Appendix I – Subsystem Definitions

National ITS Architecture definitions of Subsystems are detailed below:

Archived Data Management

The Archived Data Management Subsystem collections, archives, manages, and distributes data generated from ITS sources for use in transportation administration, policy evaluation, safety, planning, performance monitoring, program assessment, operations, and research applications. The data received is formatted and tagged with attributes that define the data source, conditions under which it was collected, data transformations, and other information (i.e., meta data) necessary to interpret the data. The subsystem can fuse ITS generated data with data from non-ITS sources and other archives to generate information products utilizing data from multiple functional areas, modes, and jurisdictions. The subsystem prepares data products that can serve as inputs to federal, state, and local data reporting systems. This subsystem may be implemented in many different ways. It may reside within an operational center and provide focused access to a particular agency's data archives. Alternatively, it may operate as a distinct center that collects data from multiple agencies and sources and provides a general data warehouse service for a region.

Commercial Vehicle Administration

The Commercial Vehicle Administration Subsystem will operate at one or more fixed locations within a region. This subsystem performs administrative functions supporting credentials, tax, and safety regulations associated with commercial vehicles. It issues credentials, collects fees, and taxes, and supports enforcement of credential requirements. This subsystem communicates with motor carriers to process credential applications and collect fuel taxes, weight/distance taxes, and other taxes and fees associated with commercial vehicle operations.

Commercial Vehicle Check

This subsystem supports automated vehicle identification at mainline speeds for credential checking, roadside safety inspections, and weigh-in-motion using two-way data exchange. These capabilities include providing warnings to the commercial vehicle drivers, their fleet managers, and proper authorities of any safety problems that have been identified, accessing, and examining historical safety data, and automatically deciding whether to allow the vehicle to pass or require it to stop with operator manual override. The Commercial Vehicle Check Subsystem also provides supplemental inspection services such as expedited brake inspections, the use of operator hand-held devices, mobile screening sites, on-board safety database access, and the enrollment of vehicles and carriers in the electronic clearance program.

Commercial Vehicle

This subsystem represents commercial vehicles and provides the sensory, processing, storage, and communications functions necessary to support safe and efficient commercial vehicle operations. The Commercial Vehicle Subsystem provides two-way communications between the commercial vehicle drivers, their fleet managers, attached freight equipment, and roadside officials. This subsystem hosts the on-board equipment that provides ITS capabilities. It includes the heavy vehicle databus and all other interface points between on-board systems and the rest of the commercial vehicle. This vehicle is used to transport goods, is operated by a professional driver, and typically administered as part of a larger fleet. This classification applies to all goods transport

vehicles ranging from small panel vans used in local pick-up and delivery services to large, multi-axle tractor-trailer rigs operating on long haul routes.

Emergency Management

The Emergency Management Subsystem represents public safety, emergency management, and other allied agency systems that support incident management, disaster response and evacuation, security monitoring, and other security and public safety-oriented ITS applications The subsystems includes the functions associated with fixed and mobile public safety communications centers including public safety call taker and dispatch centers operated by police (including transit police), fire, and emergency medical services. It includes the functions associated with Emergency Operations Centers that are activated at local, regional, state, and federal levels for emergencies and the portable and transportable systems that support Incident Command System Operations at an incident. This Center also represents systems associated with towing and recovery, freeway service patrols, HAZMAT response teams, and mayday service providers.

The subsystem managers sensor and surveillance equipment used to enhance transportation security of the roadway infrastructure (including bridges, tunnels, interchanges, and other key roadway segments) and the public transportation systems (including transit vehicles, public areas such as transit stops and stations, facilities such as transit yards, and transit infrastructure such as rail, bridges, tunnels, or bus guideways). It provides security/surveillance services to improve traveler security in public areas, not a part of the public transportation system.

The subsystem monitors alerts, advisories, and other threat information and prepares for and responds to identified emergencies. It coordinates emergency response involving multiple agencies with peer centers. It stores, coordinates, and utilizes emergency response and evacuation plans to facilitate this coordinated response. Emergency information including damage assessments, response status, evacuation information, and resource information are shared The Emergency Management Center also provides a focal point for coordination of the emergency and evacuation information that is provided to the traveling public, including wide-area alerts when immediate public notification is warranted.

The subsystem tracks and manages emergency vehicle fleets using real-time road network status and routing information from the other centers to aid in selecting the emergency vehicle(s) and routes, and works with other relevant centers to tailor traffic control to support emergency vehicle ingress and egress, implementation of special traffic restrictions and closures, evacuation traffic control plans, and other special strategies that adapt the transportation system to better meet the unique demands of an emergency.

Emergency Vehicle

This subsystem represents emergency vehicles and provides the processing, storage, and communications functions that support public safety-related connected vehicle applications. It represents a range of vehicles including those operated by police, fire, and emergency medical services. In addition, it represents other incident response vehicles including towing and recovery vehicles and freeway services patrols. It includes two-way communications to support coordinated response to emergencies. Emergency vehicles are equipped with automated vehicle location capability for monitoring by vehicle tracking and fleet management functions in the Emergency Management Subsystem. Using these capabilities, the appropriate emergency vehicle to respond

to each emergency is determined. Route guidance capabilities within the vehicle enable safe and efficient routing to the emergency.

Emissions Management

The Emissions Management Subsystem provides the capabilities for air quality managers to monitor and manage air quality. These capabilities include collecting emissions data from distributed emissions sensors (included in ITS Roadway Equipment) and directly from connected vehicles. The sensors monitor general air quality and monitor the emissions of individual vehicles on the roadway. The measures are collected, processed, and used to support environmental monitoring applications.

Fleet and Freight Management

The Fleet and Freight Management Subsystem provides the capability for commercial drivers and fleet-freight managers to receive real-time routing information and access databases containing vehicle and/or freight equipment locations as well as carrier, vehicle, freight equipment and driver information. In addition, the capability to purchase credentials electronically shall be provided, with automated and efficient connections to financial institutions and regulatory agencies, along with post-trip automated mileage and fuel usage reporting. This subsystem also provides the capability for fleet managers to monitor the safety and security of their commercial vehicle drivers and fleet. In addition, the subsystem also supports application for HAZMAT credentials and makes information about HAZMAT cargo available to agencies as required. Within this subsystem lies all the functionality associated with subsystems and components necessary to enroll and participate in international goofs' movement programs aimed at enhancing trade and transportation safety and security.

Information Service Provider

This subsystem collects, processes, stores, and disseminates transportation information to system operators and the traveling public. The subsystem can play several different roles in an integrated ITS. In one role, the ISP provides a data collection, fusing, and repackaging function, collecting information from transportation system operators, and redistributing this information to other system operators in the region and other ISPs. In this information redistribution role, the ISP provides a bridge between the various transportation systems that produce the information and the other ISPs and their subscribers that use the information. The second role of an ISP is focused on delivery of traveler information to subscribers and the public at large. The information provided includes basic advisories, traffic and road conditions, transit schedule information, yellow pages information, ride matching information, and parking information. The subsystem also provides the capability to provide specific directions to travelers by receiving origin and destination requests from travelers, generating route plans, and returning the calculated plans to the users. In addition to general route planning for travelers, the ISP also supports specialized route planning for vehicle fleets. In this third role, the ISP function may be dedicated to, or even embedded within, the dispatch system. Reservation services are also provided in advanced implementations. The information is provided to the traveler through the Personal Information Access Subsystem, Remote Traveler Support Subsystem, and the Vehicle Subsystem through available communications links. Both basic one-way (broadcast) and personalized two-way information provision are supported. The ISP is most commonly implemented as an Internet website, but it represents any traveler information distribution service including systems that broadcast digital transportation data (e.g., satellite radio networks) and systems that support distribution through

Field-Vehicle Communications networks. The ISP accomplishes these roles using constantly evolving technologies like the Internet, direct broadcast communications (email alerts, pagers, satellite radio network data broadcasts), communications through Field-Vehicle Communications networks, etc.

Maintenance and Construction Management

The Maintenance and Construction Management Subsystem monitors and manages roadway infrastructure construction and maintenance activities. Representing both public agencies and private contractors that provide these functions, this physical object manages fleets of maintenance, construction, or special service vehicles (e.g., snow and ice control equipment). The physical object receives a wide range of status information from these vehicles and performs vehicle dispatch, routing, and resource management for the vehicle fleets and associated equipment. The physical object participates in incident response by deploying maintenance and construction resources to an incident scene, in coordination with other center physical objects. The physical object manages equipment at the roadside, including environmental sensors and automated systems that monitor and mitigate adverse road and surface weather conditions. It manages the repair and maintenance of both non-ITS and ITS equipment including the traffic controllers, detectors, dynamic message signs, signals, and other equipment associated with the roadway infrastructure. Weather information is collected and fused with other data sources and used to support advanced decision support systems.

The physical object remotely monitors and manages ITS capabilities in work zones, gathering, storing, and disseminating work zone information to other systems. It manages traffic in the vicinity of the works zone and advises drivers of work zone status (either directly at the roadside or through an interface with the Transportation Information Center or Traffic Management Center Physical Objects).

Construction and maintenance activities are tracked and coordinated with other systems, improving the quality and accuracy of information available regarding closures and other roadway construction and maintenance activities.

Maintenance and Construction Vehicle

This subsystem represents maintenance, construction, or other specialized service vehicle or equipment and provides the processing, storage, and communications functions necessary to support highway maintenance and construction. All types of maintenance and construction vehicles are covered, including heavy equipment, supervisory vehicles, unmanned remote controlled field maintenance robots, and sensory platforms that may be wheeled or low altitude aerial vehicles. This subsystem provides two-way communications between drivers/operators and dispatchers and maintains and communicates current location and status information. A wide range of operational status is monitored, measured, and made available, depending on the specific type of vehicle or equipment. The subsystem may also contain capabilities to monitor vehicle systems to support maintenance of the vehicle itself and other sensors that monitor environmental conditions including the road conditions and surface weather information. This subsystem can represent a diverse set of mobile environmental sensing platforms, including wheeled vehicles and any other vehicle that collects and reports environmental information.

Parking Management

The Parking Management Subsystem provides electronic monitoring and management of parking facilities. It supports a dedicated short-range communications (DSRC) link to the Vehicle Subsystems that allows electronic collection of parking fees and monitors and controls parking meters that support conventional parking fees collection. It also includes the instruments, signs, and other infrastructure that monitors parking lot usage and provides local information about parking availability and other general parking information. The two primary approaches to monitoring parking area usage are sensing vehicles within parking spots or counting vehicles as they come in and as they leave the area. This portion of the subsystem functionally must be located in the parking facility where it can monitor, classify, and share information with customers and their vehicles. The subsystem also interfaces with the financial infrastructure and broadly disseminates parking information to other operations centers in the region. Note that the latter functionality may be located in a back office, remote from the parking facility.

Personal Information Access

This subsystem provides the capacity for travelers to receive formatted traveler information wherever they are. Capabilities include traveler information, trip planning, and route guidance. A smart phone receives route planning and other personally focused transportation services from the infrastructure in the field, at home, at work, or while en-route. This subsystem may operate independently or may be linked with vehicle on-board equipment. In addition, safety related services with the capability to broadcast safety messages and initiate a distress signal or a request for help.

Remote Traveler Support

This subsystem provides access to traveler information at transit stations, transit stops, other fixed sites along travel routes (e.g., rest stops, merchant locations), and major trip generation locations such as special event centers, hotels, office complexes, amusement parks, and theaters. Traveler information access points include kiosks and information access. At transit stops this might be simple displays providing schedule information and imminent arrival signals. This basic information may be extended to include multi-modal information including traffic conditions and transit schedules to support mode and route selection at major trip generations sites. Personalized route planning and route guidance information can also be provided based on criteria supplied by the traveler. The subsystem also supports electronic payment of transit fares.

In addition to the traveler information provisions, this subsystem also supports security and safety monitoring of public areas. This monitoring includes traveler activated silent alarms, as well as surveillance and sensor equipment. The surveillance equipment includes video (e.g., CCTV cameras) and/or audio systems. The sensor equipment includes threat sensors (e.g., chemical agent, toxic industrial chemical, biological, explosives, and radiological sensors) and object detection sensors (e.g., metal detectors).

Roadway

This subsystem includes the ITS equipment that is distributed on and along the roadway that monitors and controls traffic and monitors and manages the roadway. Equipment includes traffic detectors, environmental sensors, traffic signals, highway advisory radios, dynamic message signs, CCTV cameras and video image processing systems, grade crossing warning systems, and ramp metering systems. Lane management systems and barrier systems that control access to

transportation infrastructure such as roadways, bridges, and tunnels are also included. This subsystem also provides environmental monitoring including sensors that measure road conditions, surface weather, and vehicle emissions. Work zone systems including work zone surveillance, traffic control, driver warning, and work crew safety systems are also included. To enhance security, remotely controlled systems to protect transportation infrastructure is also provided. In advanced implementations, this subsystem supports automated vehicle safety systems by safely controlling access to and egress from an Automated Highway System through monitoring of, and communications with, AHS vehicles. Intersection collision avoidance functions are provided by determining the probability of a collision in the intersection and sending appropriate warnings and/or control actions to the approaching vehicles.

Security Monitoring

This subsystem includes surveillance and sensor equipment used to provide enhanced security and safety for transportation facilities or infrastructure. The equipment is located in non-public areas of transportation facilities (e.g., transit railway and guideways), and in public areas (e.g., transit stops, transit stations, intermodal terminals). This equipment also includes surveillance and sensor equipment located on or near major roadway features such as bridges, tunnels, and interchanges, when the equipment's primary function is one of security and safety. If the primary function of the equipment is traffic surveillance or incident detection, then the surveillance or sensors would be covered as part of the ITS Roadway Equipment. The surveillance equipment includes video (e.g., CCTV cameras) and/or audio systems. The sensor equipment includes threat sensors (e.g., chemical agent, toxic industrial chemical, biological, explosives, and radiological sensors), object detection (e.g., metal detectors), intrusion or motion detection, and infrastructure integrity monitoring (e.g., rail track continuity checking or bridge structural integrity monitoring). Limited processing of collected sensor and surveillance data is also included in this subsystem to support threat detection and classification.

Toll Administration

The Toll Administration Subsystem provides a general administration capability and supports the electronic transfer of funds from the customer to the transportation system operator or other service provider. Changes can be recorded for tolls, vehicle-mileage charging, congestion charging, or other goods and services. It supports traveler's enrollment and collection of both pre-payment and post-payment transportation fees in coordination with the financial infrastructure supporting electronic payment transactions. The system may establish and administer escrow accounts depending on the clearinghouse scheme and the type of payments involved. It may post a transaction to the customer account, generate a bill (for post-payment accounts), debit an escrow account, or interface to a financial infrastructure to debit a customer designated account. It supports communications with the ITS Roadway Payment Equipment to support fee collection operations. As an alternative, a wide-area wireless interface can be used to communicate directly with vehicle equipment. It also sets and administers the pricing structures and may implement road pricing policies in coordination with the Traffic Management Center.

Toll Collection

The Toll Collection Subsystem provides the capability for vehicle operators to pay tolls without stopping their vehicles using locally determined pricing structures and includes the capability to implement various variable road pricing policies. Each Transaction is accompanied by feedback to the customer indicating the general status of the customer's account. A record of the transaction

is provided to the Toll Administration Subsystem for reconciliation so that the customer can periodically receive a detailed record of the transaction.

Traffic Management

The Traffic Management Subsystem monitors and controls traffic and the road network. It represents centers that manage a broad range of transportation facilities including freeway systems, rural and suburban highway systems, and urban and suburban traffic control systems. It communicates with ITS Roadway Equipment and Connected Vehicle Roadside Equipment (RSE) to monitor and manage traffic flow and monitor the condition of the roadway, surrounding environmental conditions, and field equipment status. The subsystem supports HOV lane management and coordination, road pricing, and other demand management policies that can alleviate congestion and influence mode selection. It manages traffic and transportation resources to support allied agencies in responding to, and recovering from, incidents ranging from minor traffic incidents through major disasters. It also coordinates with rail operations to support safer and more efficient highway traffic management at highway-rail intersections. The Traffic Management Subsystem provides the capabilities to exercise control over those devices utilized for automated highway system (AHS) traffic and vehicle control.

Transit Management

The Transit Management Subsystem manages transit vehicle fleets and coordinates with other modes and transportation services. It provides operations, maintenance, customer information, planning and management functions for the transit property. It spans distinct central dispatch and garage management systems and supports the spectrum of fixed route, flexible route, paratransit services, transit rail, and bus rapid transit (BRT) service. The subsystems interface's support communication between transit departments and with other operating entities such as emergency response services and traffic management systems. This subsystem receives special event and real-time incident data from the traffic management subsystem. It provides current transit operations data to other center subsystems. It interfaces with the Emergency Management Subsystem to allow coordinated use of transit vehicles to facilitate response to major emergencies or evacuations. The Transit Management Subsystem collects and stores accurate ridership levels and implements corresponding fare structures. It collects operational and maintenance data from transit vehicles, manages vehicles and routes. The Transit Management Subsystem also provides the capability for automated planning and scheduling of public transit operations. It furnishes travelers with real-time travel information, continuously updated schedules, schedule adherence information, transfer options, and transit routes and fares. In addition, the subsystem supports transit security features. This includes monitoring silent alarms, both passenger and operator initiated, on-board transit vehicles. It also includes the capability to support transit vehicle operator authentication and the capability to remotely disable a transit vehicle. The subsystem includes the capability to monitor a transit vehicle being off the assigned route. The subsystem also includes the capability to alert operators and police to potential incidents identified by these security features.

Transit Vehicle

This subsystem resides in a transit vehicle and provides the sensory, processing, storage, and communications functions necessary to support safe and efficient movement of passengers. The types of transit vehicles containing this subsystem include buses, paratransit vehicles, light rail vehicles, other vehicles designed to carry passengers, and supervisory vehicles. The subsystem

collects ridership levels and supports electronic fare collection. It supports a traffic signal prioritization function that communicates with the roadside physical object to improve on-schedule performance. Automated vehicle location enhances the information available to the transit operator enabling more efficient operations. On-board sensors support transit vehicle maintenance. The subsystem supports on-board security and safety monitoring. This monitoring includes transit user or vehicle operator activated alarms (silent or audible), as well as surveillance and sensor equipment. The surveillance equipment includes video (e.g., CCTV cameras), audio systems and/or event recorder systems. It also furnishes travelers with real-time travel information, continuously updated schedules, transfer options, routes, and fares.

Vehicle

This subsystem provides the vehicle-based general sensory, processing, storage, and communications functions that support efficient, safe, and convenient travel. Many of these capabilities apply to all vehicle types including personal vehicles, commercial vehicles, emergency vehicles, transit vehicles, and maintenance vehicles. From this perspective, the vehicle includes common interfaces and functions that apply to all motorized vehicles. The radio(s) supporting V2V and V2I communications are a key component of the Vehicle. Both one-way and two-way communications options support a spectrum of information services from basic broadcast to advanced personalized information services. Advanced sensors, processors, enhanced driver interfaces, and actuators component the driver information services so that, in addition to making informed mode and route sections, the driver travels these routes in a safer and more consistent manner. Initial collision avoidance functions provide “vigilant co-pilot” driver warning capabilities. More advanced functions assume limited control of the vehicle to maintain lane position and safe headways. Ultimately, this subsystem supports full automation of all aspects of the driving task, aided by communications with other vehicles in the vicinity and in coordination with supporting infrastructure subsystems. Pre-crash safety systems are deployed, and emergency notification messages are issued when avoidable collisions do occur.