Tracking the Deployment of the Integrated Metropolitan Intelligent Transportation Systems Infrastructure in Cleveland, Akron, Lorain

FY06 Results

DRAFT

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1.0 Introduction

1.1 Background and Purpose

This report presents the results of a data gathering effort to measure the deployment of Intelligent Transportation Systems (ITS) within the Cleveland, Akron, Lorain metropolitan area. During the summer and fall of 2006, the United States Department of Transportation ITS Joint Program Office (ITS JPO) conducted a nationwide survey of ITS deployment in 108 metropolitan areas and all 50 states. The results of this survey are used to report deployment progress across the nation for a variety of purposes including program management, research, outreach, and education. In addition to written reports such as this one, the information is made available on-line.[1]

The data presented in this report are essentially descriptive in nature. Figures and tables are provided that summarize responses to individual questions.

1.2 Methodology

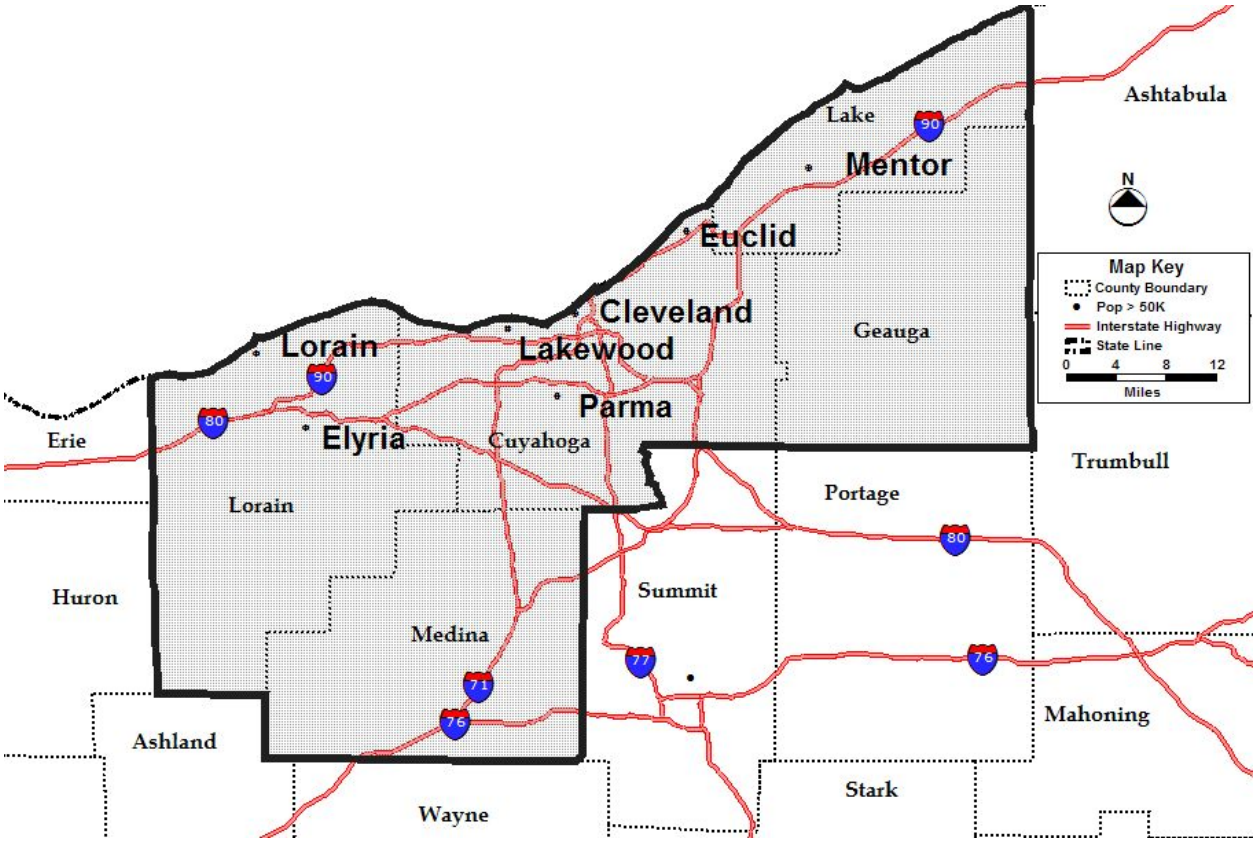
The data gathering effort collected information from a variety of state and local agencies located within the limits of the metropolitan planning boundary of the Cleveland, Akron, Lorain metropolitan area (Figure 1). Agencies targeted included the State Department of Transportation (DOT), local traffic engineering and transportation departments, public transit operators, toll operators, and public safety agencies including law enforcement and fire rescue. (See Appendix B for a list of the agencies surveyed.) Data collection was conducted through the use of surveys targeted at six application areas: Freeway Management, Arterial Management, Transit Management, Toll Collection, Fire Rescue and Law Enforcement each distributed to the appropriate agency. The following table summarizes the survey response rate for agencies surveyed in the Cleveland, Akron, Lorain Metropolitan Area.

Summary of Survey Distribution and Survey Response for Cleveland, Akron, Lorain - 2006

Survey	Number Completed	Number Distributed	Percent Returned
Arterial Management	17	18	94%
Freeway Management	3	3	100%
Transit Management	4	4	100%
Toll Collection	1	1	100%
Law Enforcement	8	9	89%
Fire Rescue	8	9	89%
Total	**41**	**44**	**93%**

[1] Detailed results for this and other metropolitan areas can be found at the following website: http://www.itsdeployment.its.dot.gov

Figure 1 Metropolitan Planning Boundary Map



1.3 Organization

Following this introductory section, the second section summarizes Arterial Management Systems. The third section summarizes Freeway Management Systems followed by Transit Management Systems, in the fourth section. The fifth section then outlines Incident Management Systems followed by Emergency Management System in the sixth section; Electronic Payment Systems will be summarized in the seventh section. Traveler Information will be outlined in the eighth then followed by final section which describes Integration.

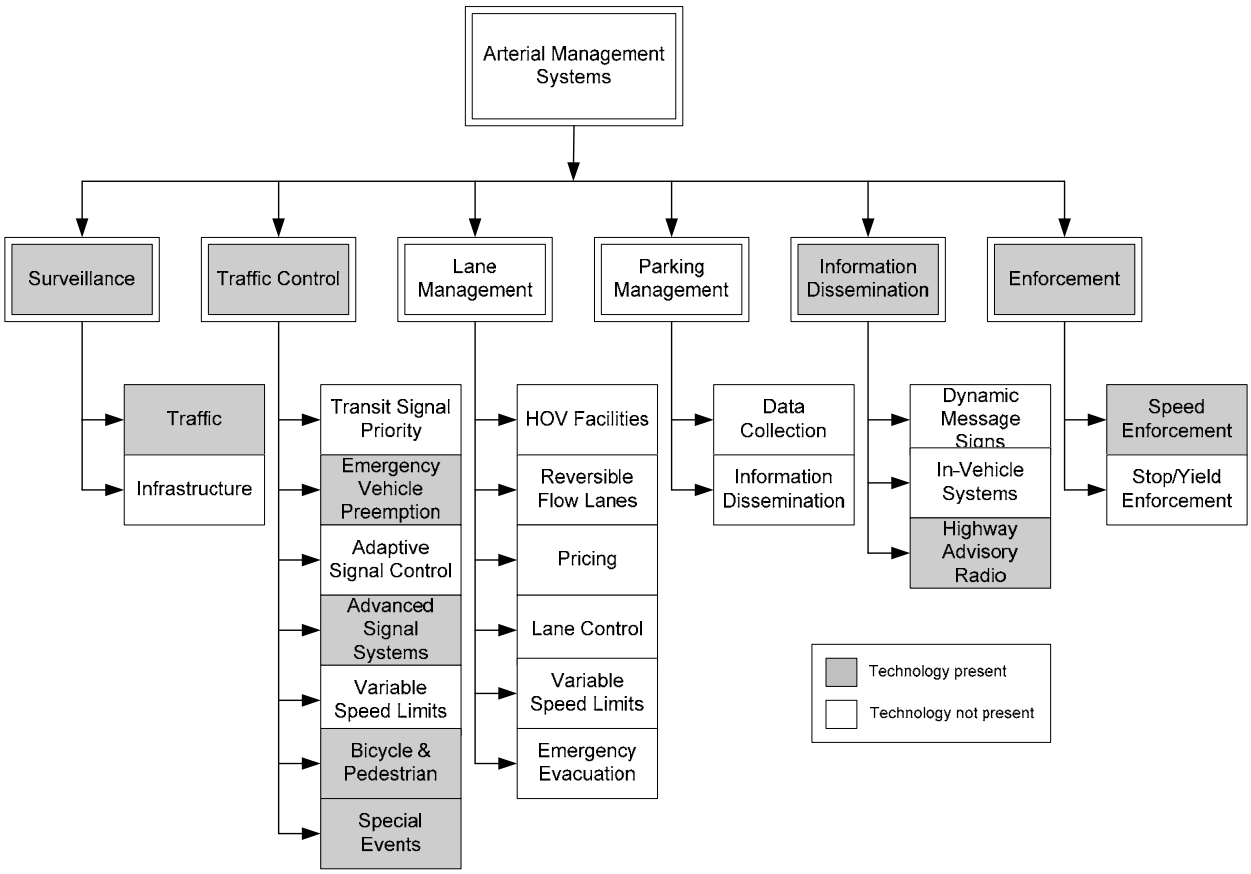
Data summaries presented is this report are structured around the ITS Taxonomy. At the highest level, the taxonomy classifies ITS infrastructure technologies into seven broad categories: Freeway Management Systems, Arterial Management Systems, Incident Management Systems, Transit Management Systems, Emergency Management Systems, Traveler Information Systems, and Electronic Payment Systems. Each of these broad categories consists of a set of several sub-categories. For example, the Freeway Management System contains six sub-categories: Surveillance, Ramp Control, Lane Management, Special Events Traffic Management, Information Dissemination, and Enforcement. Each sub-category may contain one or more applications. For example, the Freeway Management Enforcement sub-category contains three applications: Speed Enforcement, High Occupancy Vehicle (HOV) enforcement, and Ramp Meter Enforcement. Additional information regarding the ITS Taxonomy as well as access to other ITS knowledge resources, can be found at the following web address: http://www.itsoverview.its.dot.gov/.

For each section, the applicable portion of the ITS Taxonomy are displayed, with those applications reported in the local metropolitan area shaded. Survey results are reported in tables that portray the local results accompanied by the national average result (or number of metropolitan areas reporting deployment, as applicable) for comparison purposes.

2.0 Arterial Management Systems

Figure 2 presents the Arterial Management Systems taxonomy. There are six major ITS functions that make up Arterial Management Systems: Surveillance, Traffic Control, Lane Management, Parking Management, Information Dissemination, and Enforcement. The shaded boxes indicate application areas reported as locally deployed.

Figure 2-Arterial Management Systems Taxonomy



2.1 Surveillance

Many of the services possible through arterial management systems are enabled by traffic surveillance and detection technologies, such as sensors or cameras, monitoring traffic flow. The surveillance and detection technologies used to monitor traffic flow in support of ITS applications can also be used to monitor key transportation facilities for security purposes.

Technology	Survey Question	Response	National*
Traffic	Percent of signalized intersections with electronic data collection capabilities	23%	39%

Technology	Survey Question	Response	National*
Infrastructure.	Percent of arterial centerline miles with real-time traffic data collection technologies (includes CCTV) used to monitor key transportation facilities for security purposes	0%	4%

***Based on a survey of the 108 largest metropolitan areas in the nation**

2.2 Traffic Control

Traffic control measures on arterials optimize travel speeds and provide transit signal priority and signal preemption for emergency vehicles, as well as improve safety of bicyclists and pedestrians and smooth traffic flow during special events.

Technology	Survey Question	Response	National*
Transit Signal Priority	Percent of signalized intersections operated that allow signal priority for transit vehicles	0%	2%
Emergency Vehicle Preemption	Percent of signalized intersections operated that allow for signal preemption for emergency vehicles	6%	21%
Adaptive Signal Control	Percent of signalized intersections under real-time traffic adaptive control using SCOOT/SCATS or other similar advanced software	0%	3%
Advanced Signal Systems	Percent of signalized intersections operated under closed loop or central system control	33%	54%
Variable Speed Limits	Does your metropolitan area deploy variable speed systems on arterials?	No	8**
Bicycle & Pedestrians	Does your metropolitan area deploy bicycle or pedestrian systems (e.g., pedestrian detectors, pedestrian activated lighted crosswalks, specialized pedestrian signals such as 'countdown' WALK/DON'T WALK signals and bicycle-actuated signals)?	Yes	92**
Special Events	Does your metropolitan area deploy special event systems (e.g., traffic signal operating plans, temporary lane restrictions, traveler guidance, or other measures)?	Yes	81**

***Based on a survey of the 108 largest metropolitan areas in the nation**
****Number of metropolitan areas that have deployed the technology**

2.3 Lane Management

Lane management applications can promote the most effective use of available capacity during emergency evacuations, incidents, construction, and a variety of other traffic and/or weather conditions.

Technology	Survey Question	Response	National*
HOV Facilities	Total number of arterial High Occupancy Vehicle (HOV) centerline miles equipped with automated lane management technologies	0	5**
Reversible Flow Lanes	Total number of arterial reversible lane centerline miles equipped with automated lane management technologies	0	16**
Pricing	Total number of arterial centerline miles under congestion pricing and equipped with technologies to support congestion pricing strategies	0	1**
Lane Control	Total number of arterial centerline miles equipped with lane control signs supported by technologies to allow temporary closure	0	6**
Variable Speed Limits	Percent of arterial centerline miles equipped with variable speed limit technologies	0%	0%
Emergency Evacuation	Total number of arterial centerline miles equipped with lane management measures to support emergency evacuations	0	7**

***Based on a survey of the 108 largest metropolitan areas in the nation**
****Number of metropolitan areas that have deployed the technology**

2.4 Parking Management

Parking management systems with information dissemination capabilities, most commonly deployed in urban centers or at modal transfer points such as airports, monitor the availability of parking and disseminate the information to drivers, reducing traveler frustration and congestion associated with searching for parking.

Technology	Survey Question	Response	National*
Data Collection	Does your metropolitan area deploy parking management data collection systems that monitor the availability of parking?	No	14**
Information Dissemination	Does your metropolitan area deploy parking management systems that disseminate parking availability information to drivers?	No	11**

***Based on a survey of the 108 largest metropolitan areas in the nation**
****Number of metropolitan areas that have deployed the technology**

2.5 Information Dissemination

Advanced communications have improved the dissemination of information to the traveling public. Motorists are now able to receive relevant information on location-specific traffic conditions in a number of ways, including Dynamic Message Signs (DMS), Highway Advisory Radio (HAR), and In-Vehicle Signing (IVS), or specialized information transmitted to individual vehicles.

Technology	Survey Question	Response	National*
Dynamic Message Signs (DMS)	Total number of permanent DMS deployed on arterial	0	51**
In-Vehicle Systems (IVS)	Does you metropolitan area deploy IVS to distribute information to the public?	No	5**
Highway Advisory Radio (HAR)	Percent of centerline miles covered by HAR	4%	2%

***Based on a survey of the 108 largest metropolitan areas in the nation**
****Number of metropolitan areas that have deployed the technology**

2.6 Enforcement

Automated enforcement systems, such as speed enforcement and stop/yield enforcement, improve safety, reduce aggressive driving, and assist in the enforcement of traffic signal and speed compliance.

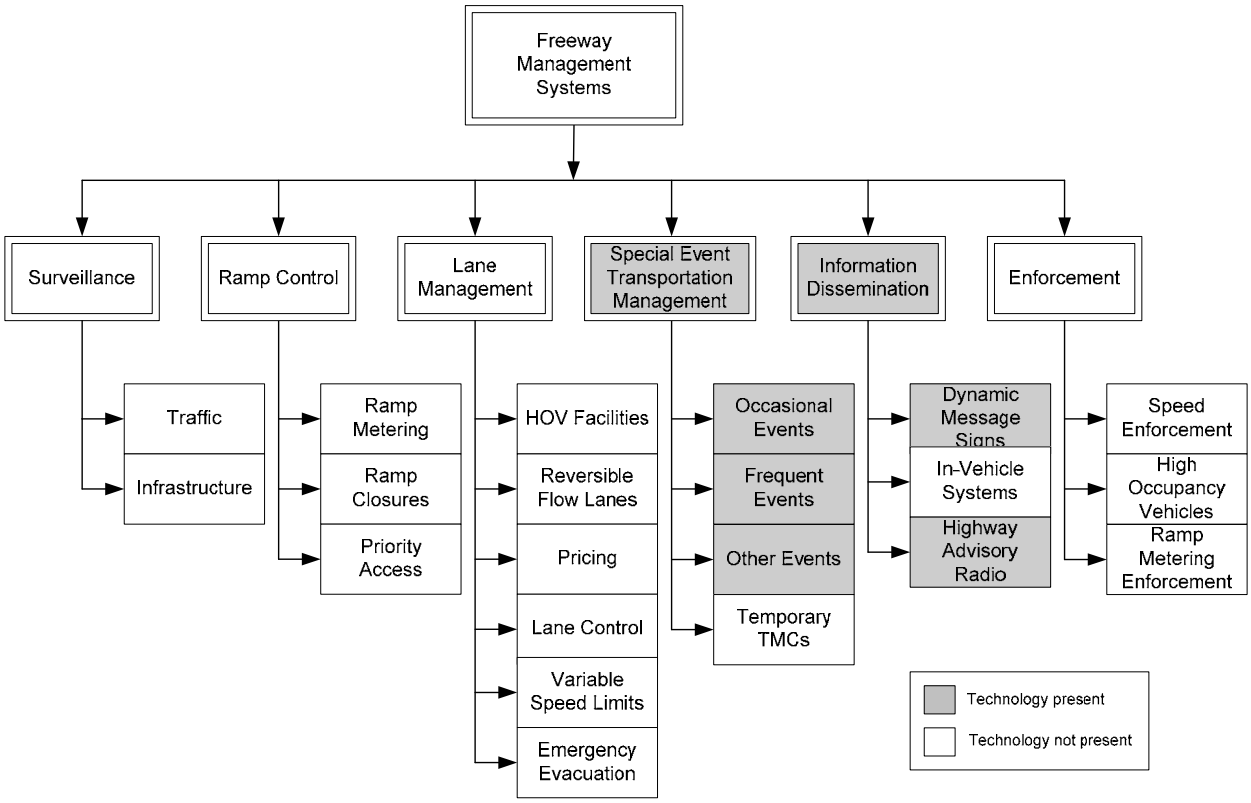
Technology	Survey Question	Response	National*
Speed Enforcement	Does you metropolitan area deploy automated speed enforcement technologies on arterials?	Yes	22**
Stop/Yield Enforcement	Percent of signalized intersections with automated photo red light running enforcement	0%	1%

***Based on a survey of the 108 largest metropolitan areas in the nation**
****Number of metropolitan areas that have deployed the technology**

3.0 Freeway Management Systems

Figure 3 presents the Freeway Management Systems taxonomy. There are six major ITS functions that make up Freeway Management Systems: Surveillance, Ramp Control, Lane Management, Special Event Transportation Management, Information Dissemination, and Enforcement. The shaded boxes indicate application areas reported as locally deployed.

Figure 3-Freeway Management Systems Taxonomy



3.1 Surveillance

Traffic surveillance systems use detectors and video equipment to support advanced freeway management systems. These sensors can also be used to monitor critical transportation infrastructure for security purposes.

Technology	Survey Question	Response	National*
Traffic	Percent of freeway centerline miles with real-time data collection technologies (Does not include CCTV)	0%	39%

Technology	Survey Question	Response	National*
Infrastructure	Percent of freeway centerline miles with real-time traffic data collection technologies (Includes CCTV) used to monitor key transportation facilities for security purposes	0%	29%

***Based on a survey of the 108 largest metropolitan areas in the nation**

3.2 Ramp Control

Traffic control measures on freeway entrance ramps, such as ramp meters, can use sensor data to optimize freeway travel speeds and ramp meter wait times.

Technology	Survey Question	Response	National*
Ramp Metering	Percent of ramps with ramp metering capability	0%	20%
Ramp Closures	Percent of ramps with automated ramp closure capability	0%	1%
Priority Access	Percent of metered ramps with priority access capability for transit vehicles	0%	0%

***Based on a survey of the 108 largest metropolitan areas in the nation**

3.3 Lane Management

Lane management applications can promote the most effective use of available capacity on freeways to encourage the use of high-occupancy commute modes.

Technology	Survey Question	Response	National*
HOV Facilities	Total number of freeway High Occupancy Vehicle (HOV) centerline miles equipped with automated lane management technologies	0	15**
Reversible Flow Lanes	Total number of freeway reversible lane centerline miles equipped with automated lane management technologies	0	8**
Pricing	Total number of freeway centerline miles under congestion pricing and equipped with technologies to support congestion pricing strategies	0	3*
Lane Control.	Total number of freeway centerline miles equipped with lane control signs supported by technologies to allow temporary closure	0	13**
Variable Speed Limits	Percent of freeway centerline miles equipped with variable speed limit technologies	0%	1%
Emergency Evacuation	Total number of freeway centerline miles equipped with lane management measures to support emergency evacuations	0	11**

***Based on a survey of the 108 largest metropolitan areas in the nation**
****Number of metropolitan areas that have deployed the technology**

3.4 Special Event Transportation Management

Special event transportation management systems can help control the impact of congestion at stadiums or convention centers. In areas with frequent events, large changeable destination signs or other lane control equipment can be installed. In areas with occasional or one-time events, portable equipment can help smooth traffic flow.

Technology	Survey Question	Response	National*
Occasional Events	Portable transportation management systems deployed at locations hosting occasional events	Yes	57**
Frequent Events	Portable transportation management systems deployed at locations hosting frequent events	Yes	42**
Other Events	Portable transportation management systems deployed at locations hosting other events	Yes	52**
Temporary TMCs	Temporary Transportation Management Centers deployed to control the impact of congestion associated with special events	No	24**

***Based on a survey of the 108 largest metropolitan areas in the nation**
****Number of metropolitan areas that have deployed the technology**

3.5 Information Dissemination

Advanced communications have improved the dissemination of information to the traveling public. Motorists are now able to receive relevant information on location-specific traffic conditions in a number of ways, including Dynamic Message Signs (DMS), Highway Advisory Radio (HAR), In-Vehicle Signing (IVS), or specialized information transmitted to individual vehicles.

Technology	Survey Question	Response	National*
Dynamic Message Signs (DMS)	Total number of permanent DMS deployed on freeways	6	86**
In-Vehicle Systems (IVS)	Does you metropolitan area employs IVS to distribute information to the public?	No	2**
Highway Advisory Radio (HAR)	Percent of centerline miles covered by HAR	20%	22%

***Based on a survey of the 108 largest metropolitan areas in the nation**
****Number of metropolitan areas that have deployed the technology**

3.6 Enforcement

Automated enforcement systems, such as speed enforcement, high-occupancy vehicle (HOV) lane enforcement, and ramp meter enforcement, improve safety and reduce aggressive driving.

Technology	Survey Question	Response	National*
Speed Enforcement	Does your metropolitan deploy automated speed enforcement technologies on freeways?	No	7**

Technology	Survey Question	Response	National*
High Occupancy Vehicles (HOV).	Does your metropolitan deploy automated HOV enforcement technologies on freeways?	No	1**
Ramp Meter Enforcement	Does your metropolitan deploy automated enforcement technologies to assist in the enforcement of ramp metering compliance?	No	0**

***Based on a survey of the 108 largest metropolitan areas in the nation**
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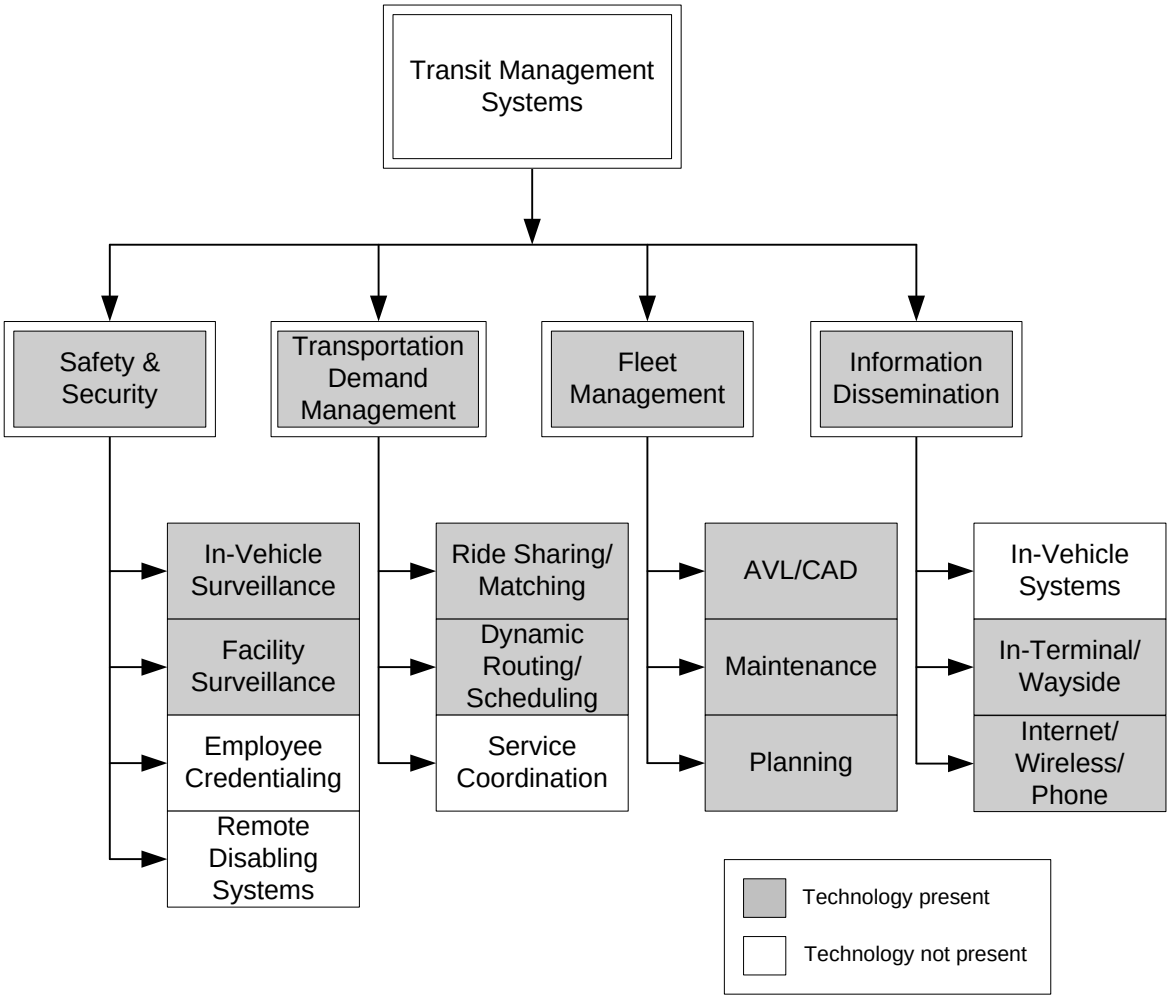
4.0 Transit Management Systems

Figure 4 presents the Transit Management Systems taxonomy. There are four major ITS functions that make up Transit Management Systems: Safety and Security, Transportation Demand Management, Fleet Management, and Information Dissemination. The shaded boxes indicate application areas reported as locally deployed.

Figure 4-Transit Management Systems Taxonomy



4.1 Safety and Security

Advanced software and communications enable data as well as voice to be transferred between transit management centers and transit vehicles for increased safety and security, improved transit operations, and more efficient fleet operations. Transit management centers can monitor in-vehicle and in-terminal surveillance systems to improve quality or service and improve the safety and security of passengers and operators.

Technology	Survey Question	Response	National*
In-Vehicle Surveillance	Percent of buses with audio or video surveillance to enhance security	23%	43%
	Percent of heavy rail vehicles with audio or video surveillance to enhance security	0%	9%
	Percent of light rail vehicles with audio or video surveillance to enhance security	0%	40%
	Percent of demand responsive vehicles with audio or video surveillance to enhance security	30%	12%
	Percent of commuter rail vehicles with audio or video surveillance to enhance security	0%	1%
	Percent of ferry boat with audio or video surveillance to enhance security	0%	30%
Facility Surveillance	Percent of bus stops with audio or video surveillance to enhance security	0%	0%
	Percent of bus depots with audio or video surveillance to enhance security	0%	31
	Percent of rail stations with audio or video surveillance to enhance security	48%	17%
Employee Credentialing	Not Collected	N/A	N/A
Remote Disabling Systems	Total number of buses that can be remotely shut down via wireless communication	0%	2%
	Total number of heavy rail vehicles that can be remotely shut down via wireless communication	0%	0%

***Based on a survey of the 108 largest metropolitan areas in the nation**

4.2 Transportation Demand Management

Transportation demand management service, such as ride sharing/matching, dynamic routing/scheduling, and service coordination, increase public access to transit resources where coverage is limited.

Technology	Survey Question	Response	National*
Ride Sharing /Matching	Does your metropolitan area provide ride sharing and carpool matching services?	Yes	41**

Dynamic Routing /Scheduling	Does your metropolitan area employ Automatic Vehicle Location, combined with dispatching and reservation technologies to provide flexible routing and scheduling?	Yes	33**
Service Coordination	Does your metropolitan area employ vehicle monitoring and communication technologies to facilitate the coordination of passenger transfers between vehicles or transit systems?	No	44**

***Based on a survey of the 108 largest metropolitan areas in the nation**
****Number of metropolitan areas that have deployed the technology**

4.3 Fleet Management

Fleet management systems improve transit reliability through implementation of Automated Vehicle Location (AVL) and Computer Aided Dispatch (CAD) systems which can reduce passenger wait times. These systems may also be implemented with in-vehicle self-diagnostic equipment to automatically alert maintenance personnel of potential problems.

Technology	Survey Question	Response	National*
AVL/CAD	Percent of buses equipped with Automated Vehicle Location (AVL)	78%	56%
	Percent of heavy rail vehicles equipped with Automated Vehicle Location (AVL)	0%	19%
	Percent of light rail vehicles equipped with Automated Vehicle Location (AVL)	0%	35%
	Percent of demand responsive vehicles equipped with Automated Vehicle Location (AVL)	80%	39%
	Percent of commuter rail vehicles equipped with Automated Vehicle Location (AVL)	0%	0%
	Percent of ferry boats equipped with Automated Vehicle Location (AVL)	0%	59%
Maintenance	Percent of buses with real-time monitoring of vehicle components	78%	30%
	Percent of heavy rail vehicles with real-time monitoring of vehicle components	0%	8%
	Percent of light rail vehicles with real-time monitoring of vehicle components	0%	13%
	Percent of demand responsive vehicles with real-time monitoring of vehicle components	80%	12%
	Percent of commuter rail vehicles with real-time monitoring of vehicle components	0%	17%
	Percent of ferry boats with real-time monitoring of vehicle components	0%	52%

Technology	Survey Question	Response	National*
Planning	Does your metropolitan area electronically store collected fare payment data for use in route and service planning?	Yes	57**

***Based on a survey of the 108 largest metropolitan areas in the nation**
****Number of metropolitan areas that have deployed the technology**

4.4 Information Dissemination

Information dissemination websites allow passengers to confirm scheduling information, improve transfer coordination, and reduce wait times. Electronic transit status information signs at bus stops help passengers manage time, and on-board systems such as next-stop audio annunciators help passengers in unfamiliar areas reach their destinations.

Technology	Survey Question	Response	National*
In-Vehicle Systems	Percent of buses that electronically display automated or dynamic traveler information (e.g., schedule and system information) to the public	0%	17%
	Percent of heavy rail vehicles that electronically display automated or dynamic traveler information (e.g., schedule and system information) to the public	0%	3%
	Percent of light rail vehicles that electronically display automated or dynamic traveler information (e.g., schedule and system information) to the public	0%	25%
	Percent of demand responsive vehicles that electronically display automated or dynamic traveler information (e.g., schedule and system information) to the public	0%	1%
	Percent of commuter rail vehicles that electronically display automated or dynamic traveler information (e.g., schedule and system information) to the public	0%	7%
	Percent of ferry boats that electronically display automated or dynamic traveler information (e.g., schedule and system information) to the public	0%	0%
In-Terminal Systems	Percent of bus stops that electronically display automated or dynamic traveler information (e.g., schedule and system information) to the public	0%	0%
	Percent of bus depots that electronically display automated or dynamic traveler information (e.g., schedule and system information) to the public	0%	10%
	Percent of rail stations that electronically display automated or dynamic traveler information (e.g., schedule and system information) to the public	21%	20%
Internet /Wireless /Phone	Does you agency use web sites to disseminate Transit Routes, Schedules, and Fare Information to the public?	Yes	92**

Technology	Survey Question	Response	National*
	Does your metropolitan use web sites to disseminate real-time Transit schedule adherence or Arrival and Departure times to the public?	Yes	38**
	Does your metropolitan area use automatic phone systems to disseminate Transit Routes, Schedules, and Fare Information to the public?	Yes	53**
	Does your metropolitan area use automatic phone to disseminate real-time Transit schedule adherence or Arrival and Departure times to the public?	No	18**

***Based on a survey of the 108 largest metropolitan areas in the nation**
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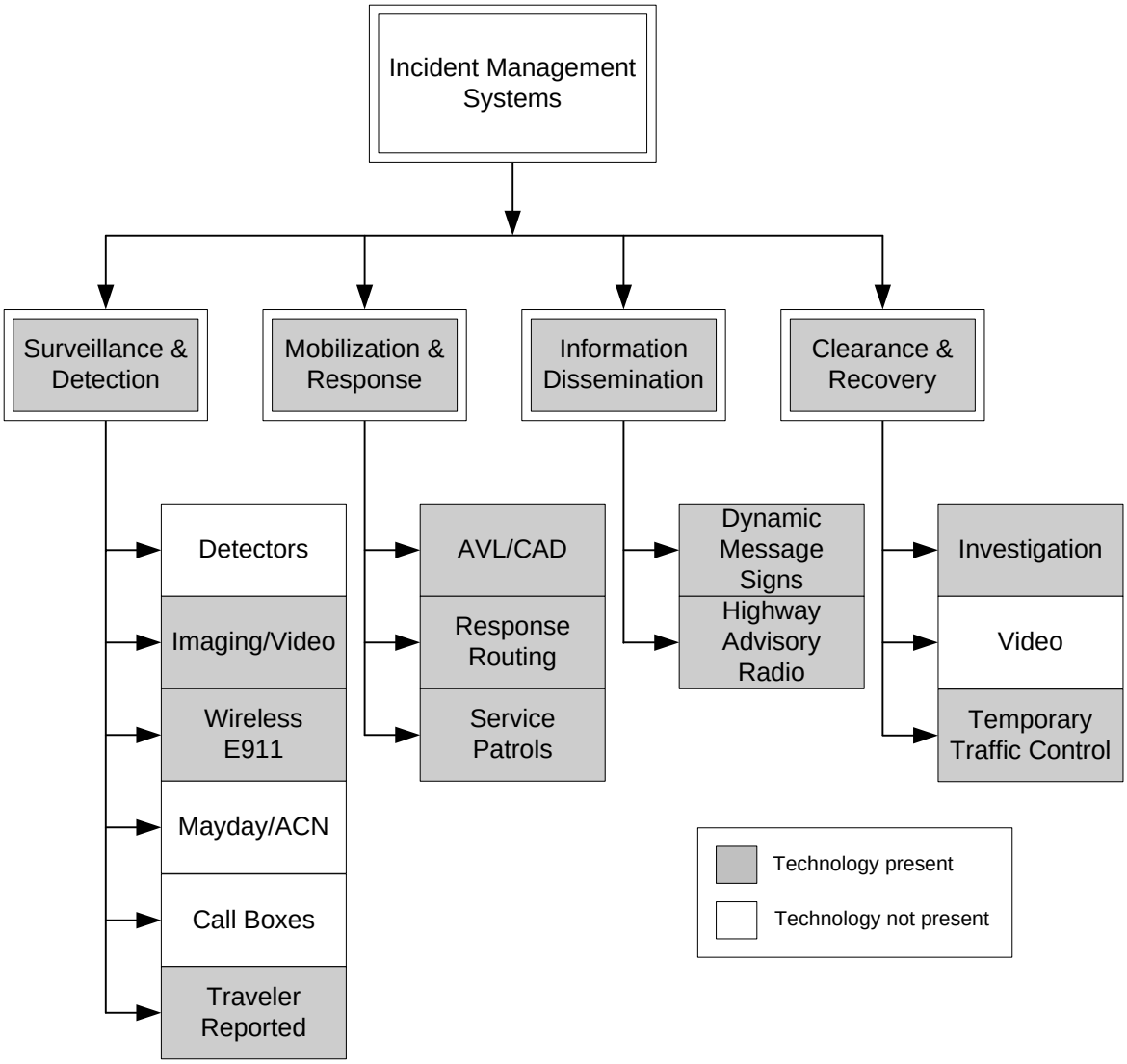
5.0 Incident Management Systems

Figure 5 contains the items comprising the Incident Management Systems taxonomy. There are four major ITS functions that make up Incident Management Systems: Surveillance and Detection, Mobilization and Response, Information Management, and Clearance and Recovery. The shaded boxes indicate application areas reported as locally deployed.

Figure 5-Incident Management Systems Taxonomy



5.1 Surveillance & Detectors

A variety of surveillance and detection technologies can help detect incidents quickly. This include inductive loop or acoustic roadway detectors, and camera systems providing frequent

still images. Information from enhanced 911 systems, mayday, and Automated Collision Notification systems, as well as roadside call boxes can also help incident management system personnel identify incidents quickly.

Technology	Survey Question	Response	National*
Detectors	Does your metropolitan area deploy inductive loop or acoustic roadway detectors on freeways?	No	48**
	Does your metropolitan area deploy inductive loop or acoustic roadway detectors on arterials?	No	29**
Imaging /Wireless	Percent of freeway miles covered by CCTV	2%	36%
	Percent of arterial miles covered by CCTV	0%	6%
Wireless/E911	Does your metropolitan area deploy wireless enhanced 911 systems on freeways?	Yes	19**
	Does your metropolitan area deploy wireless enhanced 911 systems on arterials?	No	11**
Mayday/ACN	Does your metropolitan area deploy Mayday or Advanced Crash Notification systems on freeways	No	2**
	Does your metropolitan area deploy Mayday or Advanced Crash Notification systems on arterials	No	1**
Call Boxes	Percent of freeway miles covered by Call Boxes	0%	14%
Traveler Reported	Does you metropolitan area user traveler reported information to detect incidents on freeways?	Yes	74**
	Does you metropolitan area user traveler reported information to detect incidents on arterials?	Yes	61**

***Based on a survey of the 108 largest metropolitan areas in the nation**
****Number of metropolitan areas that have deployed the technology**

5.2 Mobilization & Response

Mobilization and response may include automated vehicle location and computer-aided dispatch systems, as well as response routing systems, to help incident response teams arrive swiftly.

Technology	Survey Question	Response	National*
AVL/CAD	Do emergency responders use AVL/CAD to assist in locating and assigning appropriate responders to incidents?	Yes	98**
Response Routing	Do emergency responders use response routing systems to assist in identifying the quickest safe route to incident locations?	Yes	65**
Service Patrols	Percent of freeway centerline miles patrolled by service patrols	71%	52%
	Percent of arterial centerline miles patrolled by service patrols	25%	14%

***Based on a survey of the 108 largest metropolitan areas in the nation**
****Number of metropolitan areas that have deployed the technology**

5.3 Information Dissemination

Information dissemination systems help travelers safely navigate around incidents on the roadway. Incident management personnel can directly post incident-related.

Technology	Survey Question	Response	National*
Dynamic Message Signs (DMS)	Do the DMS deployed in your metropolitan area display freeway incident information?	Yes	89**
	Do the DMS deployed in your metropolitan area display arterial incident information?	No	54**
Highway Advisory Radio (HAR)	Is the Highway Advisory Radio (HAR) deployed in your metropolitan area used to broadcast freeway incident information?	Yes	51**
	Is the Highway Advisory Radio (HAR) deployed in your metropolitan area used to broadcast arterial incident information?	Yes	24**

***Based on a survey of the 108 largest metropolitan areas in the nation**
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5.4 Clearance & Recovery

Several technologies are available to speed the investigation of incident scenes and record necessary information for later analysis. Temporary traffic control devices help ensure the safety of incident responders and provide for the safe travel of vehicles around the incident site.

Technology	Survey Question	Response	National*
Investigation	Does your metropolitan area use technologies (e.g., total station, surveying equipment, laser, close range photogrammetry, or forensic mapping) to speed the investigation of incident scenes?	Yes	91**
Video	Does your metropolitan area use video imaging to assist with data collection at freeway incident scenes to speed the reopening of travel lanes?	No	32**
	Does your metropolitan area use video imaging to assist with data collection at arterial incident scenes to speed the reopening of travel lanes?	No	37**
Temporary Traffic Control	Does your metropolitan area deploy temporary traffic control devices, such as portable message signs and lane control signs, to help ensure the safety of freeway incident scenes?	Yes	81**
	Does your metropolitan area deploy temporary traffic control devices, such as portable message signs and lane control signs, to help ensure the safety of arterial incident scenes?	Yes	78**

***Based on a survey of the 108 largest metropolitan areas in the nation**
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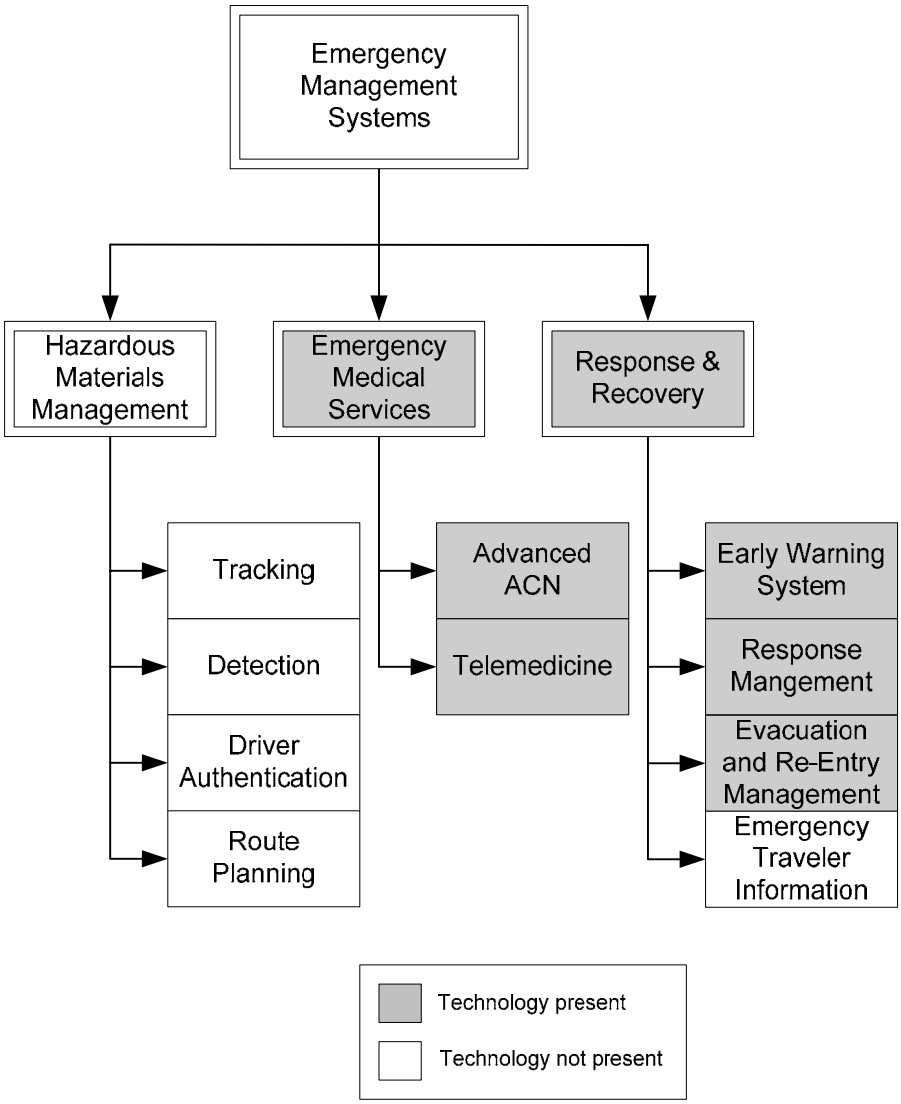
6.0 Emergency Management Systems

Figure 6 presents the Emergency Management Systems taxonomy. There are three major ITS functions that make up Emergency Management Systems: Hazardous Materials Management, Emergency Medical Services, and Response and Recovery. The shaded boxes indicate application areas reported as locally deployed.

Figure 6-Emergency Management Systems Taxonomy



6.1 Hazardous Materials Management

ITS applications associated with hazardous materials (HAZMAT) shipment can accomplish four major functions intended to provide safe and secure transport of hazardous materials by road.

Vehicle-mounted hardware provides the capability to track HAZMAT shipments and support notification of management centers when a shipment deviates from its intended route. Roadside detectors can monitor for the presence of hazardous shipments in sensitive areas and, if electronic tag information is available on the detected vehicle, confirm that the shipment is on the expected route. Driver authentication technology can confirm that the individual operating a HAZMAT vehicle is authorized to do so and report operation by unexpected drivers to public safety entities. ITS can also provide assistance to commercial vehicle operations via electronic route planning services, ensuring compliance with HAZMAT shipment restrictions along planned travel routes.

Technology	Survey Question	Response	National*
Tracking	Does your metropolitan area employ vehicle-mounted hardware to track HAZMAT shipment to detect when a shipment deviates from its intended route?	No	5**
Detection	Does your metropolitan area employ roadside detectors to monitor for the presence of hazardous shipments in sensitive areas?	No	4**
Driver Authentication	Does your metropolitan area employ driver authentication technology to confirm that the individual operating a HAZMAT vehicle is authorized to do so?	No	24**
Route Planning	Does your metropolitan area employ technology to provide assistance to commercial vehicle operators via electronic route planning services?	No	5**

***Based on a survey of the 108 largest metropolitan areas in the nation**
****Number of metropolitan areas that have deployed the technology**

6.2 Emergency Medical Services

Advanced Automated Collision Notification (ACN) and telemedicine address the detection of and response to incidents such as vehicle collisions or other incidents requiring emergency responders. In rural areas, response time for emergency medical services is greater than in metropolitan areas, resulting in more severe consequences for those in need of medical assistance. Advanced ACN systems can notify emergency personnel and provide them with valuable information on the crash, including location, crash characteristics, and possible relevant medical information regarding the vehicle occupants. Telemedicine systems provide a link between responding ambulances and emergency medical facilities, enabling doctors to advise emergency medical personnel regarding treatment of patients en route to the hospital.

Technology	Survey Question	Response	National*
Advanced ACN	Does your metropolitan area have access to Automatic Collision Notification (ACN) data?	Yes	10**
Telemedicine	Are ambulances in your metropolitan area equipped with telemedicine capability?	Yes	46**

***Based on a survey of the 108 largest metropolitan areas in the nation**
****Number of metropolitan areas that have deployed the technology**

6.3 Response & Recovery

The variety of sensors deployed on the transportation infrastructure can help provide an early warning system to detect large-scale emergencies, including natural disasters and technological and man-made disasters. In the event of a large-scale emergency, ITS applications can assist with response management through services such as the tracking of emergency vehicle fleets using automated vehicle location (AVL) technology and two-way communications between emergency vehicles and dispatchers. Evacuation operations often require a coordinated emergency response involving multiple agencies, various emergency centers, and numerous response plans. Integration with traffic and transit management systems enables emergency information to be shared between public and private agencies and the traveling public. This communication and cooperation also enables the use of the variety of ITS information dissemination capabilities to provide emergency traveler information.

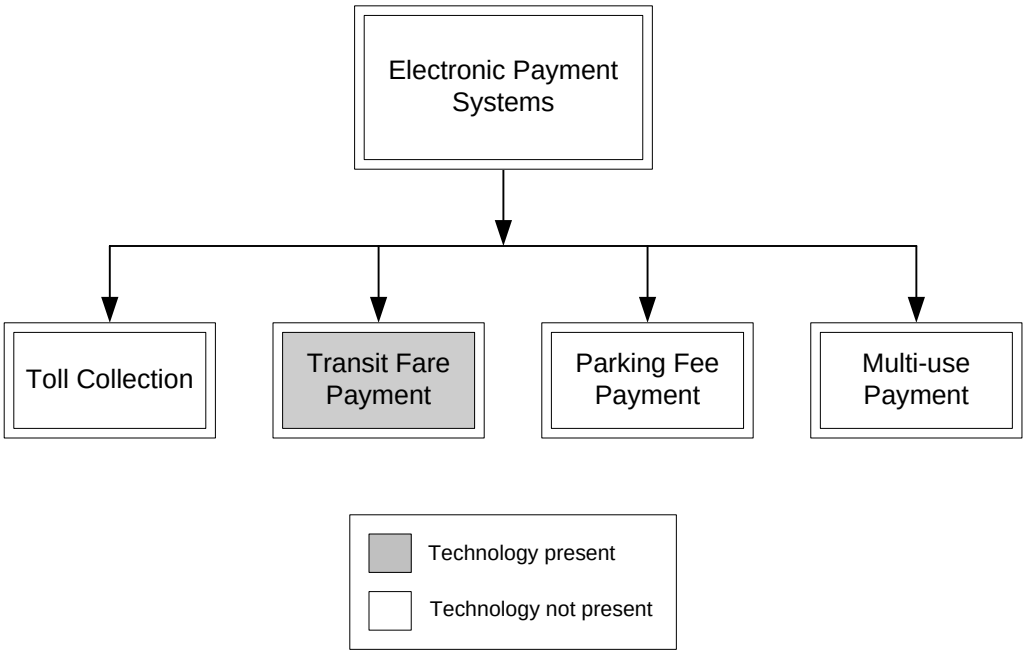
Technology	Survey Question	Response	National*
Early Warning Systems	Does your metropolitan area monitor early warning alerting and advisory systems to identify emergencies?	Yes	101**
Response Management	Do emergency responders use AVL/CAD to assist in locating and assigning appropriate responders to incidents?	Yes	98**
Evacuation and Re-Entry Management	Does your metropolitan area use integrated ITS and communications technology to coordinate evacuation management with different agencies, including traffic management and transit?	Yes	84**
Emergency Traveler	Does your metropolitan area have a dedicated emergency traveler information system?	No	37**

***Based on a survey of the 108 largest metropolitan areas in the nation**
****Number of metropolitan areas that have deployed the technology**

7.0 Electronic Payment Systems

Figure 6 presents the Electronic Payment Systems taxonomy. There are four major ITS functions that make up Emergency Management Systems: toll Collection, Transit Fare Payment, Parking Fee Payment, and Multi-use Payment. No subcategories are included in the Electronic Payment Systems taxonomy. The shaded boxes indicate application areas reported as locally deployed.

Figure 7-Electronic Payment Systems Taxonomy



7.1 Toll Collection

Electronic toll collection (ETC) supports the collection of payment at toll plazas using automated systems to increase the operational efficiency and convenience of toll collection. Systems typically consist of vehicle-mounted transponders identified by readers located in dedicated and/or mixed-use lanes at toll plazas.

Survey Question	Response	National*
Percent of toll collection plazas with Electronic Toll Collection (ETC) capabilities	0%	95%
Percent of toll collection lanes with Electronic Toll Collection (ETC) capabilities	0%	82%

***Based on a survey of the 108 largest metropolitan areas in the nation**

7.2 Transit Fare Payment

Electronic transit fare payment systems, often enabled by smart card or magnetic stripe technologies, can provide increased convenience to customers and generate significant cost savings to transportation agencies by increasing the efficiency of money handling processes and improving administrative controls.

Survey Question	Response	National*
Percent of Buses equipped with Magnetic Stripe Readers	94%	63%
Percent of Demand responsive vehicles equipped with Magnetic Stripe Readers	26%	16%
Percent of Buses equipped with Smart Card Readers (with embedded computer chip)	0%	29%
Percent of Demand responsive vehicles equipped with Smart Card Readers (with embedded computer chip)	0%	1%
Percent of Heavy rail stations equipped with Magnetic Stripe Readers	27%	39%
Percent of Heavy rail stations equipped with Smart Card Readers (with embedded computer chip)	0%	18%

***Based on a survey of the 108 largest metropolitan areas in the nation**

7.3 Parking Fee Payment

Electronic parking fee payment systems can provide benefits to parking facility operators, simplify payment for customers, and reduce congestion at entrances and exits to parking facilities. These payment systems can be enabled by any of a variety of technologies including magnetic stripe cards, smart cards, in-vehicle transponders, or vehicle-mounted bar-codes.

Survey Question	Response	National*
Does your metropolitan area deploy parking fee payment systems to simplify payment for customers and reduce congestion at exits to parking facilities?	No	25**

***Based on a survey of the 108 largest metropolitan areas in the nation**
****Number of metropolitan areas that have deployed the technology**

7.4 Multi-use Payment

Multi-use payment systems can make transit payment more convenient. Payment for bus, rail, and other public or private sector goods and services can be made using transit fare cards at terminal gates, or on check-out counters and phone booths of participating merchants located near transit stations. Multi-use systems may also incorporate the ability to pay highway tolls with the same card.

Survey Question	Response	National*
Can the same electronic fare payment system used by one transit agency be used by another Transit agency in your metropolitan area?	No	29**

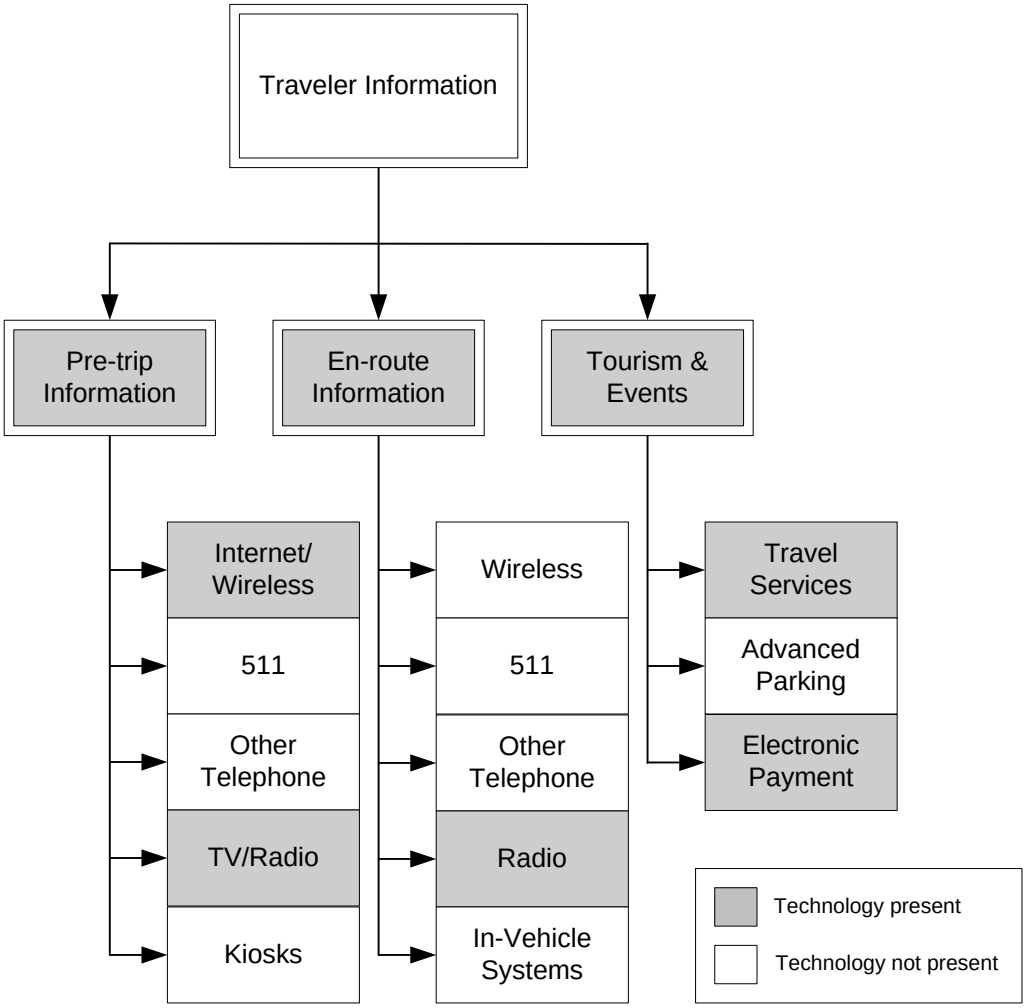
Survey Question	Response	National*
Can the same electronic fare payment system used by one toll agency be used by other toll collection systems in your metropolitan area?	No	16**

***Based on a survey of the 108 largest metropolitan areas in the nation**
****Number of metropolitan areas that have deployed the technology**

8.0 Traveler Information

Figure 8 presents the Traveler Information Systems taxonomy. There are three major ITS functions that make up Traveler Information: Pre-trip Information, En-route Information, and Tourism and Events. The shaded boxes indicate application areas reported as locally deployed.

Figure 8-Traveler Information Taxonomy



8.1 Pre-trip Information

Pre-trip traveler information provided via internet websites, other wireless devices, 511 telephone numbers, other telephone services, television, radio or kiosks allows users to make a more informed decision for trip departures, routes, and mode of travel.

Technology	Survey Question	Response	National*
Internet /Wireless	Does your metropolitan area deploy Internet/Wireless technologies to distribute pre-trip traveler information for freeways?	Yes	72**
	Does your metropolitan area deploy Internet/Wireless technologies to distribute pre-trip traveler information for arterials?	Yes	52**
511	Does your metropolitan area deploy 511 to distribute pre-trip traveler information for freeways?	No	39**
	Does your metropolitan area deploy 511 to distribute pre-trip traveler information for arterials?	No	25**
Other Telephone	Does your metropolitan area deploy other (non-511) telephone systems to distribute pre-trip traveler information for freeways?	No	16**
	Does your metropolitan area deploy other (non-511) telephone systems to distribute pre-trip traveler information for arterials?	No	6**
TV/Radio	Does your metropolitan area use TV/Radio to distribute pre-trip traveler information for freeways?	Yes	53**
	Does your metropolitan area use TV/Radio to distribute pre-trip traveler information for arterials?	Yes	47**
Kiosks	Does your metropolitan area deploy Kiosks to distribute pre-trip traveler information for freeways?	No	11**
	Does your metropolitan area deploy Kiosks to distribute pre-trip traveler information for arterials?	No	11**

***Based on a survey of the 108 largest metropolitan areas in the nation**
****Number of metropolitan areas that have deployed the technology**

8.2 En-route Information

En-route traveler information provided via wireless devices, 511 telephone numbers, other telephone services, radio, and in-vehicle signing allows users to make informed decisions regarding alternate routes and expected arrival times.

Technology	Survey Question	Response	National*
Wireless	Does your metropolitan area deploy Wireless technologies distribute en-route traveler information for freeways?	No	18**
	Does your metropolitan area deploy Wireless technologies distribute en-route traveler information for arterials?	No	4**
511	Does your metropolitan area deploy 511 to distribute en-route traveler information for freeways?	No	39**
	Does your metropolitan area deploy 511 to distribute en-route traveler information for arterials?	No	24**

Technology	Survey Question	Response	National*
Other Telephone	Does your metropolitan area deploy other (non-511) telephone systems to distribute en-route traveler information for freeways?	No	13**
	Does your metropolitan area deploy other (non-511) telephone systems to distribute en-route traveler information for arterials?	No	7**
Radio	Does your metropolitan area use Radio to distribute en-route traveler information for freeways?	Yes	52**
	Does your metropolitan area use Radio to distribute en-route traveler information for arterials?	Yes	39**
In-Vehicle Systems	Does your metropolitan area deploy In-Vehicle Systems to distribute en-route traveler information for freeways?	No	2**
	Does your metropolitan area deploy In-Vehicle Systems to distribute en-route traveler information for arterials?	No	0**

***Based on a survey of the 108 largest metropolitan areas in the nation**
****Number of metropolitan areas that have deployed the technology**

8.3 Tourism & Events

Tourism and event-related travel information systems focus on the needs of travelers in areas unfamiliar to them or when traveling to major events such as sporting events or concerts. These services address issues of mobility and traveler convenience. Information provided can include electronic yellow pages as well as transit and parking availability.

Technology	Survey Question	Response	National*
Travel Services	Does your metropolitan area deploy tourism information traveler systems that focus on the needs (i.e., electronic yellow pages, incorporating lodging reservations systems and directions to points of interest) of travelers in areas unfamiliar to them?	Yes	9**
Advanced Parking	Does your metropolitan area deploy parking management systems that provide availability status and directional guidance posted on dynamic message signs at major tourism destinations?	No	4**
Electronic Payment	Does your metropolitan area deploy electronic payment systems (i.e., magnetic stripe cards, smart cards, or similar technologies) to facilitate traveler's payment for travel and other services at tourist destinations?	Yes	9**

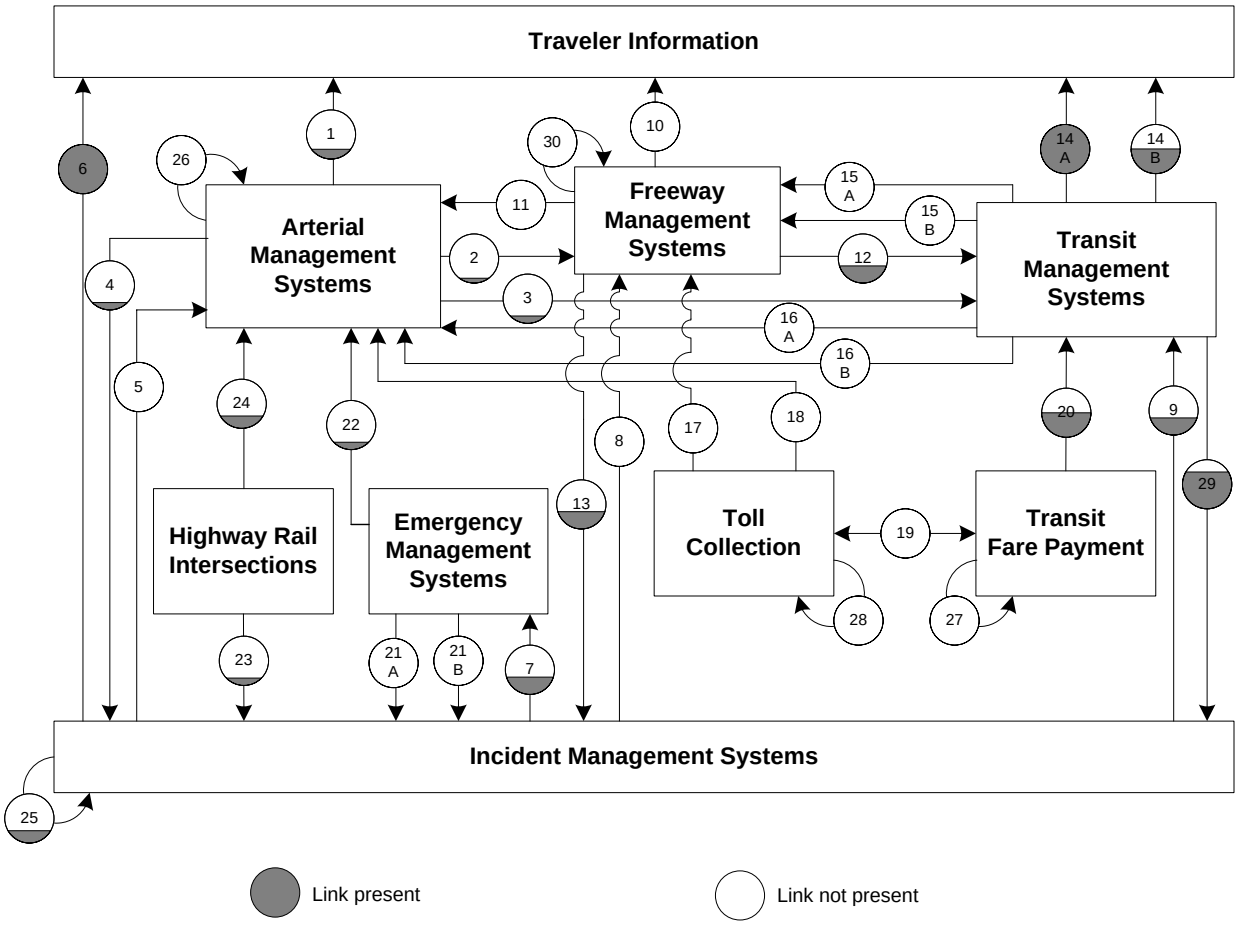
***Based on a survey of the 108 largest metropolitan areas in the nation**
****Number of metropolitan areas that have deployed the technology**

9.0 Integration

A critical aspect of ITS that provides much of its capability is the integration of individual agencies to form a unified regional traffic control system. Individual agencies routinely collect information that is used for purposes internal to that agency. For example, Arterial Management agencies monitor arterial conditions to revise signal timing and to convey these conditions to travelers through such technologies as variable message signs and highway advisory radio. Other agencies can make use of this information in formulating their 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. In addition, other Arterial Management agencies may alter signal timing to coordinate traffic management along a corridor.

To track ITS integration, definitions for inter- and intra-component integration were developed and indicators, derived from these definitions, were produced for each integration link. A total of 34 individual integration indicators was specified and is portrayed in the following figure. Each integration indicator has been assigned a number and an origin/destination path from one ITS infrastructure component to another. For example, the number “10” identifies the integration of information from the Freeway Management component to the Traveler Information component (See Appendix A for a description of all the integration links). For each defined link, the extent of integration is indicated by the shading in the circle for that link and is calculated by dividing the number of agencies that report sharing information on the link by the number of agencies surveyed. Figure 9 portrays the integration indicators for Cleveland, Akron, Lorain as of 2006.

Figure 9 - Cleveland, Akron, Lorain Integration Links



Note: Shading indicates the value of the link. For example a circle half shaded equals 50%

APPENDIX A

INTEGRATION LINK DESCRIPTION

Link	Description	Purpose
1	Arterial Management to Regional Multimodal Traveler Information	Arterial travel time, speed, and condition information are displayed by Regional Multimodal Traveler Information media.
2	Arterial Management to Freeway Management	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.
3	Arterial Management to Transit Management	Transit Management adjusts transit routes and schedules in response to arterial travel times, speeds, and conditions information collected as part of Traffic Signal Control.
4	Arterial Management to Incident Management	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.
5	Incident Management to Arterial Management	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.
6	Incident Management to Regional Multimodal Traveler Information	Incident location, severity, and type information are displayed by Regional Multimodal Traveler Information media.
7	Incident Management to Emergency Management	Incident severity, location, and type data collected as part of Incident Management are used to notify Emergency Management for incident response.
8	Incident Management to Freeway Management	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.

Link	Description	Purpose
9	Incident Management to Transit Management	Transit Management adjusts transit routes and schedules in response to incident severity, location, and type data collected as part of Incident Management.
10	Freeway Management to Regional Multimodal Traveler Information	Freeway travel time, speed, and condition information are displayed by Regional Multimodal Traveler Information media.
11	Freeway Management to Arterial Management	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.
12	Freeway Management to Transit Management	Transit Management adjusts transit routes and schedules in response to freeway travel times, speeds, and conditions information collected as part of Freeway Management.
13	Freeway Management to Incident Management	Incident Management monitors freeway travel time, speed, and condition data collected by Freeway Management to detect incidents or manage incident response.
14a	Transit Management to Regional Multimodal Traveler Information (static route information)	Transit routes, schedules, and fare information are displayed on Regional Multimodal Traveler Information media.
14b	Transit Management to Regional Multimodal Traveler Information (schedule adherence information)	Transit schedule adherence information are displayed on Regional Multimodal Traveler Information media.
15a	Transit Management to Freeway Management	Freeway ramp meters are adjusted in response to receipt of transit vehicle pre-emption signal.
15b	Transit Management to Freeway Management (transit vehicle probes)	Transit vehicles equipped as probes are monitored by Freeway Management for the purpose of determining freeway travel speeds or travel times.
16a	Transit Management to Arterial Management	Traffic signals are adjusted in response to receipt of transit vehicle pre-emption signal.

Link	Description	Purpose
16b	Transit Management to Arterial Management (transit vehicle probes)	Transit vehicles equipped as probes are monitored by Traffic Signal Control for the purpose of determining arterial speeds or travel times.
17	Electronic Toll Collection to Freeway Management (ETC equipped probes)	Vehicles equipped with electronic toll collection (ETC) tags are monitored by Freeway Management for the purpose of determining freeway travel speeds or travel times.
18	Electronic Toll Collection to Arterial Management (ETC equipped probes)	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.
19	Electronic Fare Payment and Electronic Toll Collection	Transit operators accept ETC- issued tags to pay for transit fares.
20	Electronic Fare Payment to Transit Management	Rider ship details collected as part of Electronic Fare Payment are used in transit service planning by Transit Management.
21a	Emergency Management to Incident Management (incident notification)	Incident Management is notified of incident location, severity, and type by Emergency Management for the purpose of identifying incidents on freeways or arterials.
21b	Emergency Management to Incident Management (incident clearance)	Incident Management is notified of incident clearance activities by Emergency Management for the purpose of managing incident response on freeways or arterials.
22	Emergency Management to Arterial Management	Emergency Management vehicles are equipped with traffic signal priority capability.
23	Highway-rail intersections to Incident Management (crossing status)	Incident Management is notified of crossing blockages by Highway-rail intersection for the purpose of managing incident response.
24	Highway-rail intersections to Arterial Management (crossing status)	Highway-rail intersection and Traffic Signal Control are interconnected for the purpose of adjusting traffic signal timing in response to train crossing.

Link	Description	Purpose
25	Incident Management intra-component	Agencies participating in formal working agreements or incident management plans coordinate incident detection, verification, and response.
26	Arterial Management intra-component	Agencies operating traffic signals along common corridors sharing information and possibly control of traffic signals to maintain progression on arterial routes.
27	Electronic Fare Payment intra-component.	Operators of different public transit services share common electronic fare payment media.
28	Electronic Toll Collection intra-component	Electronic Toll Collection agencies share a common toll tag for the purpose of facilitating “seam less” toll transactions.
29	Transit Management to Incident Management (incident reporting)	Transit agency operators or dispatchers report traffic incidents (e.g. stalled vehicles, crashes) as part of an organized regional incident management program.
30	Freeway Management intra-component	Freeway travel time, speeds, and conditions data collected by Freeway Management agencies are used by other Freeway Management agencies in response to changing freeway conditions for the purpose of adjusting ramp meter timing, lane control or HAR messages in response to freeway or arterial incidents.

APPENDIX B

AGENCIES SURVEYED

			Returned		
Agency Name	***2000***	***2002***	***2004***	***2005***	***2006***
Arterial Management					
Lorain County	Yes	Yes	Yes	Yes	Yes
Akron City	Yes	Yes	Yes	Yes	Yes
Summit County	Yes	Yes	Yes	Yes	Yes
Portage County	Yes	Yes	Yes	Yes	Yes
Parma City	Yes	Yes	Yes	Yes	Yes
Ohio Department of Transportation District 4	Yes	Yes	Yes	Yes	Yes
Ohio Department of Transportation District 3	Yes	Yes	Yes	Yes	Yes
Medina County	Yes	Yes	Yes	No	Yes
Lorain City	Yes	Yes	Yes	Yes	Yes
Lakewood City	Yes	Yes	Yes	Yes	Yes
Lake County	Yes	Yes	Yes	Yes	Yes
Geauga County	Yes	Yes	Yes	Yes	Yes
Euclid City	Yes	Yes	Yes	No	Yes
Elyria City	Yes	Yes	Yes	Yes	Yes
Cuyahoga County	Yes	Yes	Yes	Yes	Yes
Cleveland Heights City	Yes	Yes	Yes	Yes	Yes
Cleveland City	No	No	Yes	No	No
Ohio Department of Transportation District 12	Yes	Yes	Yes	Yes	Yes
Electronic Toll Collection					

Ohio Turnpike Commission	Yes	Yes	Yes	Yes	Yes
Freeway Management					
Ohio Turnpike Commission	Yes	Yes	Yes	Yes	Yes
Ohio Department of Transportation District 12	Yes	Yes	Yes	Yes	Yes
Ohio Department of Transportation District 4	Yes	Yes	Yes	Yes	Yes
Public Safety					
Akron City Fire Department (Emergency Medical)	Yes	Yes	NS*	NS*	NS*
Euclid City Fire Department	Yes	Yes	Yes	Yes	Yes
Summit County Sheriff Department	Yes	Yes	Yes	Yes	Yes
Parma City Police Department	Yes	Yes	Yes	Yes	Yes
Parma City Fire Department (Emergency Medical)	Yes	Yes	Yes	Yes	Yes
Parma City Fire Department	Yes	Yes	Yes	Yes	Yes
Lorain City Police Department	Yes	Yes	Yes	Yes	Yes
Akron City Fire Department	Yes	Yes	Yes	Yes	Yes
Euclid City Police Department	Yes	Yes	Yes	Yes	Yes
Elyria City Police Department	Yes	Yes	Yes	Yes	Yes
Elyria City Fire Department	Yes	Yes	Yes	Yes	Yes
Cuyahoga County Sheriff Department	Yes	Yes	Yes	Yes	No
Cleveland Heights City Police	Yes	Yes	Yes	Yes	Yes
Cleveland Heights City Fire Department	Yes	Yes	Yes	Yes	Yes
Cleveland City Police Department	Yes	Yes	Yes	Yes	Yes
Cleveland City Fire Department	Yes	No	Yes	Yes	Yes
Cleveland City Emergency Medical Services	Yes	Yes	Yes	Yes	Yes

Akron City Police Department	Yes	Yes	Yes	Yes	Yes
Lorain City Fire Department	Yes	Yes	Yes	Yes	No
Transit Management					
Metro Regional Transit Authority	Yes	Yes	Yes	Yes	Yes
Campus Bus Service	Yes	Yes	NS*	NS*	NS*
Greater Cleveland Regional Transit	Yes	Yes	Yes	Yes	Yes
Laketran	Yes	Yes	Yes	Yes	Yes
Lorain County Transit	Yes	Yes	Yes	Yes	Yes

NS*=Not Surveyed