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## APPENDIX C: SUBSYSTEMS

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The material contained herein was adopted from National ITS System Architecture documents published by FHWA in 1997 and have been modified only slightly to better complement the ITS EDP and future ITS efforts in the Greater Metropolitan Region.

### 1. CENTER SUB-SYSTEMS

#### Commercial Vehicle Administration Subsystem

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. It issues credentials, collects fees and taxes, and supports enforcement of credential requirements. This subsystem communicates with the Fleet and Freight Management Subsystems associated with the motor carriers to process credentials applications and collect fuel taxes, weight/distance taxes, and other taxes and fees associated with commercial vehicle operations. The subsystem also receives applications for, and issues special Oversize/Overweight and HAZMAT permits in coordination with other cognizant authorities. The subsystem coordinates with other Commercial Vehicle Administration Subsystems (in other states/regions) to support nationwide access to credentials and safety information for administration and enforcement functions. This subsystem supports communications with Commercial Vehicle Check Subsystems operating at the roadside to enable credential checking and safety information collection. The collected safety information is processed, stored, and made available to qualified stakeholders to identify carriers and drivers that operate unsafely.

#### Emergency Management Subsystem

The Emergency Management Subsystem operates in various emergency centers supporting public safety including police and fire stations, search and rescue special detachments, and HAZMAT response teams. This subsystem interfaces with other Emergency Management Subsystems to support coordinated emergency response involving multiple agencies. The subsystem creates, stores, and utilizes emergency response plans to facilitate coordinated response. It tracks and manages emergency vehicle fleets. Real-time traffic information received from the other center subsystems is used to further aid the emergency dispatcher in selecting the emergency vehicle(s) and routes that will provide the most timely response. Interface with the Traffic Management Subsystem allows strategic coordination in tailoring traffic control to support en-route emergency vehicles. Interface with the Transit Management Subsystem allows coordinated use of transit vehicles to facilitate response to major emergencies.

#### Emissions Management Subsystem

This subsystem operates at a fixed location and may co-reside with a Traffic Management Subsystem or may operate in its own distinct location depending on regional preferences and priorities. This subsystem provides the capabilities for air quality managers to monitor and manage air quality. These capabilities include collecting emissions data from distributed emissions sensors within the roadway subsystem. These sensors monitor general air quality within each sector of the area and also monitor the emissions of individual vehicles on the roadway. The sector emissions measures are collected, processed, and used to identify sectors exceeding safe pollution levels. This information is provided to toll administration, traffic management, and transit management systems and used to implement strategies intended to reduce emissions in and around the problem areas. Emissions data associated with individual vehicles, supplied by the Roadway Subsystem, is also processed and monitored to identify vehicles that exceed standards. This subsystem provides any functions necessary to inform the violators and otherwise ensure timely compliance with the emissions standards.

**Fleet and Freight Management Subsystem**

The Fleet and Freight Management Subsystem manages fleets of commercial vehicles. The subsystem may be a large private trucking firm or a public agency with a fleet of vehicles. Smaller scale implementations oriented towards the independent owner/operator are also supported. The subsystem provides the capability for dispatchers to receive real-time routing information and access databases containing vehicle and cargo locations as well as carrier, vehicle, cargo, and driver information. It provides for the efficient purchase of electronic credentials through automated interface with clearinghouses and regulatory agencies. The Fleet and Freight Management Subsystem may operate either in a firm's home office through dedicated facilities, or at a truck or rest stop through a public kiosk. These sites communicate with authorities via **standard** wireline communications. Alternatively, the functions provided by this subsystem could be implemented on a portable computer and managed from the cab of the vehicle using wide area wireless communications.

**Information Service Provider Subsystem**

This subsystem provides the capabilities to collect, process, store, and disseminate traveler information to subscribers and the public at large. Information provided includes basic advisories, real time traffic condition and transit schedule information, yellow pages information, ridematching 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. 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 various Vehicle Subsystems through available communications links. Both basic one-way (broadcast) and personalized two-way information provision is supported. The subsystem provides the capability for an informational infrastructure to connect providers and consumers, and gather that market information needed to assist in the planning of service improvements and in maintenance of operations.

**Traffic Management Subsystem**

The Traffic Management Subsystem operates within a traffic management center or other fixed location. This subsystem communicates with the Roadway Subsystem to monitor and manage traffic flow. Incidents are detected and verified and incident information is provided to the Emergency Management Subsystem, travelers (through Roadway Subsystem Highway Advisory Radio and Variable Message Signs), and to third party providers. The subsystem supports HOV lane management and coordination, road pricing, and other demand management policies that can alleviate congestion and influence mode selection. The subsystem monitors and manages maintenance work and disseminates maintenance work schedules and road closures. The subsystem also manages reversible lane facilities, and process probe vehicle information. The subsystem communicates with other Traffic Management Subsystems to coordinate traffic information and control strategies in neighboring jurisdictions. It also coordinates with rail operations to support safer and more efficient highway traffic management at highway-rail intersections. Finally, the Traffic Management Subsystem provides the capabilities to exercise control over those devices utilized for AHS traffic and vehicle control.

**Toll Administration Subsystem**

The Toll Administration Subsystem provides general payment administration capabilities to support electronic assessment of tolls and other transportation usage fees. This subsystem supports traveler enrollment and collection of both pre-payment and post-payment transportation fees in coordination with the existing, and evolving financial infrastructure supporting electronic payment transactions. The system sets up and administers escrow accounts to support pre-payment operations. It supports communications with the Toll Collection Subsystems (and Parking Management Subsystems and Transit Management Subsystems) to support fee collection operations. The subsystem also sets and administers the pricing structures and includes the capability to implement roadpricing policies in coordination with the Traffic Management Subsystem. The electronic financial transactions in which this subsystem is an intermediary between the consumer and the financial infrastructure shall be cryptographically protected and authenticated to preserve privacy and ensure authenticity and auditability.

**Transit Management Subsystem**

The Transit Management Subsystem provides the capability for determining accurate ridership levels and implementing corresponding fare structures. The fare system shall support travelers using a fare medium applicable for all surface transportation services. The subsystem also provides for optimized vehicle and driver assignments, and vehicle routing for fixed and flexibly routed transit services. Interface with the Traffic Management Subsystem control shall be integrated with traffic signal prioritization. This will allow for transit schedule adjustments and automated transit vehicle maintenance management with schedule tracking. The Transit Management Subsystem also provides the capability for automated planning and scheduling of public transit operations. The subsystem shall also provide the capability to furnish travelers with real-time travel information, continuously updated schedules, schedule adherence information, transfer options, and transit routes and fares. In addition, the capability for the monitoring of key transit locations with both video and audio systems shall be provided with automatic alerting of operators and police of potential incidents including support of traveler activated alarms.

**Planning Subsystem**

The Planning Subsystem accepts data from every center subsystem and uses this data to plan new deployments and new ITS operations. This data also supports policy decision making, allocation of funding, allocation of resources and other planning activities.

## 2. ROADSIDE SUB-SYSTEMS

### Commercial Vehicle Check Subsystem

The Commercial Vehicle Check 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 and Freight 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 to current capabilities by supporting expedited brake inspections. the use of operator hand-held devices, on-board safety database access. and the enrollment of vehicles and carriers in the preclearance program.

### Parking Management Subsystem

The Parking Management Subsystem provides the capability to provide parking availability and parking fee information. allow for parking payment without the use of cash with a multiple use medium, and support the detection, classification, and control of vehicles seeking parking.

### Roadway Subsystem

This subsystem includes the equipment distributed on and along the roadway which monitors and controls traffic. Equipment includes highway advisory radios, variable message signs, cellular call boxes. CCTV cameras and video image processing systems for incident detection and verification. vehicle detectors, traffic signals, grade crossing warning systems, and freeway ramp metering systems. This subsystem also provides the capability for emissions and environmental condition monitoring including weather sensors. pavement icing sensors. fog etc. HOV lane management and reversible lane management functions are also available. 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.

### Toll Collection Subsystem

The Toll Collection Subsystem provides the capability for vehicle operators to pay tolls without stopping their vehicles using pricing structures for locally determined needs and including the capability to implement various variable road pricing policies. Transactions to each customer shall be provided a confirmation and implemented to minimize fraud by supporting vehicle identification technologies and accommodating single billing to commercial carriers.

### 3. VEHICLE SUB-SYSTEM

#### Vehicle Subsystem

This subsystem resides in an automobile and provides the sensory, processing, storage, and communications functions necessary to support efficient, safe, and convenient travel by personal automobile. Information services provide the driver with current travel conditions and the availability of services along the route and at the destination. Both one-way and two-way communications options support a spectrum of information services from low-cost broadcast services to advanced, pay for use personalized information services. Route guidance capabilities assist in formulation of an optimal route and step by step guidance along the travel route. Advanced sensors, processors, enhanced driver interfaces, and actuators complement the driver information services so that, in addition to making informed mode and route selections, 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 safe headway. Ultimately, this subsystem supports completely automated vehicle operation through advanced 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 unavoidable collisions do occur.

#### Commercial Vehicle Subsystem

This subsystem resides in a commercial vehicle and provides the sensory, processing, storage, and communications functions necessary to support safe and efficient freight movement. The Commercial Vehicle Subsystem provides two-way communications between the commercial vehicle drivers, their fleet managers, and roadside officials, and provides HAZMAT response teams with timely and accurate cargo contents information after a vehicle incident. This subsystem provides the capability to collect and process vehicle, cargo, and driver safety data and status and alert the driver whenever there is a potential safety problem. Basic identification and safety status data are supplied to inspection facilities at mainline speeds. In addition, the subsystem will automatically collect and record mileage, fuel usage, and border crossings.

#### Emergency Vehicle Subsystem

This subsystem resides in an emergency vehicle and provides the sensory, processing, storage, and communications functions necessary to support safe and efficient emergency response. The Emergency Vehicle Subsystem includes two-way communications to support coordinated response to emergencies in accordance with an associated Emergency Management Subsystem. 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. In addition, the emergency vehicle may be equipped to support signal pre-emption through communications with the roadside subsystem.

#### Transit Vehicle Subsystem

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 Transit Vehicle Subsystem collects accurate ridership levels and supports electronic fare collection. An optional traffic signal prioritization function communicates with the roadside subsystem to improve on-schedule performance. Automated vehicle location functions enhance the information available to the Transit Management Subsystem enabling more efficient operations. On-board sensors support transit vehicle maintenance. The Transit Vehicle Subsystem also furnishes travelers with real-time travel information, continuously updated schedules, transfer options, routes, and fares.

#### 4. TRAVELER SUB-SYSTEMS

##### **Personal Information Access Subsystem**

This subsystem accesses traveler information at home, at work, and other locations frequented by the traveler using personal fixed and portable devices over multiple types of electronic media. Radio, television, personal computers, personal digital assistants, telephones, and any other communications-capable consumer products that can be used to supply information to the traveler are all encompassed by this subsystem definition. Sophistication ranges from simple receipt of broadcast advisories to advanced interactive capabilities which enables users to receive route plans and other real-time information tailored to their individual needs. Other available capabilities include Mayday and real-time reservation services.

##### **Remote Traveler Support Subsystem**

This subsystem provides access to traveler information at transit stations, transit stops, other fixed sites along travel routes, and at major trip generation locations such as special event centers, hotels, office complexes, amusement parks, and theaters. Traveler information access points include kiosks and informational displays supporting varied levels of interaction and information access. At transit stops, simple displays provide schedule information and imminent arrival signals. This basic information may be extended to include multi-modal information including traffic conditions and transit schedules along with yellow pages information to support mode and route selection at major trip generation sites. Personalized route planning and route guidance information can also be provided based on criteria supplied by the traveler. In addition to traveler information provision, this subsystem also supports public safety monitoring using CCTV cameras or other surveillance equipment and emergency notification within public areas. Fare card maintenance, and other features which enhance traveler convenience may also be provided at the discretion of the deploying agency.