emergency responders.

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[2] Additional Resource: US DOT, "Shared Resources: Sharing Right-Of-Way for Telecommunications: Guidance on Legal and Institutional Issues" (Publication Number FHWA-JPO-96-0015).

Sharing information requires overcoming a more complicated set of technical and institutional barriers than those associated with sharing infrastructure. However, this increased level of coordination leads to an increased level of ITS efficacy. As is the case for shared infrastructure, it is important that planners and officials commit to the success of data-sharing and invest in equipment that meets ITS standards to enable information exchange.

Example: In Seattle, WA, 19 jurisdictions will share information collected as part of the Smart Trek Metropolitan Model Deployment Initiative (MMDI). This project will compile data from key traffic corridors with information from the North, South and East side Advanced Traffic Management System (ATMS). The information from this electronic database will be shared among the 19 jurisdictions to complete a regional traffic management overview. Historical traffic and transit data will be stored as it is captured for planning and research purposes.

<u>Coordinated Control.</u> Coordinated control refers to the most complete type of integration. This phase occurs when one transportation agency uses shared information to make control decisions from a broader perspective than that of the individual agency. Where agencies merely sharing information may alter their control strategies based on data received from another agency, agencies coordinating control *jointly* plan and execute activities. For example, in anticipation of traffic congestion which may be caused by a special event, such as a professional football game, neighboring municipalities may jointly set traffic signals to improve the systemwide ability to clear out the congestion.

Coordinated control requires overcoming the highest levels of technical and institutional barriers. While in all phases of integration, it is likely that the institutional impediments will prove more challenging than the technical ones, that fact is especially true when an agency must give up some of their decision making ability. However, as with the other phases, overcoming these barriers leads to proportionally greater levels of ITS efficacy. Once again, it is imperative that planners and decision-makers commit themselves to the success of the integration project. In this case, that commitment requires agencies operating ITS infrastructure components to adopt a joint or regional, rather than local focus.

Example: In Phoenix, AZ several agencies are integrating ITS technologies to coordinate traffic management control activities. There, the AZTech Smart Corridor arterial traffic signal control system and the Arizona Department of Transportation (ADOT) Freeway Management System are being integrated to create a seamless traffic management system in the expanding metropolitan area. In addition to day-to-day coordination, traffic control and management plans for incidents and special events will also be created.

3. Measuring Deployment of the Metropolitan ITS Infrastructure

An inventory of the metropolitan ITS infrastructure can be used to evaluate the level of ITS deployment and integration within a metropolitan area. Once established, such an ITS inventory creates a sound basis for further ITS deployment planning. A metropolitan area must identify which additional ITS functions should be selected for deployment to meet the immediate regional goals for its ITS capabilities – improving the freeway management or traffic signal control systems, for example. When the inventory of the current infrastructure has been completed and these functional goals are established, the appropriate ITS packages within the National ITS Architecture should be reviewed and choices made about adding subsystems that will best meet the area's objectives. As this sequence of activities demonstrates, inventorying the metropolitan ITS infrastructure plays a valuable role in planning future ITS projects using the National ITS Architecture.

Measuring deployment. The ITS Joint Program Office has developed a deployment tracking methodology to measure the current state of ITS deployment in a metropolitan area. This methodology is designed for state and local planners to use to inventory, plan, and monitor ITS deployments. Section II of this document presents a more detailed description of this method, which is based on the metropolitan ITS infrastructure and defines performance indicators for each function performed by an infrastructure component. Section III of this document includes survey questionnaires, associated with each component and its indicators, for data gathering associated with this assessment approach.

Measuring integration. A similar method has been developed to assess the level of integration of ITS technologies. Using indicators of integration and appropriate surveys, this methodology is currently being applied for evaluating the level of shared information and coordinated control of ITS within metropolitan areas. Instead of measuring the level of function of ITS components, integration indicators measure selected interactions between those components. The interactions, which were selected through analyses of data flows in the National ITS Architecture, are illustrated in Figure 1.

These key interactions, or links, were selected as indicators for two reasons. The links are both already commonly defined and periodically measured in metropolitan areas. These interactions were identified through an examination of data flows presented in *Building the ITI: Putting the National Architecture into Action* and through discussions with FHWA and FTA staff.

There are two types of possible integration links. The first type of link refers to the integration between *different* components. An example of this kind of interaction can be seen in Figure 1. There, linkage "2" represents the transfer of arterial traffic condition information from the Traffic Signal Control component to the Freeway Management component. The second type of link refers to integration between elements of the *same* component. An example of this type of link, also shown in Figure 1, is the integration of traffic signal timing along the length of an arterial that passes through multiple jurisdictions. This linkage is identified as linkage “26."

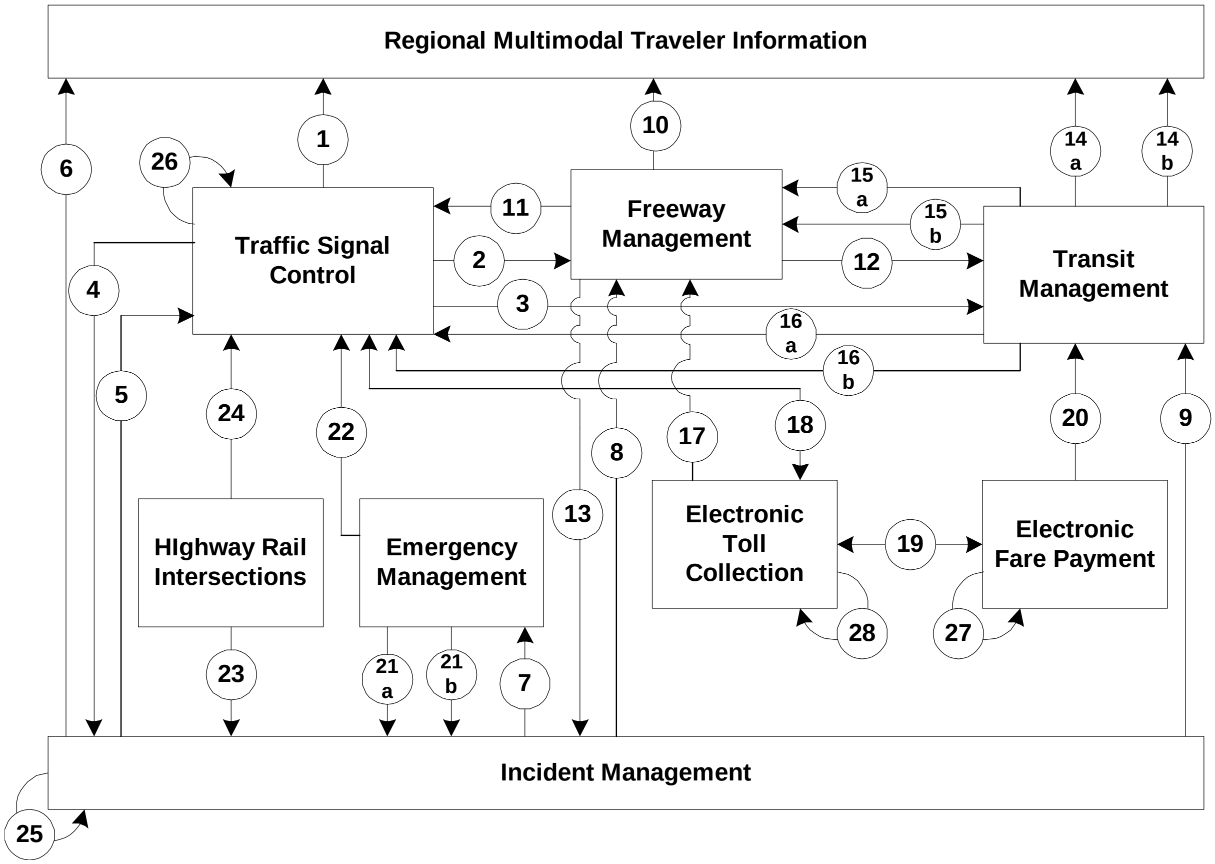

Figure 1. Integration Linkages

Table 2 further describes the interactions illustrated in Figure 1, and provides a more comprehensive listing of both the types of information that can be transferred among components and the use of that data by the receiving component. This list does not necessarily present all possible information transfers, but is included to provide a thorough introduction to the data being transferred among components in a regional transportation management system.

Table 2. Summary of Integration Linkages

Link	From-To	Information Shared	Information Use
1	TSC to RMTI	arterial travel times, speeds and conditions	display to travelers via RMTI media
2	TSC to FM	arterial travel times, speeds and conditions	adjust freeway ramp meters, VMS or HAR
3	TSC to TM	arterial travel times, speeds and conditions	adjust transit routes and schedules
4	TSC to IM	arterial travel times, speeds and conditions	detect incidents and manage incident response activities
5	IM to TSC	incident severity, location, and type	adjust traffic signal timing
6	IM to RMTI	incident severity, location, and type	display to travelers via RMTI media
7	IM to EM	incident severity, location, and type	incident notification
8	IM to FM	incident severity, location, and type	adjust freeway ramp meters, VMS, or HAR
9	IM to TM	incident severity, location, and type	adjust transit routes and schedules
10	FM to RMTI	freeway travel times, speeds, and conditions	display to travelers via RMTI media
11	FM to TSC	freeway travel times, speeds, and conditions	adjust traffic signal timing
12	FM to TM	freeway travel times, speeds, and conditions	adjust transit routes and schedules
13	FM to IM	freeway travel times, speeds, and conditions	detect incidents and manage incident response

EFP - Electronic Fare Payment
EM - Emergency Management
ETC - Electronic Toll Collection
FM - Freeway Management
HAR - Highway Advisory Radio
HRI -Highway Rail Intersections
IM - Incident Management
RMTI - Regional Multimodal Traveler Information
TM - Transit Management
TSC - Traffic Signal Control
VMS - Variable Message Sign

Table 2 (continued) Summary of Integration Linkages

Link	From-To	Information Shared	Information Use
14a	TM to RMTI	routes, schedules, and fares	display to travelers via RMTI
14b	TM to RMTI	transit schedule adherence	display to travelers via RMTI
15a	TM to FM	transit vehicle ramp preemption	adjust ramp meters
15b	TM to FM	transit vehicle probe data	determine freeway conditions
16a	TM to TSC	transit vehicle signal priority	adjust traffic signals
16b	TM to TSC	transit vehicle probe data	determine arterial conditions
17	ETC to FM	vehicle probe data	adjust freeway ramp meters, VMS, and HAR
18	ETC to TSC	vehicle probe data	adjust traffic signal timing and determine arterial conditions
19	ETC to/from EFP	fare or toll payment credit information	share fare and toll payment media
20	EFP to TM	rider origin/destination information	transit service planning
21a	EM to IM	incident notification	incident detection
21b	EM to IM	incident clearance	manage incident response
22	EM to TSC	emergency vehicle signal preemption	adjust traffic signals
23	HRI to IM	crossing status	incident detection
24	HRI to TSC	crossing status	adjust signal timing
25	IM (intra)	incident severity, location, type	incident detection and response
26	TSC (intra)	traffic signal timing	adjust traffic signal timing
27	EFP (intra)	fare payment credit information	fare payment
28	ETC (intra)	toll payment credit information	toll payment

EFP - Electronic Fare Payment
EM - Emergency Management
ETC - Electronic Toll Collection
FM - Freeway Management
HRI -Highway Rail Intersections
IM - Incident Management
RMTI - Regional Multimodal Traveler Information
TM - Transit Management
TSC - Traffic Signal Control

4. Conclusions

The integration of ITS technologies can significantly augment the effectiveness of individual ITS installations. However, integrating systems is more complicated than operating them in isolation. The methodology presented here for the metropolitan ITS infrastructure provides a conceptual framework for both understanding and assessing how well integrated the ITS are in a given region. As part of this framework, the infrastructure provides a non-technical description of functionally related components and the data flows between and within these components. These data flows can be grouped into three levels of complexity: shared infrastructure, shared information, and coordinated control. Each level, in turn, refers to progressively greater ITS integration, each requiring correspondingly more technical and institutional coordination.

The framework of nine functionally related infrastructure components, selected data interactions, and three phases of integration provides a means for generating a methodology to define and measure the level of deployment and integration within a region. This methodology entails the use of key indicators based on the functions and selected interactions of the components and associated links. A more in-depth discussion of this methodology as well as a presentation of helpful surveying materials are included in subsequent sections of this document.

The method presented here for tracking the deployment and integration of ITS technologies represents a very useful tool for transportation planners and agencies. The method outlines a process for transportation planners and officials to inventory existing systems, analyze potential packages for conformity with the National ITS Architecture, forecast technical and institutional issues, and assess the progress of the deployment. Although this methodology was developed using the framework of the metropolitan ITS infrastructure, the close relation between that infrastructure and the more comprehensive National ITS Architecture makes it easy to refer to the National ITS Architecture when planning additions to a regional ITS program.

Carrying out the sort of analysis of the state of integration described in this document should result in system purchases that can eventually be integrated into a regional architecture and that include consideration of the physical, information, and institutional demands of integration. Conforming to ITS standards in purchasing and deploying infrastructure components is important, even if integration will occur in the future, since ITS components that do not conform to a standard are unlikely to work well together. Just as important, the institutional aspects of integration need to be considered as an essential part of deployment planning. Finally, it is critical to bring representatives of the applicable agencies together early in the planning process to discuss the benefits and specific regional requirements for integration.

5. References

"Building the ITI: Putting the National Architecture into Action," Federal Highway Administration, FHWA-JPO-96-011, April 1996.

"ITS Benefits: Continuing Successes and Operational Test Results," FHWA ITS Joint Program Office, FHWA-JPO-98-002, October 1997.

"Intelligent Transportation Systems: Real World Benefits," FHWA ITS Joint Program Office, FHWA-JPO-98-018, January 1998.

"Shared Resources: Sharing Right-Of-Way for Telecommunications: Guidance on Legal and Institutional Issues" (Publication Number FHWA-JPO-96-0015).

"Smart Moves: A Decision-Makers Guide to the Intelligent Transportation Infrastructure," Public Technology, Incorporated, 1996.

"The National Architecture for ITS: A Framework for Integrated Transportation into the 21st Century" (Publication Number: FHWA-JPO-96-012)

Section II - "Describing the Metropolitan ITS Infrastructure"

DESCRIBING THE METROPOLITAN ITS INFRASTRUCTURE

Prepared for
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List of Tables

I. INTRODUCTION

A. Purpose

The purpose of this document it to assist in characterizing ITS deployment in a metropolitan area by describing a set of indicators that can be used to gauge the level of deployment of the metropolitan ITS infrastructure. This document describes nine ITS infrastructure elements, the deployment indicators used to measure the level of deployment and the integration indicators used to measure the level of integration between each element.

B. Metropolitan ITS Component Indicators

Deployment of individual elements of the metropolitan ITS infrastructure are tracked through the use of indicators (surrogates for deployment) that are tied to the major functions of each elements. For example, in the case of Freeway Management, three basic functions are defined: surveillance, traffic control, and information display. The three indicators developed to reflect these functions are: percentage of freeway centerline miles under electronic surveillance (surveillance function), percentage of freeway entrance ramps managed by ramp meters (control function), and percentage of freeway centerline miles covered by permanent VMS, HAR, or in-vehicle signing (IVS) (display function) (In some cases, different "levels" have been developed for indicators to provide additional refinement for the measure).

Example: Calculating Component Indicators for Freeway Management

Consider a metropolitan area with 100 miles of freeway and 25 freeway entrance ramps. The area has no ramp meters or lane control, 10 freeway miles for which traffic data are collected electronically and 5 freeway miles which are covered by HAR.

The component indicator for surveillance is calculated as (10/100) or 10%.

The component indicator for control is (0/25) or 0%.

The component indicator for display is (5/100) or 5%.

The component summary indicator for the freeway management is calculated as (10% + 0% + 5%)/3 = 5%

The indicators are surrogates that do not necessarily reflect the full breadth of metropolitan ITS deployment activity. The indicators selected have been chosen primarily to assist in providing simple and intuitive measures of deployment that can be counted and tracked over time.

C. Integration of Components

A critical aspect of ITS that provides much of its capability is the integration of individual elements of the metropolitan ITS infrastructure to form a unified regional transportation management system. Individual ITS elements routinely collect information that is used for purposes internal to that element. For example, Traffic Signal Control monitors arterial conditions to revise signal timing and to convey these conditions to travelers through such technologies as dynamic message signs and highway advisory radio. Other ITS element can make use of this information in formulating control strategies. For example, Transit Management may alter routes and schedules based on real-time information on arterial traffic conditions, and Freeway Management may alter ramp metering or diversion recommendations based on the same information. To be considered integration from the viewpoint of the deployment tracking methodology, information must be both transferred between elements and used effectively by the recipient element.

Example: Calculating Integration between Freeway Management and Traffic Signal Control

Consider a metropolitan area with 50 miles of freeway, 10 of which have traffic data collected electronically. The component indicator for electronic surveillance is calculated as 20%.

For the purpose of measuring integration, only the 10 miles currently under electronic surveillance are considered as the amount available for integration with other components. Therefore, if data for all 10 miles of freeway are transferred to another component, the flow metric is assigned a value of 100%.

Suppose that the 10 miles of freeway surveillance data are transferred to the Traffic Signal Control component and used to revise signal timing plans, then the control metric is assigned a value of 100%.

The combined indicator for integration is the average of the flow metric and the control metric or (100% + 100%)/2 = 100%.

D. Deployment Tracking Boundary

For purposes of tracking the metropolitan ITS infrastructure, the tracking boundary is consistent with the Metropolitan Transportation Planning Boundary. This is done for the following reasons:

- This boundary is used for transportation planning activities in a region and it is therefore more likely to be the basis for other similar inventory efforts;
- This boundary identifies the concentration of planning and programming for a region and therefore will be the focus of ITS planning and programming over the next decade; and
- This boundary is established without regard to municipal jurisdiction and provides a regional basis to describe an area.

E. Survey Coverage

Once specific operating and planning agencies are identified, surveys are distributed following the general guidelines outlined below. In some cases, these rules are not strictly followed based on discussions with Region and Division FHWA and FTA staff. In most cases, however, distribution of surveys follow these guidelines.

Emergency Management, Highway-Rail Intersection and Traffic Signal Control surveys are administered to the following agencies:

- County government agencies
- City government agencies
- State DOT.

Transit Management and Electronic Fare Payment questionnaires are distributed to each operator of public transportation in the metropolitan area as reported in the National Transit Database (formally, Section 15).

Freeway Management, Incident Management, Electronic Toll Collection and Regional Multimodal Traveler Information surveys are distributed to state transportation departments and toll operators as appropriate.

II ITS INFRASTRUCTURE COMPONENT INDICATORS

A. Freeway Management

1. Objectives of Freeway Management

The objectives of Freeway Management are to:

- Monitor traffic conditions on the freeway system,
- Identify recurring and non-recurring flow impediments so that short-term and long-term actions can be taken to alleviate congestion,
- Implement various control and management strategies (such as ramp metering, lane control, or traffic diversion), and
- Provide traveler information to travelers through infrastructure-based dissemination methods such as Variable Message Signs (VMS), Highway Advisory Radio (HAR), and In-Vehicle Signing (IVS).

2. Freeway Management Definition

Freeway Management provides transportation operations personnel with the capability to monitor traffic conditions on the freeway system; identify recurring and non-recurring flow impediments; implement appropriate traffic control and management strategies (such as ramp metering and lane control); and, provide critical information to travelers through infrastructure-based dissemination methods (such as VMS and HAR), and IVS.

Freeway Management often includes a Freeway Management Center (or multiple centers where responsibility for the freeway system is shared by more than one operating entity in a metropolitan area) and links to other ITS components in the metropolitan area. From these centers, personnel electronically monitor traffic conditions; activate response strategies; and, initiate coordination with intra-agency and inter-agency resources, including emergency response and incident management providers.

Closed-circuit television and an array of sensors (e.g., inductive loops, magnetometers, microwave radar, ultrasonic, infrared, video image processing, automatic vehicle identification (AVI), and passive acoustic devices) may be used to electronically monitor freeway conditions in real-time. Other sources of information concerning real-time freeway conditions include communications received from police and maintenance personnel as well as cellular telephone reports called in from drivers. AVI readers may also be used to acquire probe vehicle data.

Traffic condition data are analyzed to identify the cause of a flow impediment and to formulate an appropriate response in real-time. Traffic control devices, such as ramp meters or lane control devices, may be pro-actively applied to provide a better balance between freeway travel demand and capacity during congested conditions. Information may be provided to travelers through roadside traveler information devices such as VMS, HAR, and IVS. Emergency response and incident management providers may be notified to respond to non-recurring incident events.

3. Freeway Management Indicators

The following table summarizes the Freeway Management component indicators. Three functions are identified: surveillance, control, and display.

Freeway Management Indicators

Functions	Component Indicators	Numerator/Denominator
Surveillance	Percentage of freeway centerline miles under electronic surveillance for monitoring traffic flow Level 1: detectors >= 1.0/mile Level 2: detectors < 1.0/mile or probe vehicles and readers	Mileage with detectors Total freeway miles
Control	Percentage of freeway centerline miles managed by lane control *or* percentage of freeway entrance ramps managed by ramp meters (higher of two values) Level 1: isolated or fixed-time control Level 2: centrally-controlled or traffic-responsive	Mileage with lane control Total freeway miles Entrance ramps w/meters Total entrance ramps
Display	Percentage of freeway centerline miles covered by permanent VMS *or* HAR *or* IVS.	Mileage covered Total freeway miles

4. Freeway Management Integration Description

Freeway travel times, speeds, and conditions information collected by the Freeway Management component may be transferred to the following components: Incident Management (to detect or otherwise help manage incidents); Regional Multimodal Traveler Information (for display to travelers); Traffic Signal Control (to adjust signal timing in near real-time); and Transit Management (to adjust transit vehicle routing or scheduling).

The following information may be transferred from other components to the Freeway Management component: Ramp meter priority and transit vehicle probe information from Transit Management; arterial travel times, speeds, and conditions information from Traffic Signal

Control; incident severity, location and type data from Incident Management; and vehicle probe data from Electronic Toll Collection. All the data transferred to the Freeway Management component are used to adjust ramp meter timing or lane control, or to display to travelers through VMS, HAR, or in-vehicle signing.

B. Incident Management

1. Objectives of Incident Management

The objectives of Incident Management are to:

- Coordinate incident identification, response, and clearance activities across regional boundaries,
- Use traffic management capabilities to improve response times, and
- Reduce traveler delays due to incidents.

2. Incident Management Definition

Incident management provides an organized and functioning system for quickly identifying and clearing crashes, disabled vehicles, debris, and other non-recurring flow impediments from area freeways and major arterials. Roadways are cleared and flow restored as rapidly as possible, minimizing frustration and delay to travelers while at the same time meeting the requirements and responsibilities of the agencies involved. The various jurisdictions and agencies responsible for operations and enforcement have worked together to develop a policy and operations agreement that defines specific responsibilities of incident management. Such an agreement includes detection, verification, response, clearance, scene management, and traffic management and operation.

This multi-jurisdictional operating agreement ensures cooperation, coordination, and communication among all agencies including law enforcement, fire, ambulance, highway traffic control, and maintenance, as well as environmental and other public agencies. Interagency cooperation also reduces duplication of effort in coordinating incident management activities. In addition, private sector businesses that do towing and recovery may be involved in incident clearance.

Incident Management is often fully integrated with Freeway Management in order to utilize the surveillance, traffic control strategies, and traveler information resources provided by the Freeway Management. In addition, Incident Management fully maintains communications with Emergency Management Services in order to respond to incidents, manage incident sites, and restore traffic flow conditions. Finally, Incident Management may be integrated with Traffic Signal Control to affect coordination between traffic signal timing to accommodate traffic diversion during incident response.

Monitoring of freeway conditions for the purpose of incident management is usually integrated with Freeway Management, with notification of the presence of an incident provided to the Incident Management component. The Incident Management component is then responsible for developing an appropriate response strategy and for clearance of the incident. An appropriate response strategy is put into action and responsible agencies are notified to manage the incident site and clear impediments as quickly and safely as possible.

3. Incident Management Indicators

The following table contains a summary of the component indicators developed to summarize deployment levels of the incident management component of the metropolitan ITS infrastructure.

Incident Management Indicators

Functions	Component Indicators	Numerator/Denominator
Detection	1. Percentage of highway miles covered by incident detection algorithms. Level 1: freeway centerline miles Level 2: arterial centerline miles	Miles Covered Total Miles
Detection	2. Percentage of highway miles covered by free cellular phone calls to a dedicated number Level 1: freeway centerline miles Level 2: arterial centerline miles	Miles Covered Total Miles
Surveillance	3. Percentage of highway miles covered by surveillance cameras Level 1: freeway centerline miles Level 2: arterial centerline miles	Miles Covered Total Miles
Response	4. Percentage of highway miles covered by on-call publicly sponsored service patrols or towing services Level 1: freeway centerline miles Level 2: arterial centerline miles	Miles Covered Total Miles

4. Incident Management Integration Description

Incident severity, location, and type information collected by the Incident Management component may be transferred to the following components: Regional Multimodal Traveler Information (for display to travelers); Emergency Management (to coordinate response); Transit Management (to adjust transit vehicle routing); Traffic Signal control (to adjust signal timing);

and Freeway Management (to adjust ramp meter timing or lane control, or display to travelers through VMS, HAR or In-Vehicle Signing).

The following information may be transferred from other components to the Incident Management component for the purpose of detecting or otherwise managing incidents: freeway travel times, speeds, and conditions from the Freeway Management component; arterial travel times, speeds, and conditions from the Traffic Signal Control component; incident severity location and type from Highway Rail Intersection and Emergency Management components; and incident clearance information from the Emergency Management component.

C. Traffic Signal Control

1. Objectives of Traffic Signal Control

The objectives of Traffic Signal Control are to:

- Coordinate traffic signal timing patterns across urban arterials, networks and Central Business District,
- Implement traffic signal timing patterns that are responsive to traffic conditions, and
- Implement traffic signal timing patterns that are responsive to transit and emergency vehicles.

2. Definition of Traffic Signal Control

Traffic Signal Control is responsible for the coordinated control of traffic signals along urban arterials, networks, and Central Business District (CBD). Traffic Signal Control provides the capability to adjust the amount of green time for each street and coordinate operation between each signal in response to changes in demand patterns. Traffic signal timing patterns may be executed in response to pre-established "time of day" or "special event" plans, based on historical traffic conditions, or may be executed in response to real-time traffic conditions using "traffic adaptive" algorithms. Coordination can be implemented through a number of techniques including time-based and hard-wired interconnection methods. Coordination of traffic signals across agencies requires the development of data sharing and traffic signal control agreements. Therefore, a critical institutional component of Traffic Signal Control is the establishment of formal or informal arrangements to share traffic control information as well as actual control of traffic signal operation across jurisdictions.

Traffic signal control may incorporate peripheral elements not essential to the task of traffic control per se, which may enhance overall traffic management capabilities in an area. These elements could include closed circuit TV surveillance; motorist information and/or traveler information components; a data base management system to support analysis and development of management strategies; and data exchange with other traffic management systems including freeway management and incident management. Simulation may be included to project near-term traffic trends for selection of signal timing strategies to optimize throughput.

3. Traffic Signal Control Indicators

The following table contains a summary of the indicators developed to track deployment of Traffic Signal Control.

Traffic Signal Control Indicators

Functions	Component Indicators	Numerator/Denominator
Surveillance	1. Percentage of signalized arterial and CBD centerline covered by electronic surveillance for monitoring traffic flow Level 1: point detection of vehicle speeds Level 2: travel time estimation over links	Arterial + CBD miles covered Total arterial plus CBD Miles
Control	2. Percentage of arterial and CBD signalized intersections under centralized or closed loop control Level 1: static timing plans based on historical data Level 2: dynamic signal timing response based on advanced software	Arterial + CBD miles covered Total arterial plus CBD Miles
Display	3. Percentage of signalized plus CBD centerline miles covered by VMS, HAR or IVS	Arterial + CBD miles covered Total arterial plus CBD Miles

4. Traffic Signal Integration Description

Arterial travel times, speeds, and conditions are transferred from the Traffic Signal Control component to the following components: Incident Management (to screen or detect arterial incidents); Regional Multimodal Traveler Information (for traveler display); Transit Management (to adjust transit vehicle routing or scheduling); and Freeway Management (to adjust ramp meter timing or lane control timing, or display to travelers using VMS, HAR, or In-Vehicle Signing).

The following information may be transferred from other components to the Traffic Signal Control component for the purpose of adjusting signal timing or pre-emption: freeway travel times, speeds, and conditions from the Freeway Management component; road/rail intersection crossing status from the Highway Rail Intersection component; incident severity location and type from the Incident Management component; probe data from the Electronic Toll Collection and Transit Management components; signal priority data from the Transit Management component and Emergency Management component.

E. Electronic Toll Collection

1. Objectives of Electronic Toll Collection

The objectives of Electronic Toll Collection are to:

- Implement electronic financial transaction processing to reduce delay at toll collection plazas,
- Reduce the need for travelers and public agencies to handle money,
- Coordinate between agencies to establish a common payment media, and
- Reduce toll agency costs.

2. Definition of Electronic Toll Collection

Electronic Toll Collection (ETC) provides for automated collection of toll revenue through the application of in-vehicle, roadside, and communication technologies to process toll payment transactions. Participating patrons (vehicles) are identified by the use of roadside hardware and software and an identifier or "tag." In areas with more than a single toll collection authority, compatible tag technologies should be used to enhance convenience to the patron and the promotion of "seamless" transaction processing.

Communications between the roadside equipment and the identifier occur as the vehicle approaches or passes the toll collection point. When the communication is complete, the roadside equipment utilizes the identification information contained on the "tag" to initiate the in-lane processing function. The in-lane processing involves some level of validation of identification information and vehicle classification information from the patron or vehicle. Validation may include verification that a particular "tag" was issued by the particular toll authority as well as validation of the account status. After the passage of the vehicle, the in-vehicle processing ends with creation of a transaction record that is forwarded to the central processing function to consolidate the transactions for each tag and collect the appropriate toll revenue from the patron. Additional data, such as an image or images of the vehicle and/or license plate, may be collected during in-lane processing to detect and enforce violations.

3. Electronic Toll Collection Indicators

The following table contains a summary of the Electronic Toll Collection component indicators.

Electronic Toll Collection Indicators

Functions	Component Indicators	Numerator/Denominator
Control	Percentage of toll collection lanes with ETC capability	Lanes with ETC Total toll collection lanes

4. Electronic Toll Collection Integration Description

Probe data and credit identification data are transferred from the Electronic Toll Collection component to the following components for purposes of signal preemption, travel time and flow estimation, and common fare media: Traffic Signal Control (to adjust signal timing); Freeway

Management (to adjust ramp meter timing, or display to travelers through VMS, HAR), or In-Vehicle Signing; Electronic Fare Payment (to provide a common fare medium).

The following information may be transferred from other components to the Electronic Toll Collection component for the purpose of providing a common fare medium: credit identification from the Electronic Fare Payment component.

E. Electronic Fare Payment

1. Objectives of Electronic Fare Payment

The objectives of Electronic Fare Payment are to:

- Provide a single fare medium for paying travel-related fares and parking fees and
- Reduce the need for travelers and public agencies to handle money.

2. Definition of Electronic Fare Payment

Electronic Fare Payment provides electronic communication, data processing, and data storage technologies to collect travel-related fares (such as public transit fares) and parking fees. Electronic Fare Payment provides transportation agencies with the ability to automate their accounting and financial settlement processes, and provides travelers with a convenient way to pay for transportation services.

Payment cards can take a variety of forms including debit, credit, and stored value cards. The payment card technologies range from a cardboard or plastic "swipe" card with limited data storage capability to a "smart" card containing a high level of storage and data processing capacity. Cards may be encoded with a variety of electronic data that are used to initiate a fare payment transaction, process the transaction, and enforce violations of fare payment policy. In areas with more than a single transit operator, a common fare medium should be used to enhance traveler convenience and promote coordinated financial transaction processing.

Payment processing is initiated by the card reader either through direct contact with the payment card or, in the case of more advanced technologies, scanning of a card located in close proximity to the reader. The data contained on the card are interrogated by the card reader to establish fare pricing for a requested trip or parking service and to validate the patron or card account status. In the case of a debit card, the appropriate fare is immediately deducted from the payment card and a new credit level is established. In the case of a credit card, the patron account will be billed the appropriate amount. A transaction record is prepared and forwarded to the central processing function.

3. Electronic Fare Payment Indicators

The following table contains a summary of the component indicators developed for Electronic Fare Payment.

Electronic Fare Payment Indicators

Functions	Component Indicators	Numerator/Denominator
Non-rail	1. Percentage of fixed-route transit vehicles that accept electronic payment Level 1: magnetic stripe cards Level 2: smart cards	Vehicles accepting electronic fare payment Total vehicles
Rail	2. Percentage of rail transit stations that accept electronic payment Level 1: magnetic stripe cards Level 2: smart cards	Stations accepting electronic payment Total stations

4. Electronic Fare Payment Integration Description

Credit identification information may be transferred from the Electronic Fare Payment component to Electronic Toll Collection component for the purpose of enabling a common fare media. Transit ridership details obtained coincident with fare payment may also be transferred from the Electronic Fare Payment component to the Transit Management component for use in service planning.

Credit identification information obtained through the Electronic Toll Collection component may also be transferred to the Electronic Fare Payment component for the purpose of enabling a common fare media.

F. Transit Management

1. Objectives of Transit Management

The objectives of Transit Management are to:

- Monitor the location of transit vehicles to support schedule management and emergency response,
- Monitor maintenance status of the transit vehicle fleet,
- Provide demand responsive flexible routing and scheduling of transit vehicles, and
- Provide real-time, accurate, transit information to travelers

2. Definition of Transit Management

Transit Management supports management of the transit fleet by electronically monitoring vehicle locations in real time. Transit vehicles equipped with AVL technology provide the basis for vehicle tracking. Information on the current location of a transit vehicle is transmitted to a centralized dispatcher who then compares the actual location with the scheduled location. Depending on the variance between the actual and scheduled locations, actions may be taken to improve schedule adherence and to transfer information to travelers. This also supports emergency response by providing real time information on vehicle locations in emergency situations.

Transit management includes the electronic monitoring of vehicle performance parameters using in-vehicle sensors. This involves monitoring of usage statistics such as mileage and status of routine scheduled maintenance. In addition, this permits automatic monitoring of vehicle condition, including key parameters such as oil and fuel levels and tire pressure. The use of AVL also supports advanced demand-responsive computer-aided routing and scheduling. Transit dispatchers can combine real-time information on vehicle location and status with advanced computer aided dispatching systems to provide optimal vehicle assignment and routing to meet non-recurring public transportation demand.

Schedule information can be disseminated in near real-time to travelers through a variety of methods directly controlled by the transit management agencies, such as information kiosks, radio and television, and the world wide web.

3. Transit Management Indicators

The following table contains a summary of the Transit Management component indicators.

Transit Management Indicators

Functions	Component Indicators	Numerator/Denominator
AVL	1. Percentage of fixed-route transit vehicles equipped with AVL	Total vehicles with AVL Total fixed route vehicles
Maintenance	2. Percentage of fixed-route transit vehicles with electronic monitoring of vehicle components	Total vehicles with electronic monitoring Total vehicles
Paratransit	3. Percentage of paratransit vehicles operating under computer-aided dispatch (CAD)	Total paratransit vehicles under CAD Total paratransit vehicles
Display	4. Percentage of fixed-route transfer locations with electronic display of transit information Level 1: static information Level 2: real-time schedule adherence	Transfer locations with display Total transfer locations

4. Transit Management Integration Description

Information links from Transit Management to Traffic Signal Control can provide for signal priority treatment of transit vehicles to improve on-time performance. Links with Freeway Management can support ramp metering priority for transit vehicles. Transit Management can also provide Freeway Management and Traffic Signal Control with probe information for highway travel time determination. Transit location and schedule data as well as data on real-time schedule adherence can be transferred to the Regional Multimodal Traveler Information system to distribute traveler information concerning transit service performance.

Transit Management can receive information on freeway travel conditions from Freeway Management and arterial conditions from Traffic Signal Control, as well as incident location and severity from Incident Management, and adjust vehicle routing or scheduling as a result. Transit Management may also receive information on transit ridership from Electronic Fare Payment.

G. Highway-Rail Intersection

1. Objectives of Highway-Rail Intersection

The objectives of Highway-Rail intersection are to:

- Coordinate rail movements with the traffic control signal systems,
- Provide travelers with advanced warning of crossing closures, and
- Improve and automate warnings at highway-rail intersections.

2. Definition of Highway-Rail Intersection

At-grade highway-rail intersections are a special form of a roadway intersection where a roadway and one or more railroad tracks intersect. At a Highway-rail intersection, the right-of-way is shared between railroad vehicles and roadway vehicles, with railroad vehicles typically being given preference. Railroad trains, which travel at high speeds and can take up to a mile or more to stop, pose special challenges. As a result, automated systems are now becoming available that allow the deployment of safety systems to adequately warn drivers of crossing hazards.

The Highway-Rail Intersection component involves electronic surveillance of grade crossings to detect vehicles within the crossing area, either through video or other means such as loop detectors. This may eventually support real-time information on train position and estimated time of arrival at a crossing and interactive coordination between roadway traffic control centers and train control centers.

3. Highway-Rail Intersection Indicators

The following table contains a summary of the component indicator for Highway-Rail Intersections.

Highway-Rail Intersection Indicators

Functions	Component Indicators	Numerator/Denominator
Surveillance	Percentage of highway-rail intersections under electronic surveillance	HRIs with surveillance / Total HRIs

4. Highway Rail Intersection Integration Description

Integration of the Highway Rail Intersection (HRI) component with other elements of the ITS infrastructure generally involves transfer of information concerning the status of train arrival at intersections. This information concerning crossing status may be transferred to Traffic Signal Control to be used to modify signal timing to ensure vehicles are not forced onto the train tracks. This capability may be limited to one HRI and one roadway/railway intersection, or could involve one or more HRIs in a regional traffic signal control system. In addition, information on the time, location, and expected duration of train crossing status may be passed to Incident Management, which may, in turn, transmit this information to a Multimodal Traveler Information System.

H. Emergency Management

1. Emergency Management Objectives

The objective of Emergency Management are to:

- Employ advanced demand responsive dispatching capabilities to improve response times and
- Employ advanced vehicle guidance capabilities to improve response times.

2. Definition of Emergency Management

The purpose of Emergency Management Services is to improve the response time of emergency services providers thereby saving lives and reducing property damage. To reduce the response time of emergency services providers, the time it takes to notify the emergency services providers must be reduced, and the time it takes for the emergency services providers to arrive at the scene must also be reduced. The following are methods by which emergency notification can be accomplished: cellular telephone, call boxes, and mayday devices.

Emergency vehicle management is oriented to reducing the time from receipt of notification of an incident to the arrival of the emergency vehicle on the scene. The three major components of emergency vehicle management are emergency vehicle fleet management and route guidance. Emergency vehicle fleet management utilizes AVL equipment to provide computer-aided dispatching of vehicles. Through the use of real-time information on vehicle location and status, emergency service dispatchers can make optimal assignment of vehicles to incidents. The installation of route guidance equipment in emergency service vehicles provides improved directional information for drivers and improves responsiveness of emergency services.

3. Emergency Management Indicators

The following table contains a description of the Emergency Management component indicators.

Emergency Management Component Indicators

Functions	Component Indicators	Numerator/Denominator
Dispatch	1. Percentage of public sector emergency vehicles operating under computer-aided dispatch (CAD)	Vehicles under CAD / Total vehicles
Guidance	2. Percentage of public sector emergency vehicles with in-vehicle route guidance	Vehicles with route guidance / Total vehicles

4. Emergency Management Integration Description

Emergency Management provides information to Incident Management concerning the severity, location, and type of incidents. In addition, on-scene Emergency Response personnel (e.g. police, fire, or emergency medical personnel) transfer information on progress toward clearing of incidents to Incident Management. Emergency Management transfers routing information to

Traffic Signal Control to obtain priority signal control for emergency response vehicles, either through timing changes or through individual signal priority.

Emergency Management receives information from Incident Management concerning incident location, severity, and type.

I. Regional Multimodal Traveler Information

1. Objectives of Regional Multimodal Traveler Information

The objectives of Regional Multimodal Traveler Information are to:

- Collect current, comprehensive, and accurate roadway and transit performance data for the metropolitan area,
- Provide multimodal information to the traveler to support mode decision making, and
- Provide traveler information to the public via a range of communication techniques (broadcast radio, FM subcarrier, the Internet, cable TV) for presentation on a range of devices (home/office computers, television, pagers, personal digital assistants, kiosks, radio).

2. Definition of Regional Multimodal Traveler Information

Regional Multimodal Traveler Information provides the ability to collect and disseminate information about various modes of travel over the regional transportation network. Providing timely traveler information will enable the public to make informed pre-trip and en-route choices regarding mode, route, and time-of-day travel.

The Regional Multimodal Traveler Information component of the metropolitan ITS infrastructure receives roadway and transit system surveillance and detection data from a variety of sources provided by both public and private sector entities and has the capability to combine data from different sources, package the data into various formats, and provide the information to a variety of distribution channels.

As with many elements of the ITS, integration is essential to the deployment of an effective Regional Multimodal Traveler Information system. It is the aggregation of data from many disparate sources, and the presentation of these data integrated in a common, easily assimilated format, that makes Regional Multimodal Traveler Information such a valuable component in influencing mode selection, route selection, and travel-time scheduling. Not only is the traveling public served directly by offering more efficient and informed travel, but the infrastructure is served by potentially reducing demand in areas, times, and modes that are at or over capacity.

3. Regional Multimodal Traveler Information Indicators

The following table contains a summary of the Regional Multimodal Traveler Information component indicators.

Regional Multimodal Traveler Information Indicators

Functions	Component Indicators	Numerator/Denominator
Regional	1. Percentage of geographic coverage of surveillance data provided from Freeway Management, Incident Management, Traffic Signal Control, and Transit Management	*Freeway Management:* Freeway miles where travel conditions and speeds are monitored and transferred Total freeway miles *Traffic Signal:* Arterial + CBD miles where travel conditions and speeds are monitored and transferred Total arterial + CBD miles *Incident Management:* Freeway + arterial miles where incident data are transferred Total freeway + arterial miles *Transit Management:* (1) Route-miles for which route, fare, and schedule information are transferred Total route-miles (2) Route-miles for which real-time schedule adherence data are transferred Total route
Media	2. Percentage of total possible RMTI media types used to display information to travelers	Media Used 8
Multimedia	3. Percentage of total possible RMTI media used to display information on *two or more modes* to travelers	Media displaying 2+ modes 8

4. Regional Multimodal Traveler Information Integration Description

Integration is essential to the deployment of an effective Regional Multimodal Traveler Information system. It is the aggregation of data from many disparate sources, and the presentation of these data integrated in a common, easily assimilated format, that makes Regional Multimodal Traveler Information Systems functional.

Regional multimodal traveler information relies upon other ITS components to provide current travel conditions in a metropolitan area. It receives incident, traffic, and transit data from other ITS components.

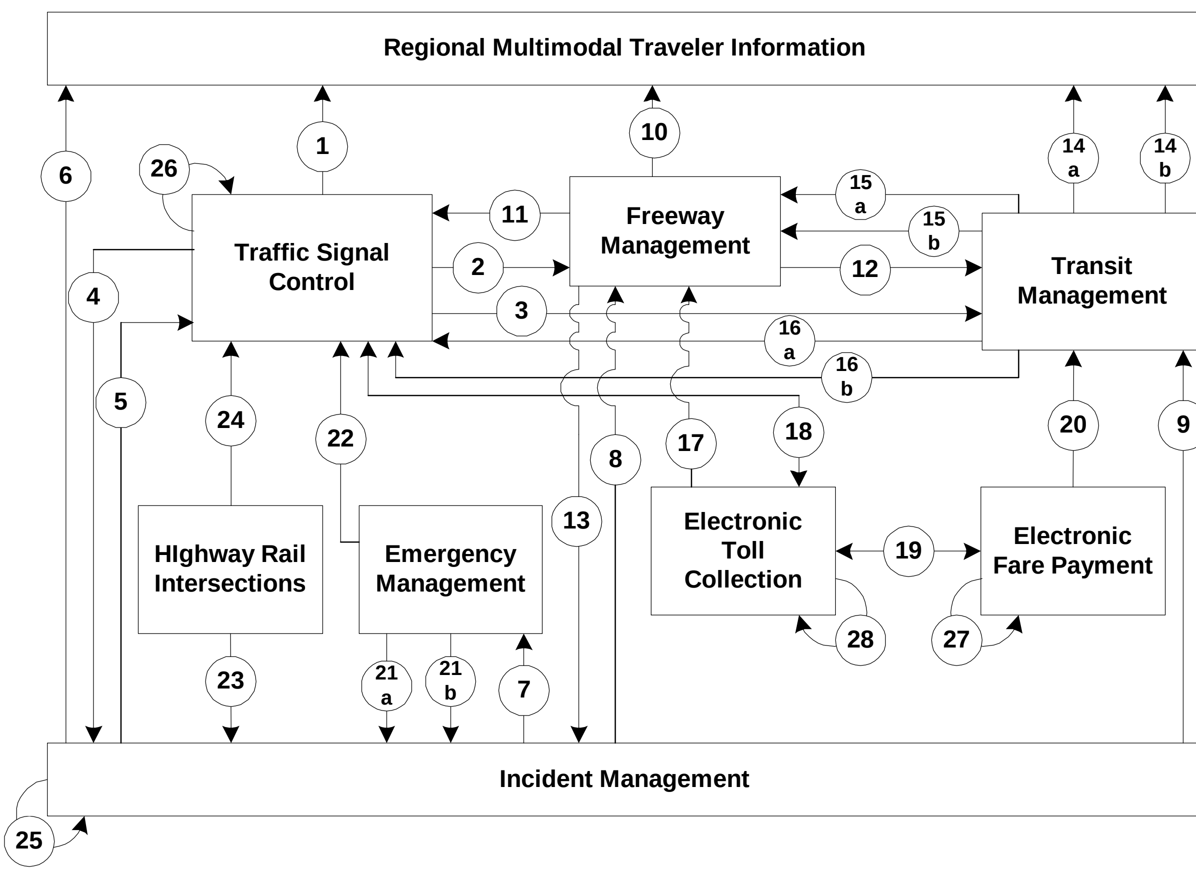
III ITS INFRASTRUCTURE INTEGRATION INDICATOR DESCRIPTION

A. Objectives of Integration

The overall goal of deployment of ITS components is to create a regionally integrated transportation system in which information is shared between components and control activities are coordinated to provide a regionally focused transportation management capability. Individual ITS components (e.g., freeway management, traffic signal control) are typically independently developed by different agencies within a metropolitan area. As a result, components frequently are not readily capable of integrated operation due to a variety of technical and institutional barriers. With the advent of ITS, metropolitan areas are in the process of overcoming these barriers to better coordinate transportation management.

B. Definition of Integration

The first step in measuring integration was to determine the links between components required to provide integrated transportation management. A total of 32 links between components were defined and are shown in the following figure. It was determined that two types of integration links are possible: (1) integration between different components, and (2) integration between different elements of the same component. An example of the first is the transfer of data from the



Traffic Signal Control component to Freeway Management concerning traffic conditions on the arterials (i.e. inter-component). An example of the second is the integration of traffic signal timing along the length of an arterial street that passes through multiple jurisdictions (i.e. intra-component).

Two factors are used in measuring existing integration: (1) information exchange and (2) control. Information exchange is defined as the transfer of information from one element to another, where the recipient element can use the information to structure its response to changing travel conditions more efficiently. Information exchange is measured with a "flow metric," which consider how much of available information is being exchanged to other components. The second factor, control, identifies the manner and use of information that is transferred to the recipient element.

C. Integration Indicators

The following table contains the description and calculation of the integration indicators.

Integration Indicators Calculation

Indicator	**Flow**	**Control**
1. Traffic Signal Control to Regional Multimodal Traveler Information **Description**: Arterial travel time, speed and condition information are displayed by Regional Multimodal Traveler Information media	**Numerator:** Number of signalized plus CBD street miles covered by a transfer of information in real-time describing arterial travel times, speeds or conditions to a *Traveler Information Provider*. **Denominator:** Total number of miles with real-time electronic traffic data collection capabilities located *within* the CBD plus the total number of miles with real-time electronic traffic data collection capabilities located *outside* the CBD	

Indicator	Flow	Control
2. Traffic Signal Control to Freeway Management **Description:** Freeway Management Center monitors arterial travel times, speeds and conditions using data provided from Traffic Signal Control in order to adjust ramp meter timing, lane control or HAR in response to changes in real-time conditions on a parallel arterial.	**Numerator:** Number of signalized plus CBD street miles covered by a transfer of information in real-time describing arterial travel times, speeds or conditions to an organization responsible for *Freeway Management*. **Denominator:** Total number of miles with real-time electronic traffic data collection capabilities located *within* the CBD plus the total number of miles with real-time electronic traffic data collection capabilities located *outside* the CBD	**Numerator:** Number of Freeway Management agencies that receive in real-time data on arterial travel times, speeds, or incidents from a *Traffic Signal System* operator. **Denominator:** Total number of agencies.
3. Traffic Signal Control to Transit Management **Description:** Transit Management adjusts transit routes and schedules in response to arterial travel times, speeds, and conditions information collected as part of Traffic Signal Control	**Numerator:** Number of signalized plus CBD street miles covered by a transfer of information in real-time describing arterial travel times, speeds or conditions to an organization responsible for *Public Transit Operations*. **Denominator:** Total number of miles with real-time electronic traffic data collection capabilities located *within* the CBD plus the total number of miles with real-time electronic traffic data collection capabilities located *outside* the CBD	**Numerator:** Number of Transit Management agencies that receive in real-time information describing arterial travel times, speeds, or conditions and use it to adjust transit routes or schedules **Denominator:** Total number of agencies
4. Traffic Signal Control to Incident Management **Description**: Incident Management monitors real-time arterial travel times, speeds and conditions using data provided from Traffic Signal Control to detect arterial incidents and manage incident response activities.	**Numerator:** Number of signalized plus CBD street miles covered by a transfer of information in real-time describing arterial travel times, speeds or conditions to an organization responsible for *Freeway or Arterial Incident Management*. **Denominator:** Total number of miles with real-time electronic traffic data collection capabilities located *within* the CBD plus the total number of miles with real-time electronic traffic data collection capabilities located *outside* the CBD.	**Numerator:** Number of Incident Management agencies that receive in real-time data on arterial travel times, speeds, or incidents from a *Traffic Signal System* operator and use this data to detect incidents. **Denominator:** Total number of agencies.

Indicator	Flow	Control
5. Incident Management to Traffic Signal Control **Description**: Traffic Signal Control monitors incident severity, location, and type information collected by Incident Management to adjust traffic signal timing or information provided to travelers in response to incident management activities.	**Numerator:** Total number of freeway plus arterial miles covered in the electronic transfer, in real-time, of information on incident severity, location, and type to an organization responsible for *Traffic Signal Control* on arterial and CBD streets**.** **Denominator:** Total number of freeway plus arterial miles covered by a formal procedure for managing incidents.	**Numerator:** Number of agencies that receive in real-time data on freeway and arterial incident severity, location and type from an organization operating a freeway or arterial incident management program **and** use this information to adjust signal timing **times** the total number of signalized intersections located within and outside CBD **Denominator:** Total number of signalized intersections located within and outside CBD
6. Incident Management to Regional Multimodal Traveler Information **Description**: Incident location, severity and type information are displayed by Regional Multimodal Traveler Information media	**Numerator:** Total number of freeway plus arterial miles covered in the electronic transfer, in real-time, of information on incident severity, location, and type to a *Traveler Information Service Provider*. **Denominator:** Total number of freeway plus arterial miles covered by a formal procedure for managing incidents.	
7. Incident Management to Emergency Management **Description:** Incident severity, location and type data collected as part of Incident Management are used to notify Emergency Management for incident response.	**Numerator:** Total number of freeway plus arterial miles covered in the electronic transfer, in real-time, of information on incident severity, location, and type to an organization responsible for *Emergency Management Services.* **Denominator:** Total number of freeway plus arterial miles covered by a formal procedure for managing incidents.	

Indicator	Flow	Control
8. Incident Management to Freeway Management **Description**: Incident severity, location, and type data collected by Incident Management are monitored by Freeway Management for the purpose of adjusting ramp meter timing, lane control or HAR messages in response to freeway or arterial incidents.	**Numerator:** Total number of freeway plus arterial miles covered in the electronic transfer, in real-time of information on incident severity, location, and type to an organization responsible for *Freeway Management*. **Denominator:** Total number of freeway plus arterial miles covered by a formal procedure for managing incidents.	**Numerator:** Number of Freeway Management agencies that receive, in real-time, data on freeway incident severity, location and type from an organization operating a *Freeway Incident Management Program* **and** use this information to adjust ramp meter timing or lane control devices in real-time or to convey information to travelers via roadside infrastructure such as VMS or HAR **Denominator:** Total number of agencies
9. Incident Management to Transit Management **Description:** Transit Management adjusts transit routes and schedules in response to incident severity, location, and type data collected as part of Incident Management	**Numerator:** Total number of freeway plus arterial miles covered in the electronic transfer, in real-time, of information on incident severity, location, and type to an organization responsible for *Public Transit Operations.* **Denominator:** Total number of freeway plus arterial miles covered by a formal procedure for managing incidents.	**Numerator:** Number of Transit Management agencies that receive information describing incident severity, location, and type in real-time **and** use it to adjust transit routes or schedules. **Denominator:** Total number of agencies
10. Freeway Management to Regional Multimodal Traveler Information **Description**: Freeway travel time, speed and condition information are displayed by Regional Multimodal Traveler Information media	**Numerator:** Number of freeway miles covered by an electronic transfer of information describing freeway travel times, speeds, or conditions from a Freeway Management agency to a *Traveler Information Service Provider*. **Denominator:** Number of miles under surveillance by Loop Detectors **plus** number of miles under surveillance by Other Technologies **plus** number of freeway segments monitored by probe reader stations **times** the average length of the segment **less** the miles covered by the probe readers that are also covered by other electronic traffic data collection equipment.	

Indicator	Flow	Control
11. Freeway Management to Traffic Signal Control **Description:** Freeway travel time, speeds, and conditions data collected by Freeway Management are used by Traffic Signal Control to adjust arterial traffic signal timing or arterial VMS messages in response to changing freeway conditions	**Numerator:** Number of freeway miles covered by an electronic transfer of information describing freeway travel times, speeds, or conditions from a Freeway Management agency to a agency responsible for *Traffic Signal Control* on arterial and CBD streets,. **Denominator:** Number of miles under surveillance by Loop Detectors **plus** number of miles under surveillance by Other Technologies **plus** number of freeway segments monitored by probe reader stations **times** the average length of the segment **less** the miles covered by the probe readers that are also covered by other electronic traffic data collection equipment.	**Numerator:** Number of agencies that receive in real-time data on freeway travel times, speeds, or conditions from a freeway management organization **and** use this information to adjust signal timing **times** the total number of signalized intersections located within and outside CBD **Denominator:** Total number of signalized intersections located within and outside CBD
12. Freeway Management to Transit Management **Description:** Transit Management adjusts transit routes and schedules in response to freeway travel times, speeds and conditions information collected as part of Freeway Management.	**Numerator:** Number of freeway miles covered by an electronic transfer of information describing freeway travel times, speeds, or conditions from a Freeway Management agency to a agency responsible for *Public Transit Operations.* **Denominator:** Number of miles under surveillance by Loop Detectors **plus** number of miles under surveillance by Other Technologies **plus** number of freeway segments monitored by probe reader stations **times** the average length of the segment **less** the miles covered by the probe readers that are also covered by other electronic traffic data collection equipment.	**Numerator:** Number of Transit Management agencies that receive information describing freeway travel times, speeds, and conditions automatically in real-time **and** use this information to adjust transit routes or schedules. **Denominator:** Number of agencies

Indicator	**Flow**	**Control**
13. Freeway Management to Incident Management **Description**: Incident Management monitors freeway travel time, speed and condition data collected by Freeway Management to detect incidents or manage incident response.	**Numerator:** Number of freeway miles covered by an electronic transfer of information describing freeway travel times, speeds, or conditions from a Freeway Management agency to an agency responsible for *Incident Management.* **Denominator:** Number of miles under surveillance by Loop Detectors **plus** number of miles under surveillance by Other Technologies **plus** number of freeway segments monitored by probe reader stations **times** the average length of the segment **less** the miles covered by the probe readers that are also covered by other electronic traffic data collection equipment.	**Numerator:** Number of Incident Management agencies that receive information describing freeway travel times, speeds, and conditions automatically in real-time **and** use this information to detect incidents or manage incident response in real-time. **Denominator:** Number of agencies.
14a. Transit Management to Regional Multimodal Traveler Information **Description**: Transit routes, schedules and fare information are displayed on Regional Multimodal Traveler Information media.	**Numerator:** Number or Transit Management agencies that *publish transit routes, schedules and fares* for display on kiosks, Internet sites, and other means to the general public **times** the total motor bus vehicles **plus** the total demand responsive vehicles **plus** the total heavy rail vehicles **plus** the total light rail vehicles **plus** the total other vehicles. **Denominator:** Total motor bus vehicles **plus** the total demand responsive vehicles **plus** the total heavy rail vehicles **plus** the total light rail vehicles **plus** the total other vehicles.	
14b. Transit Management to Regional Multimodal Traveler Information **Description**: Transit schedule adherence information are displayed on Regional Multimodal Traveler Information media	**Numerator:** Number or Transit Management agencies that provide *real-time schedule adherence* from transit vehicles for display on kiosks, Internet sites, and other means to the general public **times** the total motor bus vehicles **plus** the total demand responsive vehicles **plus** the total heavy rail vehicles **plus** the total light rail vehicles **plus** the total other vehicles. **Denominator:** Total motor bus vehicles **plus** the total demand responsive vehicles **plus** the total heavy rail vehicles **plus** the total light rail vehicles **plus** the total other vehicles.	

Indicator	**Flow**	**Control**
15a. Transit Management to Freeway Management (ramp meter priority capability) **Description:** Freeway ramp meters are adjusted in response to receipt of transit vehicle pre-emption signal	**Numerator:** Total motor bus vehicles with Ramp Meter Priority Capability. **Denominator:** Total motor bus vehicles.	**Numerator**: Number of freeway ramps that provide preemption or priority for transit vehicles. **Denominator**: Total number of freeway ramps**.**
15b. Transit Management to Freeway Management (equipped as probes) **Description:** Transit vehicles equipped as probes are monitored by Freeway Management for the purpose of determining freeway travel speeds or travel times	**Numerator:** Total motor bus vehicles equipped to serve as probes to determine highway travel time or speeds on *freeways*. **Denominator:** Total motor bus vehicles	**Numerator:** Number of Freeway Management agencies that receive, in real-time, data on freeway travel time derived from vehicle probes from an agency operating a public transit service **and** use these data to adjust ramp meter timing or lane control devices in real-time **or** convey arterial incident information to travelers via roadside infrastructure such as VMS or HAR **Denominator:** Total number of agencies
16a. Transit Management to Traffic Signal Control **Description**: Traffic signals are adjusted in response to receipt of transit vehicle pre-emption signal.	**Numerator:** Total motor bus vehicles equipped with Traffic Signal Priority Capability. **Denominator:** Total motor bus vehicles.	**Numerator:** Total number of signalized intersections located within and outside CBD that allow signal preemption or priority by transit vehicles **Denominator:** Total number of signalized intersections located within and outside CBD
16b. Transit Management to Traffic Signal Control (equipped as probes) **Description:** Transit vehicles equipped as probes are monitored by Traffic Signal Control for the purpose of determining arterial speeds or travel times.	**Numerator:** Total motor bus vehicles equipped to serve as probes to determine highway travel times or speeds on *signalized arterial streets*. **Denominator:** Total motor bus vehicles.	**Numerator:** Number of Traffic Signal Control agencies that receive, in real-time, data on arterial travel times derived from vehicle probes from an agency operating a public transit service **and** use this information to adjust signal timing. **Denominator**: Number of agencies

Indicator	Flow	Control
17. Electronic Toll Collection to Freeway Management **Description:** Vehicles equipped with electronic toll collection (ETC) tags are monitored by Freeway Management for the purpose of determining freeway travel speeds or travel times.	**Numerator:** Total freeway miles that have travel times measured with probe data received, in real-time, by an organization operating an *Electronic Toll Collection* program.. **Denominator:** Number of miles under surveillance by Loop Detectors **plus** number of miles under surveillance by Other Technologies **plus** number of freeway segments monitored by probe reader stations **times** the average length of the segment **less** the miles covered by the probe readers that are also covered by other electronic traffic data collection equipment.	**Numerator:** Number of Freeway Management agencies that receive, in real-time, data on freeway travel time derived from vehicle probes from an agency operating a public transit service **and** use these data to adjust ramp meter timing or lane control devices in real-time **or** convey arterial incident information to travelers via roadside infrastructure such as VMS or HAR **Denominator:** Total number of agencies
18. Electronic Toll Collection to Traffic Signal Control **Description:** Vehicles equipped with electronic toll collection (ETC) tags are monitored by Traffic Signal Control for the purpose of determining arterial travel speeds or travel times	**Numerator:** Total arterial miles that have travel time measured with probe data received, in real-time, from an organization operating an *Electronic Toll Collection* program. **Denominator:** Total number of arterial roadway segments that are covered by probe readers over which trave **times** are developed time the average length of the segment	**Numerator:** Number of Traffic Signal Control Agencies that receive, in real-time, data on arterial travel times derived from vehicle probes from an organization operating an Electronic Toll Collection program **and** use these data to adjust signal timing **Denominator:** Number of agencies
19. Electronic Toll Collection to/from Electronic Fare Payment **Description**: Transit operators accept ETC- issued tags to pay for transit fares	**Numerator**: Total number of transit operators that accept toll tags to pay transit fares. **Denominator**: Total number of Transit Management Fare Payment surveys **plus** the total number of Electronic Toll Collection surveys	
20. Electronic Fare Payment to Transit Management **Description:** Rider ship details collected as part of Electronic Fare Payment are used in transit service planning by Transit Management	**Numerator:** Percentage of electronically collected fare data stored for later use in service planning **times** the total number of trips rom the National Transit Database **Denominator:** Total number of trips rom the National Transit Database	

Indicator	Flow	Control
21a. Emergency Management Services to Incident Management (incident severity) **Description**: Incident Management is notified of incident location, severity and type by Emergency Management for the purpose of identifying incidents on freeways or arterials	**Numerator:** Number of Incident Management agencies that receive, in real-time, *incident severity, location and type* data from an emergency service agency **times** the average of the percent of Police, Fire and Emergency Medical services that participate in a formal working agreement or incident management team. **Denominator:** Number of agencies	
21b. Emergency Management Services to Incident Management (incident clearance activities) **Description:** Incident Management is notified of incident clearance activities by Emergency Management for the purpose of managing incident response on freeways or arterials.	**Numerator:** Number of Incident Management agencies that receive, in real-time, *incident clearance activities* data from an emergency service agency **times** the average of the percent of Police, Fire and Emergency Medical services that participate in a formal working agreement or incident management team. **Denominator:** Number of agencies	
22. Emergency Management Services to Traffic Signal Control **Description**: Emergency Management vehicles are equipped with traffic signal priority capability.	**Numerator:** Number of ER vehicles with traffic signal system communications. **Denominator:** Total number of Emergency Response vehicles operated	**Numerator:** Total number of signalized intersections located within and outside CBD that allow signal preemption or priority to emergency vehicle. **Denominator:** Total number of signalized intersection located within and outside CBD
23. Highway Rail Intersections to Incident Management **Description**: Incident Management is notified of crossing blockages by Highway-rail intersection for the purpose of managing incident response.	**Numerator:** Number of highway rail intersections covered by a transfer of information on train or vehicle blockage on highway intersection in real-time, from an agency responsible for maintaining rail intersection. **Denominator:** Total number of highway-rail intersections	

Indicator	Flow	Control
24. Highway Rail Intersections to Traffic Signal Control **Description**: Highway-rail intersection and Traffic Signal Control are interconnected for the purpose of adjusting traffic signal timing in response to train crossing.		**Numerator:** Number of traffic signals equipped with capability to adjust signal timing in response to train crossing **Denominator:** Total number of traffic signals maintained by the agency that area within 200 feet of a highway-rail intersection
25. Incident Management intra component integration **Description**: Agencies participating in formal working agreements or incident management plans coordinate incident detection, verification, and response.	**Numerator:** Percent of local state and state police + fire agencies + emergency medical vehicles participating in a formal working Incident Management agreement or Incident Management Team **Denominator:** 3	
26. Traffic Signal Control intra component integration **Description**: Agencies operating traffic signals along common corridors sharing information and possibly control of traffic signals to maintain progression on arterial routes.	**Numerator:** Number of agencies that *share information describing fixed timing plans* with other agencies in order to maintain progression on an arterial route that includes signals maintained by both agencies **or** number of agencies that *coordinate changes to fixed plans* with other agencies in order to maintain progression on an arterial route that includes signals maintained by both agencies **Denominator:** Number of agencies	
27. Electronic Fare Payment intra component integration **Description**: Operators of different public transit services share common electronic fare payment media.	**Numerator:** Number of agencies capable of having their riders use the same electronic fare media on different modes of transportation **or** number of agencies that can use other agencies electronic fare media **Denominator:** Number of agencies**.**	
28. Electronic Toll Collection intra component integration **Description:** Electronic Toll Collection agencies share a common toll tag for the purpose of facilitating "seam less" toll transactions.	**Numerator:** Number of toll operators that use tags used by other toll operators in a metropolitan area **Denominator:** Total number of Toll Operator	

IV. MEASURING AND TRACKING THE "SHOULD" CASE FOR 2005 DEPLOYMENT GOAL

Background

The deployment tracking indicators described in this document are surrogates for deployment and do not necessarily reflect the full breadth of metropolitan ITS deployment activity. They were selected to provide a simple and intuitive measure of deployment that can be counted and tracked over time. These indicators employ a convention in which a numerator consisting of the current level of deployment is compared to a denominator based on full market saturation or maximum possible deployment. Accordingly, the indicators in every case show the percentage of what "could" be deployed. However, it is clear that in many cases, local conditions will dictate a deployment strategy something short of total saturation. For example, it may only be necessary to deploy surveillance instrumentation on the portion of the freeway system where congestion or incidents are at high levels.

A more useful indicator of deployment would be to compare current deployment to the maximum required based on local criteria, resulting in the percentage of what "should" be deployed. In the 1999 update to the deployment tracking database, metropolitan communities will be asked to provide deployment goals as of 2005. Deployment tracking indicators will be measured against these goals to provide information on progress toward the "should" case. It is anticipated that deployment goals will be based on a metropolitan deployment plan based on regional needs following a comprehensive area assessment. What follows is the description of a process for describing deployment goals in a manner compatible with the deployment tracking indicators. The result of this process is an ITS network consisting of the road network segments judged appropriate for deployment of ITS technology. Written in terms of deployment tracking goals, this network becomes the basis for tracking the "should" case for deployment.

Goal Setting Steps

Goal setting using the deployment tracking methodology can be accomplished using the following steps:

- Select Preliminary ITS Planning Network
- Evaluate ITS Planning Network
- Select Final ITS Network
- Identify Coverage Goals
- Monitor Coverage Goals

1. *Select Preliminary ITS planning network.* Transportation assets that will be considered for ITS deployment will be defined. Typically, these include freeways and major arterials in addition to public transit vehicles and stations, toll plazas, and highway rail intersections.

2. *Evaluate ITS Planning Network* . Criteria are established to evaluate the performance of the ITS network. These measures can include the following:

Traffic characteristics along the route, including existing traffic volumes and congestion levels, as well as projected demand.

Travel characteristics. The greatest benefits of ITS are expected to occur on routes which carry regional traffic (i.e. trips of greater than 5 miles) as opposed to routes which primarily serve local traffic needs.

Transit routes.

National route designation.

Existing and committed levels of ITS infrastructure.

Jurisdictional coverage.

3. *Select Final ITS Network*. Needs are balanced against available resources to develop a final ITS network. The recommended ITS routes should provide broad regional coverage of the metropolitan area and focus deployment of advanced detection, monitoring, and communications on major carriers of regional traffic.

4. *Identify Coverage Goals*. This step includes the specification of deployment goals following the deployment tracking indicators. For example, in the case of Freeway Management, a goal to deploy surveillance on the most congested segments may be established. These coverage goals become the basis for monitoring progress and maintaining the program on track toward implementation.

5. *Monitor Coverage Goals*. Deployment progress is tracked using the deployment tracking indicators based on the coverage goals established for the region.

It is important to note that this recommended coverage is considered to define a realistic target for deployment of ITS in the region and provides a basis for estimating probable deployment costs. Deployment goals set in this process will evolve over time. As the regional transportation planning process continues and transportation priorities change, specific opportunities for ITS deployment will grow and wane.

Section III - “Deployment Tracking Questionnaires”

Freeway Management

*Metropolitan Area:*______________________________________ *Date Completed:*____________________

Name:____
Title:____
Organization:____
Street: ________________________________City: ____________________State: _______Zip: __________
Phone Number: ______________________________Fax Number:___________________________________
E-mail:____

The purpose of this questionnaire is to help you inventory ITS technologies and services currently deployed in your metropolitan area.

Technical questions can be directed to:

Please return completed questionnaire to:

1. Please identify the geographical and/or jurisdictional areas to which your answers to this survey apply (e.g., all freeways within the region, or freeways only within certain counties). Area of geographical or jurisdictional coverage:

Freeway Management (continued)

2. Does your agency operate a Freeway Management Center?

G No; go to Question 3. G Yes, planned to begin operation on what date? ________
G Yes, as of what date: ________

If yes, what is the name of this center?____
How many management, maintenance, and operations personnel work in this center?_____________________
What freeways are under surveillance by this center? (Please describe below, e.g.I-90 between Exit 45 and Exit 12)

____

____

How many freeway centerline miles are under surveillance by this center? ______ miles
What type of communications is used (check all that apply and provide the number of freeway centerline miles affected)?

G Twisted pair cable _____ miles
G Coaxial cable _____ miles
G Fiber optic cable _____ miles
G Microwave radio _____ miles
G Other (specify) _________________________ ________ miles
G Other (specify) _________________________ ________ miles

THE FOLLOWING QUESTIONS FOCUS ON REAL-TIME TRAFFIC DATA COLLECTION CAPABILITIES OPERATED BY YOUR AGENCY ON THE FREEWAYS. THE TYPES OF DATA COLLECTED BY THESE DEVICES MAY INCLUDE VEHICLE VOLUME, SPEED, AND DENSITY. THE DEVICES USED TO COLLECT SUCH DATA TYPICALLY INCLUDE LOOP DETECTORS, VIDEO IMAGE DETECTORS, RADAR, AND ACOUSTIC DETECTORS AND VEHICLES AS PROBES.

3. Are any of the freeways operated by your agency and located within the Metropolitan area, currently under electronic surveillance using real-time traffic data collection technologies?

G No; go to Question 4.
G Yes

If yes, what types of real-time traffic data collection technologies are used to collect data vehicle volume, speed, and density data (check all that apply)?

G Loop Detectors
G Closed Circuit Television
G Vehicle Probe Readers
G Other (specify) ____
G Other (specify) ____

3. Continued

How many of the following electronic data collection devices are deployed?

G Loop Detectors ________ stations (count each direction individually)
G Closed Circuit Television ________ cameras. Specify average range of view ______ miles.
G Other (specify) ____
G Other (specify) ____

How many freeway centerline miles are under surveillance by the following data collection technologies?

G Loop Detectors _____ miles
G Closed Circuit Television _____ miles
G Other (specify) _____________________________________ miles
G Other (specify) _____________________________________ miles

4. Does your agency operate probe reader stations to collect traffic data on freeways?

G No; go to Question 5.
G Yes

If yes: How many probe reader stations are installed? ________________
How many freeway segments are monitored? _________________
What is the average length of these segments? ________________ miles

Approximately how many probe vehicles are deployed? ________________ vehicles

How many freeway miles covered by probe readers are also covered by other electronic traffic data collection equipment used to estimate vehicle speed (e.g., loop detectors to estimate speed)? __________________ miles

How many probe vehicles are counted on a segment during a typical five-minute period during peak travel times? ___________________ vehicles

THE FOLLOWING QUESTIONS FOCUS ON THE TECHNOLOGIES USED BY YOUR AGENCY TO DISTRIBUTE INFORMATION TO TRAVELERS DIRECTLY USING ROADSIDE INFRASTRUCTURE ON THE FREEWAYS.

5.What types of roadside technologies are used to distribute traveler information on the freeways check all that apply and provide the number deployed)?

G Permanent variable message signs (VMS)Number deployed: ______ signs
G Highway advisory radio (HAR) Number deployed: ______ stations
G In-vehicle signing Number deployed: ______ transmitter locations
G Other (specify) ______________________Number deployed: ______
G None—traveler information is not distributed via roadside technologies

6. How many of the freeway centerline miles are covered by the following roadside technologies deployed to distribute traveler information on the freeways (check all that apply and estimate the number of freeway centerline miles covered).

G Permanent variable message signs (VMS) Miles: ______
G Highway advisory radio (HAR) Miles: ______
G In-vehicle signing Miles: ______
G Other (specify) ______________________ Miles: ______
G Other (specify) ______________________ Miles: ______
G None—traveler information is not distributed

THE FOLLOWING QUESTIONS CONCERN THE USE OF RAMP METERING AND LANE CONTROL ON THE FREEWAYS.

7. Does your agency operate ramp meters on freeways?

G No; go to Question 8.
G Yes

If yes:

How many freeway entrance ramps are located on the freeway system operated by your agency? ______ number

How many entrance ramps are under ramp meter control? ______ number

How many of these ramp meters operate under isolated control? ______ number

How many of these ramp meters operate under central control? ______ number

How many of these ramp meters provide preemption or priority for transit vehicles? ______ number

How many of these ramp meters provide preemption or priority to emergency vehicles? ______ number

How many freeway-to-freeway ramps are under some form of ramp meter control? ______ number

8. Does your agency operate lane control devices (e.g., changeable overhead directional arrows) on freeways?

G No; go to Question 9.
G Yes

If yes, how many freeway miles are under lane control? ___________ miles

THE FOLLOWING QUESTIONS CONCERN THE USE OF THE WORLD WIDE WEB (WWW) TO DISTRIBUTE FREEWAY TRAVEL CONDITION INFORMATION.

9. Does your agency maintain a World Wide Web site that displays real-time freeway travel conditions?

G No; go to Question 10.
G Yes

If yes, freeway centerline miles displayed: _______________ miles
If yes, to the best of your knowledge, is this web page used by any groups, organizations, or agencies to manage any of the following functions (check all that apply).

G Incident management
G Traffic signal control
G Public transit operations and planning
G Distribution of freeway travel condition information (e.g., commercial radio station)
G Other (specify) ____

THE FOLLOWING QUESTIONS ARE USED TO DETERMINE IF THERE IS TRANSFER IN TIME INTERVALS NO LARGER THAN 5-MINUTES VIA ELECTRONIC MEANS, FREEWAY TRAVEL TIMES, SPEEDS, OR CONDITIONS (E.G., DATA FROM LOOP DETECTORS) DATA TO OTHER GROUPS, AGENCIES OR ORGANIZATIONS.

10. Does your agency share, electronically and in time intervals no larger than 5-minutes, data describing freeway travel times, speeds, or conditions with any organization responsible for the following activities (check all that apply)? Note: If the only transfer occurs via a World Wide Web site, please go to Question 12.

G Incident management
Name of organization, agency or group:____
Freeway centerline miles covered by the transfer: ______________ miles
Method used to transfer data (check one):
G Transfer between separate computer systems
G A common (shared) data based
G Other (specify)____

G Traffic signal control on arterial and Central Business District streets
Name of organization, agency or group:____
Freeway centerline miles covered by the transfer: ______________ miles
Method used to transfer data (check one):
G Transfer between separate computer systems
G A common (shared) data based
G Other (specify)____

10. Continued.

G Public transit operations
Name of organization, agency or group:____
Freeway centerline miles covered by the transfer: _____________ miles
Method used to transfer data (check one):
- G Transfer between separate computer systems
- G A common (shared) data based
- G Other (specify)____

G Traveler information service provider (e.g. Regional Multimodal Traveler Information Center, private Information Service Provider [ISP])
Name of organization, agency or group:____
Freeway centerline miles covered by the transfer: _____________ miles
Method used to transfer data (check one):
- G Transfer between separate computer systems
- G A common (shared) data based
- G Other (specify)____

G Do not electronically share these data

11. Does your agency share, electronically and in time intervals no longer than 5-minutes, data on freeway entrance ramp queue lengths with agencies responsible for traffic signals?

G No; go to Question 12.
G Yes

If yes, what is the name of the organization, agency, or group receiving these data? ____________________

Number of freeway entrance ramps covered: ____________________

Method used to transfer data (check one):

G Transfer between separate computer systems
G A common (shared) data base
G Other (specify) ______________________________________

THE FOLLOWING QUESTIONS ARE USED TO DETERMINE WHETHER YOUR AGENCY RECEIVES, IN REAL-TIME VIA ELECTRONIC MEANS, DATA FROM OTHER GROUPS, AGENCIES OR ORGANIZATIONS

12. Does your agency receive, in real-time via electronic means, data on arterial travel times, speeds, or incidents from an operator traffic signal systems? (The data must be summarized in time intervals no larger than 5-minutes.)

G No; go to Question 13.
G Yes

If yes, what is the name of the organization, agency, or group providing these data?______________________

How are these data used by your agency to manage the freeway system (check all that apply)?

G Adjust ramp meter timing or lane control devices in real-time
G Convey arterial incident information to travelers via roadside infrastructure such as VMS or HAR
G Other (specify)____

13. Does your agency receive, in real-time via electronic means, data on freeway incident severity, location and type from the organization or group operating a freeway incident management program? (The data must be summarized in time intervals no larger than 5-minutes.)

G No; go to Question 14.
G Yes

If yes, what is the name of the organization, agency, or group providing these data?______________________

How are these data used by your agency to manage the freeway system (check all that apply)?

G Adjust ramp meter timing or lane control devices in real-time
G Convey arterial incident information to travelers via roadside infrastructure such as VMS or HAR
G Other (specify)____

Freeway Management (continued)

14. Does your agency receive, in real-time via electronic means, data on freeway travel time data derived from vehicle probes from an agency, organization or group operating an electronic toll collection program? (The data must be summarized in time intervals no larger than 5-minutes.)

G No; go to Question 15.
G Yes

If yes, what is the name of the organization, agency, or group providing these data?______________________

How many freeway miles have travel times measured with these probe data?____________________________

How are these data used by your agency to manage the freeway system (check all that apply)?

G Adjust ramp meter timing or lane control devices in real-time
G Convey arterial incident information to travelers via roadside infrastructure such as VMS or HAR
G Other (specify)____

15. Does your agency receive, in real-time via electronic means, data on freeway travel time data derived from vehicle probes from an agency, organization, or group operating a public transit service? (The data must be summarized in time intervals no larger than 5-minutes.)

G No
G Yes

If yes, what is the name of the organization, agency, or group providing these data?______________________

How many freeway miles have travel times measured with these probe data?____________________________

How are these data used by your agency to manage the freeway system (check all that apply)?

G Adjust ramp meter timing or lane control devices in real-time
G Convey arterial incident information to travelers via roadside infrastructure such as VMS or HAR
G Other (specify)____

Additional Comments:

Incident (Freeway and Arterial) Management

*Metropolitan Area:*______________________________________ *Date Completed:*____________________

Name:____
Title:____
Organization:____
Street: ________________________________City: ____________________State: _______Zip: ___________
Phone Number: _____________________________Fax Number:_______________________________________
E-mail:____

The purpose of this questionnaire is to help you inventory ITS technologies and services currently deployed in your metropolitan area.

Technical questions can be directed to:

____
____
____
____

Please return completed questionnaire to:

____
____
____
____

1. Please identify the geographical and/or jurisdictional areas to which your answers to this survey apply (e.g., all freeways within the region, or freeways only within certain counties). Area of geographical or jurisdictional coverage:

____
____
____
____
____
____
____
____
____
____
____
____

Incident Management (continued)

2. Does your agency (or any other agency) operate or sponsor any of the following on-call Incident Management services on freeways?

- G Publicly operated service patrol vehicles during peak travel periods.
- G Privately operated service patrol vehicles operated under public contract during peak travel periods.
- G Publicly owned vehicles with towing equipment operating during peak travel periods.
- G None of the above

How many freeway centerline miles are patrolled by these services? ____________________

Comments:

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3. Does your agency (or any other agency) operate or sponsor any of the following on-call Incident Management services on arterials?

- G Publicly operated service patrol vehicles during peak travel periods.
- G Privately operated service patrol vehicles operated under public contract during peak travel periods.
- G Publicly owned vehicles with towing equipment operating during peak travel periods.
- G None of the above

How many freeway arterial centerline miles are patrolled by these services? ____________________

Comments:

THE FOLLOWING QUESTIONS ARE USED TO DETERMINE WHETHER YOU ARE TRANSFERRING, IN REAL-TIME VIA ELECTRONIC MEANS, INCIDENT SEVERITY, LOCATION, AND TYPE DATA TO OTHER GROUPS, AGENCIES OR ORGANIZATIONS.

4. Do you electronically transfer, in real-time, incident severity, location, and type data to any organization responsible for any of the following activities (check all that apply):

G Freeway Management

Name of organization, agency or group____
Freeway centerline miles covered by this transfer:______________________________
Arterial centerline miles covered by this transfer:______________________________

Method used to transfer data (check all that apply):
G Phone call or radio transmission
G Transfer between separate computer system
G A common shared data base
G Other (specify)____

G Traffic signal control on arterials and Central Business District streets

Name of organization, agency or group____
Freeway centerline miles covered by this transfer:______________________________
Arterial centerline miles covered by this transfer:______________________________

Method used to transfer data (check all that apply):
G Phone call or radio transmission
G Transfer between separate computer system
G A common shared data base
G Other (specify)____

G Emergency Management services (e.g. police, fire, ambulance)

Name of organization, agency or group____
Freeway centerline miles covered by this transfer:______________________________
Arterial centerline miles covered by this transfer:______________________________

Method used to transfer data (check all that apply):
G Phone call or radio transmission
G Transfer between separate computer system
G A common shared data base
G Other (specify)____

4. Continue

G Public transit operations

Name of organization, agency or group______________________________________
Freeway centerline miles covered by this transfer:____________________
Arterial centerline miles covered by this transfer:____________________

Method used to transfer data (check all that apply):
- G Phone call or radio transmission
- G Transfer between separate computer system
- G A common shared data base
- G Other (specify)____

G Traveler information service provider (e.g. Regional Multimodal Traveler Information Center, private Information Service Provider [ISP])

Name of organization, agency or group______________________________________
Freeway centerline miles covered by this transfer:____________________
Arterial centerline miles covered by this transfer:____________________

Method used to transfer data (check all that apply):
- G Phone call or radio transmission
- G Transfer between separate computer system
- G A common shared data base
- G Other (specify)____

THE FOLLOWING QUESTIONS ARE USED TO DETERMINE WHETHER YOUR AGENCY RECEIVES, IN REAL-TIME VIA ELECTRONIC MEANS, DATA FROM OTHER GROUPS, AGENCIES OR ORGANIZATIONS THAT IS USED BY YOUR AGENCY TO MANAGE INCIDENTS

5. Does your agency receive, in real-time via electronic means, data on arterial travel times, speeds, or incidents from an operator of traffic signal systems?

G No
G Yes
If yes, what is the name of the organization, agency or group providing these data?____________________

How many arterial centerline miles are covered by this transfer? ______________

How are these data used by your agency for incident management (check all that apply)?
- G Detect incidents
- G Manage incident response in real-time
- G Other (specify)____

Incident Management (continued)

6. Does your agency receive, in real-time via electronic means, data on freeway travel times, speeds, or conditions from the organization or group operating a freeway management system?

G No
G Yes
If yes, what is the name of the organization, agency or group providing these data?________________________

How many freeway centerline miles are covered by this transfer? _________________

How are these data used by your agency for incident management (check all that apply)?
G Detect incidents
G Manage incident response in real-time
G Other (specify)____

7. Does your agency receive, in real-time via electronic means incident clearance activities data from an emergency services agency, organization or group (e.g., do emergency response personnel on an incident scene report that the incident has been cleared)?

G No
G Yes

If yes, what are the names of the organization, agency or group providing these data?

____
____
____
____
____
____
____
____
____

How many freeway centerline miles are covered by these types of data? ________________ miles.
How many arterial centerline miles are covered by these types of data? ________________ miles.

How does this transfer occur (check all that apply):
G Phone calls or radio transmissions
G Transfer between separate computer system
G Through a common (shared) data base

Incident Management (continued)

8. Does your agency receive, in real-time via electronic means incident severity, location and type data from an emergency services agency, organization or group (e.g., do emergency management personnel report the occurrence and characteristics of an incident directly to your agency)?

G No
G Yes

If yes, what are the names of the organization, agency or group providing these data?

____
____
____
____
____
____
____
____
____

How many freeway centerline miles are covered by these types of data? _______________ miles.
How many arterial centerline miles are covered by these types of data? _______________ miles.

How does this transfer occur (check all that apply):
G Phone calls or radio transmissions
G Transfer between separate computer system
G Through a common (shared) data base

9. Does your agency receive, in real-time via electronic means, data on train or vehicle blockage of highway rail intersections from an agency, organization or group responsible for maintaining highway rail intersections?

G No
G Yes

If yes, what is the name of the organization, agency or group providing these data?_______________________

How many highway rail intersections are covered by this transfer? _______ grade crossings

10. The following questions are concerned with the methods used by your agency to *detect and verify* incidents.

a. Does a formal procedure for managing incidents exist in your area?
G No
G Yes, please estimate the mileage covered:
Freeway centerline miles: ____________________
Arterial centerline miles: ____________________
Name of coordinating agency:____

b. Are incidents reported by the public via cellular phone calls?
G No
G Yes: Is it a free call? G No G Yes
Is it to a dedicated phone number specifically for incident reporting and separate from 911?
G No
G Yes, what agency receives the calls?____

c. Are incidents detected using computer algorithms based on electronically collected traffic data (e.g. from loop detectors)?
G No
G Yes: How many freeway centerline miles are covered by the algorithms?_________________
How many arterial centerline miles are covered by the algorithms?_________________

d. If methods other than cellular phone calls or detection algorithms are used to detect incidents, use the following table to describe the additional methods.

Detection Method	*Freeway centerline miles covered by the method*	*Arterial centerline miles covered by the method*

e. If a method other than Closed Circuit Television is used to verify incidents, please describe it below.

____
____
____
____

Freeway centerline miles covered by this method: ________________ miles
Arterial centerline miles covered by this method: ________________ miles

11. The following questions relate to your procedures for *incident response*.

a. Do you have either: 1) a formal working agreement or arrangement (e.g., an Incident Management Plan) or 2) a formal Incident Management Team that meets on a regular basis (check all that apply):

- G formal working agreement/arrangement
- G formal Incident Management Team
- G other (please describe):____
- G none of the above, go to Question 12.

b. What percentage of local and state police, fire, and emergency medical services participate in a formal working agreement or Incident Management team:

Percentage of individual agencies in the region:

Police agencies:	__________ %
Fire agencies:	__________ %
Emergency Medical Services:	__________ %
Other:	__________ %
Other:	__________ %

c. Please describe the details of the arrangements that are made for towing/wrecker services to remove damaged vehicles from incident scenes. This includes both public agencies and contracted private sources (e.g., private towing services through towing contracts, rotation arrangements, or contracted rotation agreements).

____
____
____
____
____
____
____
____

12. If your agency keeps formal records or statistics on the following items, please provide the following information:

a. Average number of incident calls/responses per year: _________
b. Average response time: _________
c. Average clearance time (to clear traffic lanes): ________

Additional Comments:

Traffic Signal Control Systems

*Metropolitan Area:*______________________________________ *Date Completed:*____________________

Name:____
Title:____
Organization:____
Street: _________________________________City: ____________________State: _______Zip: __________
Phone Number: _____________________________Fax Number:___________________________________
E-mail:____

The purpose of this questionnaire is to help you inventory ITS technologies and services currently deployed in your metropolitan area.

Technical questions can be directed to:

Please return completed questionnaire to:

1. Please identify the geographical and/or jurisdictional areas to which your answers to this survey apply (e.g., all freeways within the region, or freeways only within certain counties). Area of geographical or jurisdictional coverage:

THE FOLLOWING QUESTIONS CONCERN TRAFFIC SIGNALS. THESE QUESTIONS DISTINGUISH BETWEEN TRAFFIC SIGNALS LOCATED ON ALL STREETS WITHIN THE CENTRAL BUSINESS DISTRICT(S) (QUESTION 2) AND ON ARTERIALS LOCATED OUTSIDE THE CENTRAL BUSINESS DISTRICT(S) (QUESTION 3).

2. Traffic Signals located within the Central Business District(s)

a. Total number of signalized intersections: ______________________
b. Total number of signalized intersections under closed loop control:______________________
c. Total number of signalized intersections under centralized control:______________________
d. Total number of signalized intersections with real-time traffic adaptive control using SCOOT/SCATS or similar advanced software: ______________________
e. Year of last upgrade of traffic signal control system software: ______________________
f. Total number of signalized intersections that allow signal preemption or priority by emergency vehicles: ______________________
g. Total number of signalized intersections that allow signal preemption or priority by transit vehicles:______________________
h. Please summarize the approximate age for each signal controllers located within the Central Business District by completing the table below.

	Number of Controllers by Age (years)				
Type of Signal Controller	***0-5***	***6-10***	***11-15***	***16-20***	***21+***
NEMA					
170/179					
2070					
Other (specify)					
Other (specify)					

3. Traffic Signals located on arterial streets outside the Central Business District(s)

a. Total number of signalized intersections: ______________________
b. Total number of signalized intersections under closed loop control:______________________
c. Total number of signalized intersections under centralized control:______________________
d. Total number of signalized intersections with real-time traffic adaptive control using SCOOT/SCATS or similar advanced software: ______________________
e. Date of last upgrade of traffic signal control system software: _____________________
f. Total number of signalized intersections that allow signal preemption or priority by emergency vehicles: ______________________
g. Total number of signalized intersections that allow signal preemption or priority by transit vehicles:______________________

3. Continued.

h. Please summarize the approximate age for each signal controllers located within the Central Business District by completing the table below.

	Number of Controllers by Age (years)				
Type of Signal Controller	***0-5***	***6-10***	***11-15***	***16-20***	***21+***
NEMA					
170/179					
2070					
Other (specify)					
Other (specify)					

4. Does your agency operate a Centralized Traffic Signal Control Center?

G No
G Yes, as of what date? __________
G Yes, planned to begin on what date? __________

If yes, please answer the following:

What is the name of this center?: ____
Number of management, maintenance, and operations personnel: ____________________________
Latest year when this center was upgraded: _______________________
What is the name of the system developer?____
What is the make/model of the central computer that controls the system?_______________________
What system software is used to control the system? ____________________________

What type of communications is used by this system (check all that apply and indicate the number of arterial centerline miles affected)?

G Twisted pair cable _____ Arterial centerline miles
G Coaxial cable _____ Arterial centerline miles
G Fiber optic cable _____ Arterial centerline miles
G Microwave radio _____ Arterial centerline miles
G Other: ____________ _____ Arterial centerline miles

THE FOLLOWING QUESTIONS ARE DESIGNED TO DETERMINE WHETHER YOUR AGENCY HAS ESTABLISHED EITHER FORMAL OR INFORMAL WORKING AGREEMENTS TO SHARE TRAFFIC SIGNAL TIMING PLANS OR COORDINATE TRAFFIC SIGNAL CONTROL ON ARTERIALS WITH ANOTHER AGENCY.

5. Does your agency share information describing fixed timing plans with other agencies in order to maintain progression on an arterial route that includes signals maintained by both of your agencies?

a. Total number of adjacent jurisdictions that share an arterial route with you:________________________
b. **G** No, do not share information. Go to Question 6.
G Yes, information is shared.

If yes, what are the names of these agencies?____

Comments: ____

6. Does your agency coordinate changes to fixed timing plans with other agencies in order to maintain progression on an arterial route that includes signals maintained by both of your agencies?

G No, go to Question 7.
G Yes

If yes, how is this response accomplished (check all that apply)?
G shift to traffic responsive at same time **G** rely on automated dynamic response

What are the name of the agencies?____

Comments: ____

7. Does your agency ever turn over control of traffic signals normally maintained by your agency to another agency to manage special events, emergencies, or other short term time periods?

G No, go to Question 8.
G Yes

If yes, what are the name of the agencies? ____

Comments:____

THE FOLLOWING QUESTIONS ARE DESIGNED TO DETERMINE THE NATURE OF ARTERIAL ROADWAY SURVEILLANCE ACTIVITIES . THESE QUESTIONS DISTINGUISH BETWEEN ARTERIAL ROADWAYS LOCATED WITHIN THE CENTRAL BUSINESS DISTRICT(S) (QUESTION 8) AND ARTERIAL ROADWAYS LOCATED OUTSIDE THE CENTRAL BUSINESS DISTRICT(S) (QUESTION 9).

Traffic Signal Control Systems (continued)

8. All streets located within the Central Business District(s)

a. Number of centerline miles with real-time electronic traffic data collection capabilities (e.g., loop detectors that provide volume and speed data at midblock locations; this excludes actuators on intersection approaches):
   Miles covered: ___________________
   Technologies used: ___________________
b. Number of variable message signs on mainline streets: ___________________
c. Number of miles covered by Highway Advisory Radio: ___________________
d. Number of variable message signs controlling parking access: ___________________
e. Number of in-vehicle signing transmitter locations: ___________________
f. Number of CCTV cameras deployed: ___________________
   How much of an arterial can be viewed by a single camera (on average): ___________________ miles

9. Arterial streets located outside the Central Business District(s)

a. Number of centerline miles with real-time electronic traffic data collection capabilities (e.g., loop detectors that provide volume and speed data at midblock locations; this excludes actuators on intersection approaches):
   Miles covered: ___________________
   Technologies used: ___________________
b. Number of variable message signs on mainline streets: ___________________
c. Number of miles covered by Highway Advisory Radio: ___________________
d. Number of variable message signs controlling parking access: ___________________
e. Number of in-vehicle signing transmitter locations: ___________________
f. Number of CCTV cameras deployed: ___________________
   How much of an arterial can be viewed by a single camera (on average): ___________________ miles

THE FOLLOWING QUESTIONS RELATE TO THE USE OF VEHICLE PROBES TO MEASURE TRAVEL TIMES ON ARTERIAL ROADWAY SEGMENTS. A SEGMENT IS DEFINED AS A SECTION OF HIGHWAY BOUNDED ON EITHER END BY A PROBE READER LOCATION. TRAVEL TIMES OVER THIS SEGMENT ARE DERIVED FROM DATA OBTAINED FROM PROBE VEHICLES PASSING OVER THE SEGMENT.

10. Does your agency maintain probe readers to estimate travel times on arterial roadway segments?

G No, go to Question 11.
G Yes

If yes, please answer the following questions.

a. How many arterial roadway segments are covered by probe readers over which travel times are developed? ______________
b. What is the average length of these segments? _______ miles
c. Approximately how many probe vehicles exist in the regional fleet of vehicles? ________
d. How many arterial centerline miles covered by probe vehicles sensing are also covered by electronic traffic data collection equipment (e.g., mid-block sensors)?_______ miles
e. How many probe vehicles are typically counted during a five-minute period during peak travel times?_____________

Comments:____
____

THE FOLLOWING QUESTIONS ARE DESIGNED TO DETERMINE WHETHER YOUR AGENCY COMMUNICATES INFORMATION DESCRIBING ARTERIAL TRAVEL TIMES, SPEEDS, OR CONDITIONS IN REAL-TIME, IN TIME INTERVALS NO LARGER THAN 5 MINUTES, AND BY ELECTRONIC MEANS TO OTHER TRANSPORTATION MANAGEMENT AGENCIES AND ORGANIZATIONS.

11. Do you electronically transfer information describing arterial travel times, speeds, or conditions, in real-time to any organization responsible for any of the following activities (check all that apply):

G Freeway management
Name of organization, agency, or group: ____
Number of signalized plus CBD street centerline miles covered by the transfer: ______________ miles.

Method used to transfer data (Check one):
G Transfer between separate computer system
G A common shared database
G Other: Please describe: ____

11. Continued.

G Freeway or arterial incident management
Name of organization, agency, or group: ____
Number of signalized plus CBD street centerline miles covered by the transfer: ___________ miles.

Method used to transfer data (Check one):
- G Transfer between separate computer system
- G A common shared database
- G Other: Please describe: ____

G Public transit operations
Name of organization, agency, or group: ____
Number of signalized plus CBD street centerline miles covered by the transfer: ___________ miles.

Method used to transfer data (Check one):
- G Transfer between separate computer system
- G A common shared database
- G Other: Please describe: ____

G Traveler information service provider (e.g., Regional Multimodal Traveler Information Center, private Information Service Provider [ISP])
Name of organization, agency, or group: ____
Number of signalized plus CBD street centerline miles covered by the transfer: ___________ miles.

Method used to transfer data (Check one):
- G Transfer between separate computer system
- G A common shared database
- G Other: Please describe: ____

G Do not electronically share information.

THE FOLLOWING QUESTIONS ARE USED TO DETERMINE WHETHER YOUR AGENCY RECEIVES, IN REAL-TIME VIA ELECTRONIC MEANS, DATA FROM OTHER GROUPS, AGENCIES OR ORGANIZATIONS.

12. Does your agency receive, in real-time via electronic means, data on freeway travel times, speeds, or conditions from a freeway management organization?

G No; go to Question 13.
G Yes

If yes,
What is the name of the organization, agency or group providing these data?:____________________________
How much of the freeway system is covered by this transfer?:_________________________ miles
How are these data used by your agency to manage the traffic signal system (check all that apply)?:
G Adjust signal timing
G Convey information to travelers via arterial roadside media such as VMS or HAR
G Other, please describe: ____

13. Does your agency receive, in real-time via electronic means, data on freeway and arterial incident severity, location, and type from the organization or group operating a freeway or arterial incident management program?

G No; go to Question 14.
G Yes

If yes,
What is the name of the organization, agency or group providing these data?:____________________________
How much of the freeway or arterial system is covered by this transfer?:_________________________ miles
How are these data used by your agency to manage the traffic signal system (check all that apply)?:
G Adjust signal timing
G Convey information to travelers via arterial roadside media such as VMS or HAR
G Other, please describe: ____

14. Does your agency receive, in real-time via electronic means, data on arterial travel times derived from vehicle probes from an agency, organization, or group operating an electronic toll collection program?

G No; go to Question 15.
G Yes

If yes,
What is the name of the organization, agency or group providing these data?:____________________________
How many arterial miles have travel time measured with this probe data?:_________________________ miles
How are these data used by your agency to manage the traffic signal system (check all that apply)?:
G Adjust signal timing
G Convey information to travelers via arterial roadside media such as VMS or HAR
G Other, please describe: ____

15. Does your agency receive, in real-time via electronic means, data on arterial travel times derived from vehicle probes from an agency, organization, or group operating a public transit service?

G No; go to Question 16.
G Yes

If yes,
What is the name of the organization, agency or group providing these data?:___________________________
How many arterial miles have travel times measured with these probe data?:______________________ miles
How are these data used by your agency to manage the traffic signal system (check all that apply)?:
G Adjust signal timing
G Convey information to travelers via arterial roadside media such as VMS or HAR
G Other, please describe: ____

16. Does your agency receive, in real-time via electronic means, data on highway-rail intersection crossing status (e.g., train presence or scheduled closing) derived from an agency, organization, or group operating a highway rail intersection?

G No
G Yes

If yes,
What is the name of the organization, agency or group providing these data?:___________________________
How many highway rail intersections are included in this information ?:______________________ crossings
How are these data used by your agency to manage the traffic signal system (check all that apply)?:
G Adjust signal timing
G Convey information to travelers via arterial roadside media such as VMS or HAR
G Other, please describe: ____

Additional Comments:

Electronic Toll Collection (ETC)

*Metropolitan Area:*______________________________________ *Date Completed:*____________________

Name:____
Title:____
Organization:____
Street: _______________________________City: ___________________State: _______Zip: ___________
Phone Number: ____________________________Fax Number:__________________________________
E-mail:____

The purpose of this questionnaire is to help you inventory ITS technologies and services currently deployed in your metropolitan area.

Technical questions can be directed to:

Please return completed questionnaire to:

1. Please identify the geographical and/or jurisdictional areas to which your answers to this survey apply (e.g., all freeways within the region, or freeways only within certain counties). Area of geographical or jurisdictional coverage:

Electronic Toll Collection (continued)

2. Please complete the following for each bridge, tunnel, or railroad operated by your agency. ***Note: for questions concerning toll collection lanes, include all lanes whether they are located on the mainline of entry/exit ramps.***

Bridge, Tunnel, or Tollroad Name (e.g. Harbor tunnel, I-90, Florida Turnpike):__________________________

Percent of all toll payment made wit Electronic Toll Collection (ETC):_________________________________

What technologies are used? (check all that apply)
- G Antennae location:
- G in-pavement
- G focused beam
- G distributed overhead
- G other:____

In-vehicle equipment:
- G tag based Vendor:____
- G integrated circuit card-based Vendor:____

Number of toll collection lanes operated:__________________________________
Number of toll collection lanes with dedicated ETC:______________________________
Number of toll collection lanes with mixed manual and ETC:______________________________

Toll collection tags issued:_____________________________

Are these tags also used by other toll operators in your metropolitan area (check one)?
- G no
- G yes, what are the name of the toll operators?
  ____
  ____
  ____

Are there any operators of public transportation that accept you toll tags to pay transit fares (check one)?
- G no
- G yes, what are the names of the transit operators?
  ____
  ____
  ____

Electronic Toll Collection (continued)

2. Continued.

Bridge, Tunnel, or Tollroad Name (e.g. Harbor tunnel, I-90, Florida Turnpike):___________________________

Percent of all toll payment made wit Electronic Toll Collection (ETC):__________________________________

What technologies are used? (check all that apply)

- G Antennae location:
- G in-pavement
- G focused beam
- G distributed overhead
- G other:____

In-vehicle equipment:

- G tag based Vendor:____
- G integrated circuit card-based Vendor:____

Number of toll collection lanes operated:____________________________________
Number of toll collection lanes with dedicated ETC:________________________________
Number of toll collection lanes with mixed manual and ETC:________________________________

Toll collection tags issued:______________________________

Are these tags also used by other toll operators in your metropolitan area (check one)?

- G no
- G yes, what are the name of the toll operators?

____
____
____

Are there any operators of public transportation that accept you toll tags to pay transit fares (check one)?

- G no
- G yes, what are the names of the transit operators?

____
____
____

Additional Comments:

Transit Management and Electronic Fare Payment

*Metropolitan Area:*_______________________________________ *Date Completed:*____________________

Name:____
Title:____
Organization:____
Street: _________________________________City: ____________________State: _______Zip: ___________
Phone Number: ______________________________Fax Number:___________________________________
E-mail:____

The purpose of this questionnaire is to help you inventory ITS technologies and services currently deployed in your metropolitan area.

Technical questions can be directed to:

Please return completed questionnaire to:

1. Please identify the geographical and/or jurisdictional areas to which your answers to this survey apply (e.g., all freeways within the region, or freeways only within certain counties). Area of geographical or jurisdictional coverage:

2. Please complete the following for all the services your agency operates (Note: the shaded area do not require a response)

	Motor Bus	***Demand Responsive***	***Heavy Rail***	***Light Rail***	***Other***
Total vehicles operated					
Total router miles operated					
Number of stations					
Vehicles equipped with Automatic Vehicle Location Capability					
Vehicles equipped with Automatic Vehicle Identification Capability					
Vehicles equipped with Traffic Signal Priority Capability					
Vehicles equipped with Ramp Meter Priority Capability					
Vehicles equipped with Electronically Registering Fareboxes					
Vehicles (stations) equipped with Magnetic Stripe Readers			Stations: Vehicles:	Stations: Vehicles:	
Vehicles (stations) equipped with Smart Card Readers			Stations: Vehicles:	Stations: Vehicles:	
Vehicles equipped with navigation aids to facilitate operations					
Vehicles operated under computer aided dispatch system (e.g. data messaging capability)					
Vehicles that have component system (e.g. engine, brakes) electronically monitored as part of a fleet management/monitoring system					

3. Do you have major fixed route bus or rail transfer locations that display schedule and fare information electronically (e.g., television screen, kiosk, terminal)?

G No; go to Question 4.
G Yes, please complete the following:

a. How many major bus transfer points do you have? _____________
b. How many major bus transfer points display traveler information? _____________
c. How many rail transfer stations do you have? _____________
d. How many rail transfer stations display date? _____________

What methods are used to display information:____
What type of information is displayed (check all that apply)?

G Published routes, schedules, and fares
G Real-time schedule adherence
G Other (specify) ____

4. Do you use electronic fare media (e.g., magnetic strip card, smart card, etc.) to collect fares on the services you provide?

G No; go to Question 5.
G Yes
If yes, do you store these data electronically for later use in route and service planning?
G No; go to Question 5.
G Yes
If yes, approximately what percentage of electronically collected fare data is stored for later use in service planning? ______ % of fares

5. The following questions relate to the use of common electronic fare media between your agency and other transit agencies in your metropolitan area.

a. Please complete the following regarding your operations.

If you operate modes in addition to fixed-route bus, which ones are capable of having their riders use the same electronic fare media (e.g., stripe or smart cards)? (check all that apply)
G Light Rail G Heavy Rail G Paratransit Services
G Other(specify)___________________________________

b. Please complete the following regarding other transit operators within your metropolitan area.

For all the other transit agencies operating within your metropolitan area, how many are capable of having their riders use the same electronic fare media (e.g., stripe or smart cards) as you do? (provide the appropriate number of agencies)
Fixed-route buses_________ Light Rail________ Heavy Rail________Paratransit Services________
Other (specify)____

THE FOLLOWING QUESTIONS ARE DESIGNED TO DETERMINE WHETHER YOUR AGENCY USES TRAFFIC SURVEILLANCE DATA COLLECTED BY OTHER TRANSPORTATION AGENCIES TO ADJUST TRANSIT ROUTES AND SCHEDULES IN REAL-TIME. FOR EXAMPLE, YOUR AGENCY MAY RECEIVE INFORMATION FROM ANOTHER AGENCY IN YOUR REGION THAT INDICATES A STREET IS BLOCKED DUE TO A TRAFFIC ACCIDENT. YOUR AGENCY MAY THEN USE THIS INFORMATION TO ADJUST A TRANSIT ROUTE OR SCHEDULE IN REAL-TIME TO ACCOMMODATE ANY DELAY ASSOCIATED WITH THIS ACCIDENT.

6. Do you receive information describing freeway travel times, speeds, or conditions automatically in real time via electronic means (e.g., from a regional freeway management center)?

G No; go to Question 7.
G Yes

If yes, please identify the agency providing the information and describe how this transfer of information is accomplished:

____
____
____

If yes, do you use these data to adjust transit routes or schedules in any way?

G No
G Yes

7. Do you receive information describing arterial travel times, speeds, or conditions in real-time via electronic means (e.g., from a traffic signal control system)?

G No; go to Question 8.
G Yes

If yes, please identify the agency providing the information and describe how this transfer of information is accomplished:

____
____
____

If yes, do you use these data to adjust transit routes or schedules in any way?

G No
G Yes

8. Do you receive information describing incident severity, location, and type in near real-time by any means (e.g., from a regional incident management program)? (A phone call, radio transmission, or computer-based notification all qualify as "near real-time.")

G No; go to Question 9.
G Yes

If yes, please identify the agency providing the information and describe how this transfer of information is accomplished:

____
____
____

If yes, do you use these data to adjust transit routes or schedules in any way?

G No
G Yes

THE FOLLOWING QUESTIONS ARE DESIGNED TO DETERMINE WHETHER YOUR AGENCY PROVIDES INFORMATION TO A REGIONAL MULTIMODAL TRAVELER INFORMATION CENTER OR INFORMATION SERVICE PROVIDER. THESE ENTITIES ARE REPOSITORIES FOR DATA ON SYSTEM PERFORMANCE FROM SEVERAL MODES, INCLUDING TRANSIT, AND DISSEMINATE THIS INFORMATION TO TRAVELERS THROUGH A VARIETY OF MEDIA SUCH AS KIOSKS, INTERNET SITES, CABLE TV, AND PERSONAL NAVIGATION DEVICES.

9. Does your agency provide information describing your motor bus, demand responsive, heavy rail, light rail, or other services to another public or private organization in your region for display on kiosks, Internet sites, and other means to the general public?

G No; go to Question 10
G Yes

If yes, what type of information is provided and how many of the route-miles operated by motor bus, demand responsive, heavy rail, light rail or other services are included (check all that apply):

G Publish transit routes, schedules and fares

Name of organization, group, or agency that receives the information:____________________________
Total route miles included in the information transferred (check all that apply and provide the total route miles covered by the transfer):

G Motor bus _______
G Demand Responsive _______
G Heavy Rail _______
G Light Rail _______

9. Continue

G Real-time schedule adherence from transit vehicles in operation transferred by electronic means

Name of organization, group, or agency that receives the information:____________________________
Total route miles included in the information transferred (check all that apply and provide the total route miles covered by the transfer):

G Motor bus _______
G Demand Responsive _______
G Heavy Rail _______
G Light Rail _______

10. Are your motor buses equipped as vehicle probes to determine highway travel times or speeds on freeways?

G No; go to Question 11.
G Yes

If yes, how many motor buses are equipped to serve as probes? ___________

How is the information collected by the probe vehicles transferred for use in freeway management? (check all that apply)

G Transfer between separate computer systems _______
G A common shared data base is used _______
G Other, please describe____

11. Are your motor buses equipped as vehicle probes to determine highway travel times or speeds on signalized arterial streets?

G No
G Yes

If yes, how many motor buses are equipped to serve as probes? ___________

How is the information collected by the probe vehicles transferred for use in traffic signal control? (check all that apply)

G Transfer between separate computer systems _______
G A common shared data base is used _______
G Other, please describe____

Additional Comments:

Highway-Rail Intersections

*Metropolitan Area:*______________________________________ *Date Completed:*____________________

Name:____
Title:____
Organization:____
Street: ________________________________City: ____________________State: _______Zip: __________
Phone Number: ______________________________Fax Number:___________________________________
E-mail:____

The purpose of this questionnaire is to help you inventory ITS technologies and services currently deployed in your metropolitan area.

Technical questions can be directed to:

Please return completed questionnaire to:

1. Please identify the geographical and/or jurisdictional areas to which your answers to this survey apply (e.g., all freeways within the region, or freeways only within certain counties). Area of geographical or jurisdictional coverage:

2. Please complete the following for highway-rail intersections located on roadways maintained by your agency

a. Total number traffic signals maintained by your agency that are within 200 feet of a highway-rail intersection: 2.a. _________

b. Total number of these traffic signals equipped with the capability to adjust signal timing in response to train crossing (e.g., signal pre-emption or coordination to avoid vehicle entrapment or interconnection with active crossing devices)? 2.b. _________

c. Total number of all highway-rail intersections located on roadways maintained by your agency equipped with video surveillance capabilities: 2.c. _________

d. Total number of all highway-rail intersections located on roadways maintained by your agency equipped with electronic surveillance (other than video) of the crossing area (e.g., loop detectors to identify vehicles within the crossing area): 2.d. _________

e. Total number of all highway-rail intersections located on roadways maintained by your agency with the capability to predict train arrivals electronically: 2.e. _________

f. Total number of all highway-rail intersections located on roadways maintained by your agency equipped with electronic traffic violator devices: 2.f. _________

g. Highway-rail intersections equipped with at least one of the technologies listed in Items 2c through 2f: 2.g. _________

h. Total number of highway-rail intersections that are located on roadways maintained by your agency: 2.h. _________

Highway-Rail Intersections (continued)

Additional Comments:

Emergency Management Services

*Metropolitan Area:*______________________________________ *Date Completed:*____________________

Name:____
Title:____
Organization:____
Street: ________________________________City: ____________________State: _______Zip: ___________
Phone Number: ______________________________Fax Number:____________________________________
E-mail:____

The purpose of this questionnaire is to help you inventory ITS technologies and services currently deployed in your metropolitan area.

Technical questions can be directed to:

____

Please return completed questionnaire to:

____

1. Please identify the geographical and/or jurisdictional areas to which your answers to this survey apply (e.g., all freeways within the region, or freeways only within certain counties). Area of geographical or jurisdictional coverage:

____

Emergency Management Services (continued)

2. Please complete the following for *publicly-funded emergency services* only

Police: Agency Name:____

Total number of Emergency Response (ER) vehicles operated (e.g., cruisers): ___________
Total number of ER vehicles equipped with in-vehicle navigation capability: ___________
Total number of ER vehicles equipped with automated vehicle identification (AVI): ___________
Total number of ER vehicles under a computer-aided dispatch system: ___________
Total number of ER vehicles with traffic signal system communications (e.g., for priority): ___________

Fire: Agency Name:____

Total number of Emergency Response (ER) vehicles operated (e.g., cruisers): ___________
Total number of ER vehicles equipped with in-vehicle navigation capability: ___________
Total number of ER vehicles equipped with automated vehicle identification (AVI): ___________
Total number of ER vehicles under a computer-aided dispatch system: ___________
Total number of ER vehicles with traffic signal system communications (e.g., for priority): ___________

Emergency Medical: Agency Name:____

Total number of Emergency Response (ER) vehicles operated (e.g., cruisers): ___________
Total number of ER vehicles equipped with in-vehicle navigation capability: ___________
Total number of ER vehicles equipped with automated vehicle identification (AVI): ___________
Total number of ER vehicles under a computer-aided dispatch system: ___________
Total number of ER vehicles with traffic signal system communications (e.g., for priority): ___________

Other: Agency Name:____

Total number of Emergency Response (ER) vehicles operated (e.g., cruisers): ___________
Total number of ER vehicles equipped with in-vehicle navigation capability: ___________
Total number of ER vehicles equipped with automated vehicle identification (AVI): ___________
Total number of ER vehicles under a computer-aided dispatch system: ___________
Total number of ER vehicles with traffic signal system communications (e.g., for priority): ___________

Other: Agency Name:____

Total number of Emergency Response (ER) vehicles operated (e.g., cruisers): ___________
Total number of ER vehicles equipped with in-vehicle navigation capability: ___________
Total number of ER vehicles equipped with automated vehicle identification (AVI): ___________
Total number of ER vehicles under a computer-aided dispatch system: ___________
Total number of ER vehicles with traffic signal system communications (e.g., for priority): ___________

Additional Comments:

Regional Multimodal Traveler Information

*Metropolitan Area:*______________________________________ *Date Completed:*____________________

Name:____
Title:____
Organization:____
Street: ________________________________City: ____________________State: _______Zip: __________
Phone Number: _____________________________Fax Number:___________________________________
E-mail:____

The purpose of this questionnaire is to help you inventory ITS technologies and services currently deployed in your metropolitan area.

Technical questions can be directed to:

Please return completed questionnaire to:

1. Please identify the geographical and/or jurisdictional areas to which your answers to this survey apply (e.g., all freeways within the region, or freeways only within certain counties). Area of geographical or jurisdictional coverage:

2. Please indicate below which methods are used by your agencies or organizations to disseminate traveler information to the public, who disseminate information, number of devices or users, and content of the traveler information. Check all that apply. Use additional sheets if more than one Information Service Provider is involved.

Dedicated cable TV

a. Information Service Provider (e.g., who transmits or provides information to end user?)
____

b. Number of end users: ________________

c. Types of information transmitted or displayed (check all that apply):

G freeway travel times, speeds, or conditions
G arterial travel times, speeds, or conditions
G transit routes, schedules, or fares
G real-time transit schedule adherence
G intercity bus or rail schedules
G airline schedules
G television picture of roadway conditions
G other: ____

comments: ____

Telephone Systems

a. Information Service Provider (e.g., who transmits or provides information to end user?)
____

b. Number of end users: ________________

c. Types of information transmitted or displayed (check all that apply):

G freeway travel times, speeds, or conditions
G arterial travel times, speeds, or conditions
G transit routes, schedules, or fares
G real-time transit schedule adherence
G intercity bus or rail schedules
G airline schedules
G other: ____

comments: ____

2. Continued.

Internet Web Sites

a. Information Service Provider (e.g., who transmits or provides information to end user?)
____

b. Number of daily hits: _____________

c. Types of information transmitted or displayed (check all that apply):

G freeway travel times, speeds, or conditions
G arterial travel times, speeds, or conditions
G transit routes, schedules, or fares
G real-time transit schedule adherence
G intercity bus or rail schedules
G airline schedules
G television picture of roadway conditions
G other: ____

comments: ____

Pagers, personal data assistants, or other personal devices

a. Information Service Provider (e.g., who transmits or provides information to end user?)
____

b. Number of devices in use: _____________

c. Types of information transmitted or displayed (check all that apply):

G freeway travel times, speeds, or conditions
G arterial travel times, speeds, or conditions
G transit routes, schedules, or fares
G real-time transit schedule adherence
G intercity bus or rail schedules
G airline schedules
G other: ____

comments: ____

2. Continued.

Interactive TV

a. Information Service Provider (e.g., who transmits or provides information to end user?)
____

b. Number of end users: _________________

c. Types of information transmitted or displayed (check all that apply):

G freeway travel times, speeds, or conditions
G arterial travel times, speeds, or conditions
G transit routes, schedules, or fares
G real-time transit schedule adherence
G intercity bus or rail schedules
G airline schedules
G television picture of roadway conditions
G other: ____

comments: ____

Kiosks

a. Information Service Provider (e.g., who transmits or provides information to end user?)
____

b. Number of kiosks installed: _________________

c. Types of information transmitted or displayed (check all that apply):

G freeway travel times, speeds, or conditions
G arterial travel times, speeds, or conditions
G transit routes, schedules, or fares
G real-time transit schedule adherence
G intercity bus or rail schedules
G airline schedules
G television picture of roadway conditions
G other: ____

comments: ____

2. Continued.

E-mail or other Direct PC communication

a. Information Service Provider (e.g., who transmits or provides information to end user?)
____

b. Number of end users: _______________

c. Types of information transmitted or displayed (check all that apply):

G freeway travel times, speeds, or conditions
G arterial travel times, speeds, or conditions
G transit routes, schedules, or fares
G real-time transit schedule adherence
G intercity bus or rail schedules
G airline schedules
G other: ____

comments: ____

In-vehicle navigation systems

a. Information Service Provider (e.g., who transmits or provides information to end user?)
____

b. Number of vehicles with navigation systems: _______________

c. Types of information transmitted or displayed (check all that apply):

G freeway travel times, speeds, or conditions
G arterial travel times, speeds, or conditions
G transit routes, schedules, or fares
G real-time transit schedule adherence
G intercity bus or rail schedules
G airline schedules
G other: ____

comments: ____

2. Continued.

Other (specify)____

a. Information Service Provider (e.g., who transmits or provides information to end user?)
____

b. Number of end users: ________________

c. Types of information transmitted or displayed (check all that apply):

G freeway travel times, speeds, or conditions
G arterial travel times, speeds, or conditions
G transit routes, schedules, or fares
G real-time transit schedule adherence
G intercity bus or rail schedules
G airline schedules
G television picture of roadway conditions
G other: ____

comments: ____

Other (specify)____

a. Information Service Provider (e.g., who transmits or provides information to end user?)
____

b. Number of end users: ________________

c. Types of information transmitted or displayed (check all that apply):

G freeway travel times, speeds, or conditions
G arterial travel times, speeds, or conditions
G transit routes, schedules, or fares
G real-time transit schedule adherence
G intercity bus or rail schedules
G airline schedules
G television picture of roadway conditions
G other: ____

comments: ____

Additional Comments: