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Chapter 4

System Architecture

4.1 SYSTEM ARCHITECTURE

4.1.1 Introduction

This chapter will identify appropriate equipment packages and subsystems for each of the recommended market packages. Then functional requirements will be developed for each equipment package. The functional (logical) architecture and the physical architecture of the ITS improvements proposed for the Wichita area are also presented. The logical and physical architecture described herein are consistent with guidelines set forth in the ITS National Architecture. This chapter addresses the market packages recommended in the ITS User Service Plan prepared for the Wichita area. Three basic architecture alternatives for center subsystems are also discussed and the recommended configuration is presented.

Each market package consists of equipment packages and subsystems, as defined by the National Architecture. The National Architecture also defines functional requirements for each equipment package. Functional requirements describe those functions or processes that are necessary to perform/provide ITS user services. Requirements described in this document are derived from the ITS National Architecture using the Process Specifications developed for the ITS National Program Plan.

The logical architecture focuses on functional processes and information flows, independent of specific institutions and technologies. The logical architecture does not define where or by whom ITS services are provided. The logical architecture defines market packages in graphical form as Data Flow Diagrams (DFD's). For example, Surface Street Control is among the market packages recommended for short term implementation in the Wichita area. The logical architecture defines Surface Street Control's equipment packages (functional processes) as TMC Basic Signal Control, Traffic Maintenance, and Roadway Signal Controls. Associated data or information flows identified in the logical architecture for this market package consist of signal control data and signal status data and take the form of DFD's.

The physical architecture addresses market packages based on where their functional processes (as defined in the logical architecture) are located or performed and on the similarity of their functions to other transportation functions The physical architecture is organized into four main parts, called systems, to accommodate the various transportation functions defined in the ITS National Architecture. The four systems are Center, Roadside, Traveler, and Vehicle. Each of these four systems consist of subsystems such as the Traffic Management Subsystem (within the Center System) and the Roadway Subsystem (within the Roadside System) that correspond more closely to the physical location where functions are actually performed. In the case of Surface Street Control, the functional processes provided by the TMC Basic Signal Control equipment package and the Traffic Maintenance equipment package are located within the Traffic

Management Subsystem which would include the City DPW's signal operations section. The functional processes provided by the Roadway Signal Controls equipment package is within the Roadway Subsystem, which includes items such as traffic signals, and VMS's.

4.1.2 Functional Requirements Development Process

This section traces the relationship between the market packages recommended for the Wichita area to specific functional requirements through decomposition of each market package.

User Service and Market Package Relationship

Individual user services represent broad capabilities (e.g., traffic control) designed to address transportation problems and goals. Each user service is supported by several market packages. Market packages that represent more narrow capabilities and functions which, depending on the number and type deployed, determine the user service's level of comprehensiveness. The user service traffic control, for example, includes 11 market packages ranging from surface street control to in-vehicle signing. Market packages allow jurisdictions such as Wichita to prioritize its transportation goals and to deploy ITS in an incremental manner that is consistent with its priorities.

Market Package – Subsystem – Equipment Package Relationship

Each market package consists of subsystems and equipment packages. The subsystem represents a set of transportation functions that would typically be grouped together within a specific jurisdiction, such as Sedgwick County or physical location, such as the Sedgwick County Emergency Communications Center.

The National ITS Architecture organizes subsystems into four main groupings:

- Traveler subsystems: involve equipment and capabilities required to provide travelers with travel related information. Remote interactive information reception and personal route guidance are examples of the type of equipment packages grouped within traveler subsystems.

- Center subsystems: provides management, administration, and support functions for the transportation system. These subsystems involve equipment and capabilities associated with data storage, processing and dissemination. As such, center subsystems include subsystems such as traffic management and transit management. TMC probe information collection and transit center tracking and dispatch are examples of the types of equipment packages grouped within center subsystems.

- Roadside subsystems: provides the direct interface to vehicles traveling on the roadway network. These subsystems involve equipment and capabilities associated with direct data collection and interface between the transportation system and travelers. Roadside subsystems include subsystems such as roadway and toll collection. Roadway signal controls and toll plaza toll collection are examples of the types of equipment packages grouped within roadside subsystems.

- Vehicle subsystems: involve equipment and capabilities associated with data interface with vehicles. This group of subsystems includes commercial vehicle subsystems and emergency vehicle subsystems. On board cargo monitoring and on board vehicle signal coordination are examples of equipment packages grouped with vehicle subsystems.

Each market package consists of several equipment packages that are located in one or more subsystems. For example, the network surveillance market package consists of the *collect traffic surveillance* and *roadway basic surveillance* equipment packages which are located in the *traffic management* and *roadway subsystems*, respectively.

Tables 4-1, 4-2, and 4-3 show the subsystems and equipment packages required to support market packages recommended for short-, medium-, and long term implementation in the Wichita area. As shown in these figures equipment packages are distributed among the subsystems depending on where the technologies/capabilities represented by the equipment package would reside. The equipment package for providing roadway surveillance, for example, might consist of technologies such as CCTV cameras or loop detectors. The National Architecture lists this equipment package in the roadway subsystem (roadside subsystem group), as this is where these technologies would most likely be located. The following tables list the recommended market packages, corresponding subsystems, and equipment packages for short, medium, and long term deployment.

Table 4-1 Recommended Short Term Market Packages, Corresponding Subsystems, and Equipment Packages

SUBSYSTEMS AND ASSOCIATED EQUIPMENT PACKAGES	Network Surveillance	Surface Street Control	Freeway Control	Traffic Information Dissemination	Incident Managemet System	Standard Railroad Grade Crossing	Advanced Railroad Grade Crossing	Railroad Operations Coordination	Multi-Modal Coordination	Broadcast Traveler Information	Interactive Traveler Information	HAZMAT Management	Commercial Vehicle Admin. Processes	Weigh-In-Motion	Roadside CVO Safety	Emergency Response	Emergency Routing	Mayday Support	Transit Vehicle Tracking
TRAFFIC MANAGEMENT SUBSYSTEM																			
Collect Traffic Surveillance	■																		
HRI Traffic Mgmt.						■	■	■											
Rail Operations Coordination								■											
TMC Freeway Control			■																
TMC Basic Signal Control		■																	
TMC Incident Detection			■																
TMC Incident Dispatch Coordination and Communication					■							■							
TMC Multi-Modal Coordination									■								■		
TMC Traffic Information Dissemination				■															
Traffic Maintenance		■	■																
INFORMATION SERVICE PROVIDER SUBSYSTEM																			
Basic Information Broadcast										■									
Emergency Route Plan Information Dissemination																	■		
Interactive Infrastructure Information											■								
TRANSIT MANAGEMENT SUBSYTEM																			
Transit Center Multi-Modal Coordination									■										
Transit Center Tracking and Dispatch											■								■
EMERGENCY MANAGEMENT SUBSYSTEM																			
Emergency and Incident Mgmt. Communications																■			
Emergency Mayday and E911 I/F																		■	
Emergency Response Management					■											■			
Emergency Vehicle Routing/ Communications																	■		
FLEET AND FREIGHT MANAGEMENT SUBSYSTEM																			
Fleet Credentials and Taxes Mgmt. & Reporting													■						
Fleet HAZMAT Mgmt.												■							

Table 4-1 Recommended Short Term Market Packages, Corresponding Subsystems, and Equipment Packages (Continued)

SUBSYSTEMS AND ASSOCIATED EQUIPMENT PACKAGES	Network Surveillance	Surface Street Control	Freeway Control	Traffic Information Dissemination	Incident Managemet System	Standard Railroad Grade Crossing	Advanced Railroad Grade Crossing	Railroad Operations Coordination	Multi-Modal Coordination	Broadcast Traveler Information	Interactive Traveler Information	HAZMAT Management	Commercial Vehicle Admin. Processes	Weigh-In-Motion	Roadside CVO Safety	Emergency Response	Emergency Routing	Mayday Support	Transit Vehicle Tracking
COMMERCIAL VEHICLE ADMINISTRATION SUBSYSTEM																			
Credentials and Taxes Administration													■						
CV Information Exchange															■				
CV Safety Administration															■				
ROADWAY SUBSYSTEM																			
Roadway Basic Surveillance	■																		
Roadway Signal Controls		■																	
Roadway Freeway Control			■																
Roadway Incident Detection			■																
Roadway Traffic Information Dissemination				■															
Standard Speed Rail Crossing						■													
High Speed Rail Crossing							■												
Roadside Signal Priority									■										
COMMERCIAL VEHICLE CHECK SUBSYSTEM																			
Citation and Accident Electronic Recording															■				
Roadside Safety Inspection															■				
Roadside Weigh-In-Motion														■					

Table 4-1 Recommended Short Term Market Packages, Corresponding Subsystems, and Equipment Packages (Continued)

SUBSYSTEMS AND ASSOCIATED EQUIPMENT PACKAGES	Network Surveillance	Surface Street Control	Freeway Control	Traffic Information Dissemination	Incident Managemet System	Standard Railroad Grade Crossing	Advanced Railroad Grade Crossing	Railroad Operations Coordination	Multi-Modal Coordination	Broadcast Traveler Information	Interactive Traveler Information	HAZMAT Management	Commercial Vehicle Admin. Processes	Weigh-In-Motion	Roadside CVO Safety	Emergency Response	Emergency Routing	Mayday Support	Transit Vehicle Tracking
VEHICLE SUBSYSTEM																			
Basic Vehicle Reception									■	■									
Interactive Vehicle Reception											■								
Vehicle Mayday I/F																		■	
TRANSIT VEHICLE SUBSYSTEM																			
On Board Vehicle Signal Coordination									■									■	■
EMERGENCY VEHICLE SUBSYSTEM																			
Incident Management Communications																■			
On Board Emergency Vehicle Incident Management Communications																■			
On-Board Vehicle Signal Coordination																	■		
COMMERCIAL VEHICLE SUBSYSTEM																			
On-Board Cargo Monitoring												■							
On-Board CV Electronic Data														■	■				
PERSONAL INFORMATION ACCESS SUBSYSTEM																			
Personal Basic Information Reception										■									
Personal Interactive Information Reception											■								
Personal Mayday I/F																		■	
REMOTE TRAVELER SUPPORT SUBSYSTEM																			
Remote Basic Information Reception										■									
Remote Interactive Information Reception											■								
Remote Mayday I/F																		■	

Table 4-2 Recommended Medium Term Market Packages, Corresponding Subsystems, and Equipment Packages

SUBSYSTEMS AND ASSOCIATED EQUIPMENT PACKAGES	Probe Surveillance	Regional Traffic control	Traffic Network Performance Evaluation	Dynamic Toll/ Parking Fee Management	Transit Fixed-Route Operations	Demand Response Transit Operations	Transit Passenger & Fare Management	Transit Security	Autonomous Route Selection	Dynamic Route Guidance	Autonomous Route Guidance	Yellow Pages & Reservations	Fleet Administration	Electronic Clearance	ITS Planning	Transit Maintenance
TRAFFIC MANAGEMENT SUBSYSTEM																
TMC Probe Information Collection	■															
TMC Regional Traffic Control		■														
TMC Toll/Parking Coordination				■												
TMC Traffic Network Performance Evaluation			■													
INFORMATION SERVICE PROVIDER SUBSYSTEM																
Basic Information Broadcast										■						
Infrastructure Provided Route Selection													■			
Infrastructure Provided Yellow Pages & Reservations												■				
Interactive Infrastructure Information	■					■						■				
ISP Probe Information Collection	■															
TRANSIT MANAGEMENT SUBSYTEM																
Transit Center Fare and Load Management							■									
Transit Center Fixed-Route Operations					■											
Transit Center Security								■								
Transit Center Paratransit Operations						■										
Fleet Maintenance Mgmt.															■	
EMERGENCY MANAGEMENT SUBSYSTEM																
Emergency Response Management								■								
TOLL ADMINISTRATION SUBSYSTEM																
Toll Administration				■												
FLEET AND FREIGHT MANAGEMENT SUBSYSTEM																
Fleet Administration													■			
Fleet Maintenance Mgmt.													■			

Table 4-2 Recommended Medium Term Market Packages, Corresponding Subsystems, and Equipment Packages (Continued)

SUBSYSTEMS AND ASSOCIATED EQUIPMENT PACKAGES	Probe Surveillance	Regional Traffic control	Traffic Network Performance Evaluation	Dynamic Toll/ Parking Fee Management	Transit Fixed-Route Operations	Demand Response Transit Operations	Transit Passenger & Fare Management	Transit Security	Autonomous Route Selection	Dynamic Route Guidance	Autonomous Route Guidance	Yellow Pages & Reservations	Fleet Administration	Electronic Clearance	ITS Planning	Transit Maintenance
COMMERCIAL VEHICLE ADMINISTRATION SUBSYSTEM																
CV Information Exchange																
PLANNING SUBSYSTEM																
Data Collection and ITS Planning																
ROADWAY SUBSYSTEM																
Roadway Probe Beacons																
Toll Collection Subsystem																
Toll Plaza Toll Collection																
PARKING MANAGEMENT SUBSYSTEM																
Parking Management																
COMMERCIAL VEHICLE CHECK SUBSYSTEM																
Roadside Electronic Clearance																

Table 4-2 Recommended Medium Term Market Packages, Corresponding Subsystems, and Equipment Packages (Continued)

SUBSYSTEMS AND ASSOCIATED EQUIPMENT PACKAGES	Probe Surveillance	Regional Traffic control	Traffic Network Performance Evaluation	Dynamic Toll/ Parking Fee Management	Transit Fixed Route Operations	Demand Response Transit Operations	Transit Passenger & Fare Management	Transit Security	Autonomous Route Selection	Dynamic Route Guidance	Autonomous Route Guidance	Yellow Pages & Reservations	Fleet Administration	Electronic Clearance	ITS Planning	Transit Maintenance
VEHICLE SUBSYSTEM																
Basic Vehicle Reception										■						
Interactive Vehicle Reception	■											■				
Vehicle Toll/ Parking I/F	■			■												
Vehicle Route Guidance									■	■	■					
Probe Vehicle Software	■															
Transit Vehicle Subsystem																
Vehicle Dispatch Support					■											
On-Board Transit Driver I/F						■										
On-Board Transit Fare & Load Management							■									
On-Board Transit Security								■								
On Board Maintenance																■
COMMERCIAL VEHICLE SUBSYSTEM																
On-Board CV Electronic Data														■		
On-Board Trip Monitoring													■			
PERSONAL INFORMATION ACCESS SUBSYSTEM																
Personal Basic Information Reception										■		■				
Personal Interactive Information Reception						■										
Personal Route Guidance									■	■	■					
REMOTE TRAVELER SUPPORT SUBSYSTEM																
Remote Interactive Information Reception						■						■				
Remote Transit Fare Management							■									
Remote Transit Security I/F								■								

Table 4-3 Recommended Long Term Market Packages, Corresponding Subsystems, and Equipment Packages

SUBSYSTEMS AND ASSOCIATED EQUIPMENT PACKAGES	Environmental Hazards	Route Guidance	Transportation Management/	In Vehicle Signing	On Board CVO Safety	CVO Fleet Maintenance
TRAFFIC MANAGEMENT SUBSYSTEM						
TMC Advanced Signal Control						
TMC Incident Detection						
TMC Input to In Vehicle Signing						
INFORMATION SERVICE PROVIDER SUBSYSTEM						
Infrastructure Provided Route Selection						
Interactive Infrastructure Information						
ISP-Advanced Integrated Support						
FLEET AND FREIGHT MANAGEMENT SUBSYSTEM						
Fleet Maintenance Mgmt.						
COMMERCIAL VEHICLE ADMINISTRATION SUBSYSTEM						
CV Information Exchange						
CV Safety Administration						
EMISSIONS MANAGEMENT SUBSYSTEM						
Emissions and Environmental Data Management						
ROADWAY SUBSYSTEM						
In Vehicle Signing						
Environmental Monitoring						
COMMERCIAL VEHICLE CHECK SUBSYSTEM						
Citation and Accident Electronic Recording						
Roadside Safety Inspection						
VEHICLE SUBSYSTEM						
Vehicle Route Guidance						
Interactive Vehicle Reception						
In-Vehicle Signing						
COMMERCIAL VEHICLE SUBSYSTEM						
On-Board CV Safety						
On-Board Trip Monitoring						
PERSONAL INFORMATION ACCESS SUBSYSTEM						
Personal Interactive Information Reception						
Route Guidance						

4.1.3 Wichita Subsystems

This section provides a link between the market packages proposed for the Wichita area and their constituent subsystems. The Tables 4-4 through 4-6 list the subsystems for each market package, by deployment phase.

Table 4-4 Recommended Short Term Market Packages and Associated Subsystems

SUBSYSTEMS AND ASSOCIATED EQUIPMENT PACKAGES	Network Surveillance	Surface Street Control	Freeway Control	Traffic Information Dissemination	Incident Managemet System	Standard Railroad Grade Crossing	Advanced Railroad Grade Crossing	Railroad Operations Coordination	Multi-Modal Coordination	Broadcast Traveler Information	Interactive Traveler Information	HAZMAT Management	Commercial Vehicle Admin. Processes	Weigh-In-Motion	Roadside CVO Safety	Emergency Response	Emergency Routing	Mayday Support
TRAFFIC MANAGEMENT SUBSYSTEM	■	■	■	■	■	■	■	■	■			■					■	
INFORMATION SERVICE PROVIDER SUBSYSTEM										■	■						■	
TRANSIT MANAGEMENT SUBSYTEM									■									
EMERGENCY MANAGEMENT SUBSYSTEM					■											■	■	■
FLEET AND FREIGHT MANAGEMENT SUBSYSTEM												■	■					
COMMERCIAL VEHICLE ADMINISTRATION SUBSYSTEM													■		■			
ROADWAY SUBSYSTEM	■	■	■	■		■	■		■									
COMMERCIAL VEHICLE CHECK SUBSYSTEM														■	■			
VEHICLE SUBSYSTEM									■	■	■							
EMERGENCY VEHICLE SUBSYSTEM																■	■	
TRANSIT VEHICLE SUBSYSTEM									■									■
COMMERCIAL VEHICLE SUBSYSTEM												■		■	■			
PERSONAL INFORMATION ACCESS SUBSYSTEM										■	■							■
REMOTE TRAVELER SUPPORT SUBSYSTEM										■	■							■

Table 4-5 Recommended Medium Term Market Packages and Associated Subsystems

SUBSYSTEMS AND EQUIPMENT PACKAGES	Probe Surveillance	Regional Traffic control	Traffic Network Performance Evaluation	Dynamic Toll/ Parking Fee Management	Transit Vehicle Tracking	Transit Fixed- Route Operations	Demand Response Transit Operations	Transit Passenger & Fare Management	Transit Security	Autonomous Route Selection	Dynamic Route Guidance	Autonomous Route Guidance	Yellow Pages & Reservations	Fleet Administration	Electronic Clearance	ITS Planning	Transit Maintenance
TRAFFIC MANAGEMENT SUBSYSTEM	■	■	■	■													
INFORMATION SERVICE PROVIDER SUBSYSTEM	■						■				■		■	■			
TRANSIT MANAGEMENT SUBSYTEM					■	■	■	■	■								■
EMERGENCY MANAGEMENT SUBSYSTEM									■								
TOLL ADMINISTRATION SUBSYSTEM				■													
FLEET AND FREIGHT MANAGEMENT SUBSYSTEM														■			
COMMERCIAL VEHICLE ADMINISTRATION SUBSYSTEM															■		
PLANNING SUBSYSTEM																■	
ROADWAY SUBSYSTEM	■																
TOLL COLLECTION SUBSYSTEM				■													
PARKING MANAGEMENT SUBSYSTEM				■													
COMMERCIAL VEHICLE CHECK SUBSYSTEM															■		
VEHICLE SUBSYSTEM	■			■						■	■	■	■				
TRANSIT VEHICLE SUBSYSTEM					■	■	■	■	■								■
COMMERCIAL VEHICLE SUBSYSTEM														■	■		
PERSONAL INFORMATION ACCESS SUBSYSTEM							■			■	■	■	■				
REMOTE TRAVELER SUPPORT SUBSYSTEM							■	■	■				■				

Table 4-6 Recommended Long Term Market Packages and Associated Subsystems

SUBSYSTEMS AND EQUIPMENT PACKAGES	Emissions & Environmental Hazards Sensing	ISP-Based Route Guidance	Integrated Transportation Management/ Route Guidance	In Vehicle Signing	On-Board CVO Safety	CVO Fleet Maintenance	Demand Response Transit Operations	Transit Passenger & Fare Management	Transit Security	Autonomous Route Selection	Dynamic Route Guidance	Autonomous Route Guidance	Yellow Pages & Reservations	Fleet Administration	Electronic Clearance	ITS Planning
TRAFFIC MANAGEMENT SUBSYSTEM																
INFORMATION SERVICE PROVIDER SUBSYSTEM																
FLEET AND FREIGHT MANAGEMENT																
COMMERCIAL VEHICLE ADMINISTRATION																
EMISSIONS MANAGEMENT SUBSYSTEM																
ROADWAY SUBSYSTEM																
COMMERCIAL VEHICLE CHECK SUBSYSTEM																
VEHICLE SUBSYSTEM																
COMMERCIAL VEHICLE SUBSYSTEM																
PERSONAL INFORMATION ACCESS SUBSYSTEM																

4.1.4 Wichita Functional Requirements

This section lists the equipment packages (underlined) and corresponding functional requirements (bullets) under the subsystems identified in the National ITS Architecture that have been proposed for the Wichita area. Each subsystem represents a set of transportation functions or processes that are likely to be collected together by one physical agency, jurisdiction, or physical location (e.g., within a Sedgwick County emergency vehicle).

4.1.4.1 Center Subsystems

Traffic Management Subsystem

The Traffic Management Subsystem operates within a traffic operations 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 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.

Short term Implementation

<u>Collect Traffic Surveillance</u>

- Process Traffic Data for Storage
- Update Traffic Display Map Data
- Provide Traffic Operations Personnel Traffic Data Interface
- Process Traffic Data
- Update Data Source Static Data
-

<u>HRI Traffic Management</u>

- Manage HRI Closures
- Manage Alerts and Advisories
- Exchange Data with Traffic Management
-

<u>Rail Operations Coordination</u>

- Manage Rail Traffic Control Data
- Exchange Data with Rail Operations
-

<u>TMC Basic Freeway Control</u>

- Determine Indicator State for Freeway Management
- Determine Ramp State
- Output Control Data for Freeways

TMC Basic Signal Control

- Output Control Data for Roads
- Determine Indicator State for Road Management
- Select Strategy

TMC Incident Detection

- Provide Current Incidents Store Interface
- Analyze Traffic Data for Incidents
- Maintain Static Data for Incident Management
- Store Possible Incident Data
- Review and Classify Possible Incidents
- Review and Classify Predicted Incidents
- Provide Predicted Incidents Store Interface

TMC Incident Dispatch Coordination/Communication

- Retrieve Incident Data
- Respond to Current Incidents
- Analyze Incident Response Log
- Provide Traffic Operations Personnel Incident Data Interface
- Manage Possible Defined Responses Store
- Manage Defined Incident Response Data
- Update Incident Display Map Data

TMC Multi-Modal Coordination

- Exchange data with Other Traffic Centers

TMC Traffic Information Dissemination

- Provide Static Data Store Output Interface
- Maintain Traffic and Sensor Static Data
- Retrieve Traffic Data

Traffic Maintenance

- Provide Indicator Fault Interface for C and M
- Maintain Indicator Fault Data Store
- Collect Indicator Fault Data
- Provide Traffic Operations Personnel Indicator Fault Interface

Medium Term Implementation

TMC Probe Information Collection

- Process Tag Data for Link Time Data

TMC Regional Traffic Control

- Exchange data with Other Traffic Centers

TMC Toll/Parking Coordination

- Implement Demand Management Policy

MC Traffic Network Performance Evaluation

- Calculate Forecast Demand
- Generate Predictive Traffic Model
- Update Demand Display Map Data
- Collect Demand Forecast Data
- Implement Demand Management Policy
- Provide Traffic Operations Personnel Demand Interface

Long term Implementation

TMC Advanced Signal Control

- Generate Predictive Traffic Model
- Process Traffic Data

TMC Input to In-Vehicle Signing

- Output In-vehicle Signage Data

Not Recommended

Distributed Road Management

- Exchange data with Other Traffic Centers

TMC for AHS

- Manage AHS Operations

TMC HOV/Reversible Lane Management

- Process TM Detected Violations
- Monitor HOV lane use

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.

Short term Implementation

Basic Information Broadcast

- Provide Media Operator Traffic Data Interface
- Provide Transit Vehicle Operations Data Interface
- Collect Transit Data for Advisory Messages
- Collect Yellow Pages Data
- Provide ISP Operator Broadcast Parameters Interface
- Provide Traffic Data Retrieval Interface
- Provide Media System Traffic Data Interface
- Provide Traffic and Transit Advisory Messages
- Provide Media Operator Incident Data Interface
- Provide Media System Incident Data Interface
- Provide Traffic and Transit Broadcast Messages

EM Route Plan Information Dissemination

- Provide Vehicle Route Calculation Data

Interactive Infrastructure Information

- Distribute Advanced Tolls and Fares
- Collect Price Data for ITS Use
- Process Traveler Map Update Payments
- Collect Payment Transaction Records
- Provide ISP Operator Interface for Trip Planning Parameters
- Manage Intermodal Service Supplier Interface
- Confirm Traveler's Trip Plan
- Provide Trip Planning Information to Traveler
- Distribute Advanced Tolls and Parking Lot Charges
- Route Traveler Advanced Payments
- Collect Traffic Data for Advisory Messages
- Provide Mutli-modal Route Selection
- Process Traveler,Trip and Other Services Payments
- Update Other Routes Selection Map Data
- Provide ISP Operator Route Parameters Interface
- Distribute Advanced Charges and Fares

- Provide Transit Media Interface for Emergencies
- Select Other Routes
- Select Transit Route
- Provide Vehicle Route Calculation Data
- Calculate Vehicle Probe Data for Guidance
- Calculate Vehicle Route
- Update Vehicle Route Selection Map Data
- Provide Route Segment Data for Other Areas
- Collect Yellow Pages Data
- Process Driver Map Update Payments

Medium Term Implementation

<u>Infrastructure Provided Route Selection</u>

- Provide Vehicle Route Calculation Data
- Select Other Routes
- Provide Route Segment Data for Other Areas
- Select Transit Route
- Update Other Routes Selection Map Data
- Provide Mutli-modal Route Selection
- Provide Vehicle Route Calculation Data
- Provide Vehicle Route Calculation Data
- Provide ISP Operator Route Parameters Interface
- Update Vehicle Route Selection Map Data
- Provide Vehicle Route Calculation Data
- Calculate Vehicle Route

<u>Infrastructure Provided Yellow Pages & Reservation</u>

- Provide Yellow Pages Data and Reservations
- Process Yellow Pages Services Provider Payments
- Provide Traveler Yellow Pages Information and Reservations
- Collect and Update Traveler Information
- Register Yellow Pages Service Providers
- Collect Yellow Pages Data

<u>ISP Probe Information Collection</u>

- Provide Vehicle Route Calculation Data

Long term Implementation

<u>ISP Advanced Integrated Control Support</u>

- Provide Vehicle Route Calculation Data

Not Recommended

Infrastructure Provided Dynamic Ridesharing

- Report Ride Match Results to Requestor
- Match Rider and Provider
- Screen Rider Requests
- Confirm Traveler Rideshare Request
- Process Traveler Rideshare Payments

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 control shall be integrated with traffic signal prioritization for transit schedule adjustments and the transit vehicle maintenance management shall be automated 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.

Short term Implementation

Transit Center Tracking and Dispatch

- Provide Transit Vehicle Correction Data Output Interface
- Provide Transit Vehicle Deviation Data Output Interface
- Manage Transit Vehicle Deviations
- Manage Transit Vehicle Operations Data
- Provide Transit Vehicle Status Information

Transit Center Multi-Modal Coordination

- Manage Transit Vehicle Deviations

Medium Term Implementation

Transit Center Fare and Load Management

- Process Fare Payment Violations
- Update Transit Fare Data
- Manage Transit Vehicle Advanced Payments
- Collect Bad Transit Fare Payment Data

- Bill Transit User for Transit Fare
- Check for Advanced Transit Fare Payment
- Manage Transit Fare Financial Processing
- Determine Advanced Transit Fares
- Register for Advanced Transit Fare Payment
- Process Vehicle Fare Collection Violations
- Process Transit User Other Services Payments

Transit Center Fixed-Route Operations

- Provide Transit Driver Information Store Interface
- Provide Transit Plans Store Interface
- Report Transit Driver Information
- Generate Transit Driver Route Assignments
- Assess Transit Driver Eligibility
- Access Transit Driver Cost Effectiveness
- Produce Transit Service Data for external use
- Produce Transit Service Data for Manage Transit Use
- Provide Transit Fleet Manager Interface for Services Generation
- Generate Schedules
- Update Transit Map Data
- Assess Transit Driver Performance
- Provide Interface for Other TRM Data
- Provide Interface for Transit Service Raw Data
- Manage Transit Operational Data Store
- Assess Transit Driver Availability
- Generate Transit Routes

Transit Center Security

- Provide Transit System Operator Security Interface
- Manage Transit Security
- Process Roadside Fare Collection Violations
- Generate Responses for Incidents
- Collect Transit Vehicle Emergency Information
- Get Transit User Image for Violation
- Coordinate Multiple Agency Responses to Incidents

Transit Center Paratransit Operations

- Confirm Demand Responsive Transit Schedule and Route
- Process Demand Responsive Transit Trip Request
- Generate Demand Responsive Transit Schedule and Routes
- Compute Demand Responsive Transit Vehicle Availability

Fleet Maintenance Management

- Report Transit Vehicle Information
- Update Transit Vehicle Information
- Generate Technician Work Assignments
- Monitor And Verify Maintenance Activity
- Manage Transit Vehicle Operations Data Store
- Generate Transit Vehicle Maintenance Schedules
- Monitor Transit Vehicle Condition

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. The subsystem tracks and manages emergency vehicle fleets using automated vehicle location technology and two way communications with the vehicle fleet. Real-time traffic information received from the other center subsystems is used to further aide 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.

Short term Implementation

Emergency and Incident Management Communication

- Determine Coordinated Response Plan
- Communicate Emergency Status
- Provide Operator Interface for Emergency Data

Emergency Mayday and E-911 I/F

- Identify Emergencies from Inputs
- Communicate Emergency Status
- Provide Operator Interface for Emergency Data

Emergency Vehicle Routing and communications

- Dispatch Vehicle
- Maintain Vehicle Status
- Provide Operator Interface for Emergency Data

Medium Term Implementation

Emergency Response Management

- Select Response Mode
- Manage Emergency Response
- Assess Response Status
- Manage Emergency Service Allocation Store
- Dispatch Vehicle
- Provide Operator Interface for Emergency Data
- Update Emergency Display Map Data

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 instructure 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 road pricing 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.

Medium Term Implementation

<u>Toll Administration</u>

- Manage Toll Financial Processing
- Process Violations for Tolls
- Register for Advanced Toll Payment
- Manage Bad Toll Payment Data
- Collect Probe Data From Toll Transactions
- Update Toll Price Data

Fleet and Freight Management Subsystem

The Fleet and Freight Management Subsystem provides the capability for commercial drivers and dispatchers to receive real-time routing information and access databases containing vehicle and cargo locations as well as carrier, vehicle, cargo, 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. The Fleet Management Subsystem also provides the capability for Fleet Managers to monitor the safety of their commercial vehicle drivers and fleet. The subsystem also supports application for HazMat credentials and makes information about HazMat cargo available to agencies as required.

Short Term Implementation

Fleet Credentials and Taxes Management and Reporting

- Provide Commercial Fleet Payment Instrument Interface
- Manage CV Electronic Credential and Tax Filing Interface
- Provide Flt Mgr Electronic Credentials and Tax Filing Interface
- Manage Commercial Fleet Electronic Credentials and Tax Filing

Fleet HAZMAT Management

- Manage Commercial Fleet Electronic Credentials and Tax Filing

Medium Term Implementation

Fleet Administration

- Provide Fleet Manager Commercial Vehicle Communications
- Provide Commercial Vehicle Manager Tag Data Interface
- Manage Driver Instruction Store
- Provide Commercial Fleet Static Route

Fleet Maintenance Management

- Manage Driver Instruction Store

Not Recommended

Freight Administration and Management

- Manage Cargo

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 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.

Short Term Implementation

Credentials and Taxes Administration

- Obtain Electronic Credential and Tax Filing Payment
- Process Commercial Vehicle Violations
- Manage Commercial Vehicle Trips and Clearances
- Process Commercial Vehicle Payments
- Communicate with Other Commercial Vehicle Administration System
- Process Data Received from Roadside Facilities
- Update Permits and Duties Store
- Output Commercial Vehicle Enrollment Data to Roadside Facilities
- Process CV Violations
- Manage Commercial Vehicle Credentials and Enrollment

CV Information Exchange

- Communicate with Other Commercial Vehicle Administration System
- Output Commercial Vehicle Enrollment Data to Roadside Facilities

CV Safety Administration

- Manage Commercial Vehicle Credentials and Enrollment

Long Term Implementation

International Border Crossing

- Manage Commercial Vehicle Trips and Clearances

International CV Administration

- Process Data Received from Roadside Facilities
- Output Commercial Vehicle Enrollment Data to Roadside Facilities

Emissions Management Subsystem

This subsystem operates at a fixed location and may co-reside with the 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.

Long Term Implementation

Emissions and Environmental Data Management

- Process Pollution Data
- Manage Pollution State Data Store
- Provide Traffic Operations Personnel Pollution Data Interface
- Manage Pollution Reference Data Store
- Manage Pollution Data Log
- Update Pollution Display Map Data

4.1.4.2 Roadway Subsystems

Roadway Subsystems

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.

Short term Implementation

Roadway Basic Surveillance

- Process Traffic Images
- Process Traffic Sensor Data

Roadway Signal Controls

- Process Indicator Output Data for Roads
- Monitor Roadside Equipment Operation for Faults

Roadway Freeway Control

- Process Indicator Output Data for Freeways
- Process Indicator Output Data for Roads
- Monitor Roadside Equipment Operation for Faults

Roadway Incident Detection

- Process Traffic Sensor Data

Roadway Traffic Information Dissemination

- Process Indicator Output Data for Roads

Standard Rail Crossing

- Manage Device Control
- Control Vehicle Traffic at Passive HRI
- Determine HRI Status
- Perform Equipment Self-Test
- Close HRI on Command
- Maintain Device State
- Report HRI Status on Approach
- Provide SSR Device Controls
- Provide Closure Parameters
- Control HRI Traffic Signals
- Maintain HRI Closure Data
- Interact with Wayside Systems
- Control Vehicle Traffic at Active HRI
- Control HRI Warnings and Barriers

Advanced Rail Crossing

- Close HRI on Detection
- Detect HRI Hazards
- Advise and Protect Train Crews
- Provide Interactive Interface
- Provide HSR Device Controls
- Detect Roadway Events
- Generate Alerts and Advisories
- Report Alerts and Advisories
- Provide ATS Alerts
- Detect Imminent Vehicle/Train Collision

Roadside Signal Priority

- Manage Indicator Preemptions

Medium Term Implementation

Roadway Probe Beacons

- Collect Vehicle Tag Data for Link Time Calculations

Long term Implementation

Roadway In-Vehicle signing

- Process In-vehicle Signage Data

Roadway Pollution and Environmental Hazards Indicators

- Process Vehicle Pollution Data
- Detect Roadside Pollution Levels

Not Recommended

Automated Road Signing

- Process In-vehicle Signage Data
- Process Vehicle Smart Probe Data for Output
- Process Collected Vehicle Smart Probe Data
- Collect Vehicle Smart Probe Data

Roadway HOV Usage

- Process Traffic Sensor Data

Roadway Intersection Collision System

- Provide Intersection Collision Avoidance Data

Roadway Reversible Lanes

- Process Indicator Output Data for Roads

Roadway Systems for AHS

- Check Vehicle for AHS eligibility
- Manage AHS Check-in and Check-out

Toll Collection Subsystem

The Toll Collection Subsystem provides the capability for vehicle operators to pay toll 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.

Medium Term Implementation

Toll Plaza Toll Collection

- Check for Advanced Tolls Payment
- Calculate Vehicle Toll
- Produce Roadside Displays
- Determine Advanced Toll Bill
- Detect Vehicle for Tolls
- Obtain Toll Violator Image
- Bill Driver for Tolls

- Read Tag Data for Tolls

Parking Management Subsystem

The Parking 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.

Medium Term Implementation

Parking Management

- Register for Advanced Parking Lot Payment
- Manage Parking Lot Financial Processing
- Read Parking Lot Tag Data
- Collect Bad Charge Payment Data
- Update Parking Lot Data
- Process Parking Lot Violations
- Manage Parking Lot Reservations
- Determine Advanced Charges
- Produce Parking Lot Displays
- Obtain Parking Lot Violator Image
- Detect Vehicle for Parking Lot Payment
- Calculate Parking Lot Occupancy
- Determine P+R needs for Transit Management
- Provide Parking Lot Operator Interface
- Provide Parking Service Provider Interface
- Determine Parking Lot State
- Check for Advanced Parking Lot Payment
- Bill Driver for Parking Lot Charges
- Calculate Vehicle Parking Lot Charges

Commercial Vehicle Check Subsystems

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 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 electronic clearance program.

Short term Implementation

Citation and Accident Electronic Recording

- Carry-out Commercial Vehicle Roadside Safety Screening

Roadside Safety Inspection

- Provide Commercial Vehicle Checkstation Communications
- Administer Commercial Vehicle Roadside Safety Datadase
- Carry-out Commercial Vehicle Roadside Inspection
- Carry-out Commercial Vehicle Roadside Safety Screening
- Provide Commercial Vehicle Roadside Operator Interface
- Provide Commercial Vehicle Inspector Handheld Terminal Interface

Roadside WIM

- Detect Commercial Vehicle

Medium Term Implementation

Roadside Electronic Screening

- Produce Commercial Vehicle Driver Message at Roadside
- Administer Commercial Vehicle Roadside Credentials Database
- Provide Commercial Vehicle Roadside Operator Interface
- Process Screening Transactions
- Carry-out Commercial Vehicle Roadside Safety Screening
- Provide Commercial Vehicle Reports
- Detect Commercial Vehicle

Long Term Implementation

International Border Crossing

- Provide Commercial Vehicle Border Screening

4.1.4.3 Vehicle Subsystems

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.

Short term Implementation

Basic Vehicle Reception

- Provide Driver Interface
- Prepare and Output In-vehicle Displays

Interactive Vehicle Reception

- Prepare and Output In-vehicle Displays
- Provide Driver Interface

Vehicle Mayday I/F

- Build Automatic Collision Notification Message
- Provide Driver In-vehicle Communications Function
- Provide Communications Function
- Build Driver Personal Security Message

Medium Term Implementation

Probe Vehicle Software

- Provide Dynamic In-vehicle Guidance

Vehicle Route Guidance

- Process Vehicle Location Data
- Update Vehicle Navigable Map Database
- Provide Autonomous In-vehicle Guidance
- Determine In-vehicle Guidance Method
- Provide Dynamic In-vehicle Guidance
- Provide Driver Guidance Interface

Vehicle Toll/Parking Interface

- Provide Driver Toll Payment Interface
- Provide Driver Parking Lot Payment Interface
- Provide Payment Instrument Interface for Parking
- Provide Payment Instrument Interface for Tolls
- Provide Vehicle Payment Instrument Interface

Long term Implementation

In-Vehicle Signing System

- Provide Driver Interface
- Prepare and Output In-vehicle Displays

Not Recommended

Driver Safety Monitoring System

- Carry-out Safety Analysis
- Process Vehicle On-board Data

Driver Visibility Improvement System

- Enhance Driver's Vision

Vehicle Intersection Collision Warning

- Produce Collision and Crash Avoidance Data

Vehicle Intersection Control

- Produce Collision and Crash Avoidance Data
- Process Vehicle On-board Data

Vehicle Lateral Control

- Provide Driver Interface
- Provide Lane Servo Control
- Provide Change Lane Servo Control
- Process data for Vehicle Actuators
- Provide Vehicle Control Data Interface
- Provide Command Interface

Vehicle Lateral Warning System

- Produce Collision and Crash Avoidance Data
- Process Vehicle Sensor Data

Vehicle Longitudinal Control

- Provide Command Interface
- Process data for Vehicle Actuators
- Provide Speed Servo Control
- Provide Vehicle Control Data Interface
- Provide Headway Servo Control
- Provide Driver Interface

Vehicle Longitudinal Warning System

- Produce Collision and Crash Avoidance Data

Vehicle Pre-Crash Safety Systems

- Process Vehicle Sensor Data
- Produce Collision and Crash Avoidance Data

Vehicle Safety Monitoring System

- Process Vehicle On-board Data
- Carry-out Safety Analysis

Vehicle Systems for AHS

- Manage Platoon Following
- Communicate with other Platoon Vehicles
- Process Sensor Data for AHS input
- Provide Driver Interface
- Provide AHS Control

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.

Short Term Implementation

On-board Vehicle Signal Coordination

- Determine Transit Vehicle Corrective Instructions
- Request Transit Vehicle Preemptions

Medium Term Implementation

On-board Trip Monitoring

- Determine Transit Vehicle Deviation and ETA
- Process Transit Vehicle Sensor Trip Data
- Determine Transit Vehicle Corrective Instructions
- Provide Transit Vehicle Location Data

Vehicle Dispatch Support

- Provide Demand Responsive Transit Driver interface
- Process Demand Responsive Transit Vehicle Availability Data

On-board Transit Driver I/F

- Provide Transit Vehicle Driver Interface
- Provide Transit User Advisory Interface
- Update Transit Driver Information

On-board Transit Fare and Load Management

- Manage Transit Fare Billing on Vehicle
- Detect Transit User on Vehicle
- Provide Transit User Interface on Vehicle
- Determine Transit Fare on Vehicle
- Provide Transit Vehicle Payment Instrument Interface
- Update Transit Vehicle Fare Data
- Determine Transit User Needs on Vehicle
- Provide Transit Vehicle Passenger Data

On-board Transit Security

- Provide Transit Driver Interface for Emergencies
- Manage Transit Emergencies

On-board Maintenance

- Process Transit Vehicle Sensor Maintenance Data
- Process Transit Vehicle Sensor Trip Data

Emergency Vehicle Subsystems

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 preemption through communications with the roadside subsystem.

Short term Implementation

On-board EV Incident Management Communication

- Provide Emergency Vehicle Driver Interface

On-board Vehicle Signal Coordination

- Track Vehicle

Commercial Vehicle Subsystems

This subsystem resides in a commercial vehicle 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, 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.

Short term Implementation

On-board Cargo Monitoring

- Provide Cargo Data for Incident Notification

On-board CV Electronic Data

- Provide Commercial Vehicle Driver Interface
- Provide CV Driver Electronic Credential and Tax Filing Interface
- Produce Commercial Vehicle Driver Message on Vehicle
- Manage Commercial Vehicle Tag Data Store
- Provide Lock Tag Data Interface
- Transmit Commercial Vehicle Tag Data
- Provide Commercial Vehicle On-board Data Store Interface
- Collect On-board Commercial Vehicle Sensor Data
- Analyze Commercial Vehicle On-board Data
- Provide Commercial Driver Tag Data Interface

Medium Term Implementation

On-board Trip Monitoring

- Collect On-board Commercial Vehicle Sensor Data
- Communicate Commercial Vehicle On-board Data to Roadside
- Provide Commercial Vehicle Driver Communications
- Provide Commercial Vehicle Driver Interface
- Provide Vehicle Static Route
- Provide Commercial Vehicle Driver Routing Interface
- Communicate Commercial Vehicle On-board Data to Vehicle Manager
- Analyze Commercial Vehicle On-board Data

Long term Implementation

<u>On-board CV Safety</u>

- Communicate Commercial Vehicle On-board Data to Roadside
- Collect On-board Commercial Vehicle Sensor Data
- Provide Commercial Vehicle Driver Interface
- Analyze Commercial Vehicle On-board Data

4.1.4.4 Traveler Subsystems

Personal Information Access Subsystem

This subsystem provides the capability for travelers to receive formatted traffic advisories from their homes, place of work, major trip generation sites, personal portable devices, and over multiple types of electronic media. These capabilities shall also provide basic routing information and allow users to select those transportation modes that allow them to avoid congestion, or more advanced capabilities to allow users to specify those transportation parameters that are unique to their individual needs and receive travel information. This subsystem shall provide capabilites to receive route planning from the infrastructure at fixed locations such as in their homes, their place of work, and at mobile locations such as from personal portable devices and in the vehicle or perform the route planning process at a mobile information access location. This subsystem shall also provide the capability to initiate a distress signal and cancel a prior issued manual request for help.

Short term Implementation

<u>Personal Basic Information Reception</u>

- Provide Traveler Personal Interface

<u>Personal Interactive Information Reception</u>

- Get Traveler Personal Request
- Provide Personal Payment Instrument Interface
- Provide Traveler with Personal Travel Information
- Update Traveler Personal Display Map Data

<u>Personal Mayday I/F</u>

- Provide Traveler Emergency Message Interface
- Provide Traveler Emergency Communications Function
- Build Traveler Personal Security Message

Medium Term Implementation

<u>Personal Route Guidance</u>

- Provide Autonomous Traveler Guidance
- Provide Traveler Guidance Interface

- Process Traveler Location Data
- Update Traveler Navigable Map Database
- Determine Traveler Guidance Method
- Provide Dynamic Traveler Guidance

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 theatres. Traveler information access points include kiosks and informational displays supporting varied levels of interaction and information access. At transit stops, simple displays providing schedule information and imminent arrival signals can be provided. 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 these public areas. Fare card maintenance, and other features which enhance traveler convenience may also be provided at the discretion of the deploying agency.

Short term Implementation

Remote Basic Information Reception

- Provide Transit Roadside Passenger Data

Remote Interactive Information Reception

- Provide Traveler Kiosk Interface
- Inform Traveler
- Update Traveler Display Map Data at Kiosk
- Provide Remote Terminal Payment Instrument Interface
- Provide Transit User Roadside Payment Instrument Interface
- Get Traveler Request
- Provide Traveler Kiosk Payment Instrument Interface

Remote Mayday I/F

- Provide Traveler Kiosk Interface

Medium Term Implementation

Remote Transit Fare Management

- Update Roadside Transit Fare Data
- Provide Transit User Roadside Vehicle Data Interface
- Provide Transit Roadside Passenger Data

- Provide Transit User Roadside Fare Interface
- Determine Transit Fare at Roadside
- Detect Transit User at Roadside
- Provide Transit User Roadside Communications Interface
- Provide Transit User Roadside Data Interface
- Provide Remote Terminal Payment Instrument Interface
- Manage Transit Fare Billing at Roadside
- Provide Transit User Roadside Payment Instrument Interface
- Determine Transit User Needs at Roadside

Remote Transit Security I/F

- Detect Transit User at Roadside

4.2. LOGICAL ARCHITECTURE

This section provides an overview of the role of the logical architecture within the National Architecture framework and then provides the logical architecture of the market packages proposed for implementation in Wichita in the short, medium, and long term. Each subsection includes a brief description of the market package, its functions, and corresponding data flow diagram.

4.2.1 Overview of Logical Architecture

The Logical Architecture presents a functional view of the ITS user services. This perspective is separated from likely implementations and physical interface requirements. It defines the functions or process specifications that are required to perform ITS user services, and the information or data flows that need to be exchanged between these functions. The functional definition process begins by identifying those elements which are inside the architecture, and those which are not. For example, travelers are external to the architecture, but the equipment that they use to obtain information or to provide inputs is inside the architecture. In other words, the architecture defines the functions ITS must perform in support of a traveler's requirements, not the functions of the traveler. A financial institution that processes tolls is outside of the architecture, whereas the ITS components that detect vehicles and collect tolls are inside. Existing broadcast media for the transmission of traveler information are outside of the architecture, but the elements that provide ITS traveler information to the media are inside. Communications within the rail infrastructure are outside the architecture but the support for the highway-rail interface is inside. ITS functions are depicted using data flow diagrams. DFD's show the information or data that must be exchanged to perform the described functions.

4.2.2 Logical Architecture for Short Term Market Packages

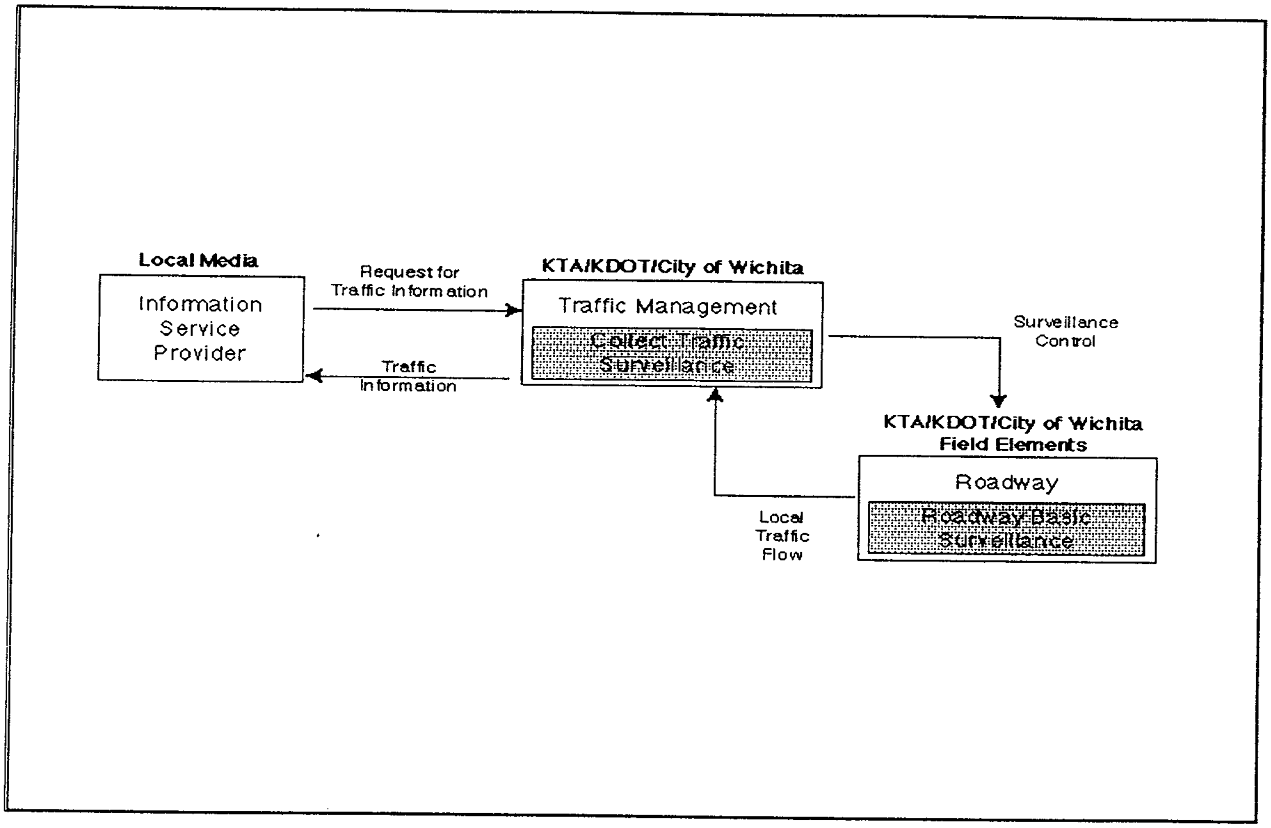
This section defines the logical architecture for short term market packages recommended for the Wichita area. The following market packages are addressed in this section:

Network Surveillance
Surface Street Control
Freeway Control
Traffic Information Dissemination
Multi-Modal Coordination
Incident Management System
HAZMAT Management
Standard Railroad Grade Crossing
Advanced Railroad Grade Crossing
Railroad Operations Coordination
Broadcast Traveler Information
Interactive Traveler Information
Emergency Response
Emergency Routing
Mayday Support
Commercial Vehicle Administrative Processes
Weigh-In-Motion
Roadside CVO Safety
Transit Vehicle Tracking
Transit Passenger and Fare Management

Network Surveillance

This basic market package provides the fixed roadside surveillance elements utilizing hardwire communication to transmit the surveillance data. This includes items as simple as vehicle detectors connected to traffic signal controllers or as complex as CCTV cameras transmitting video data to traffic control centers. This enables traffic managers to monitor road conditions, identify and verify incidents, analyze and reduce the collected data, and make it available to users and private information providers.

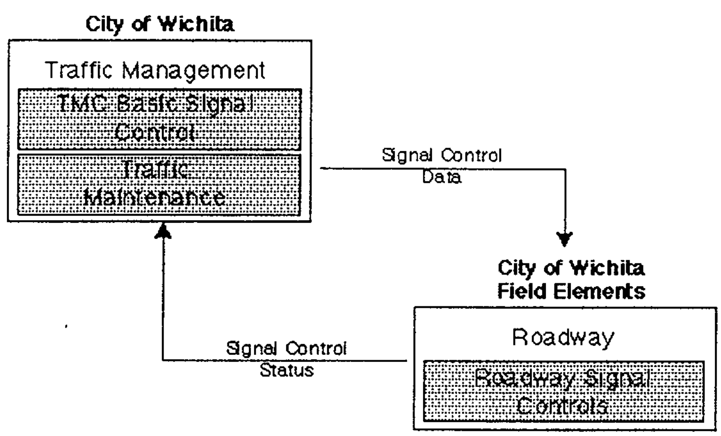
Figure 4-1 Network Surveillance Logical Architecture



Surface Street Control

This market package provides the communication links and the signal control equipment for completely local surface street control and/or arterial traffic management control. An example would be arterial signal control. This market package is considered as a intra-jurisdictional package since coordination between adjacent cities is required to coordinate signal control along arterials. This package is consistent with typical urban traffic signal control systems.

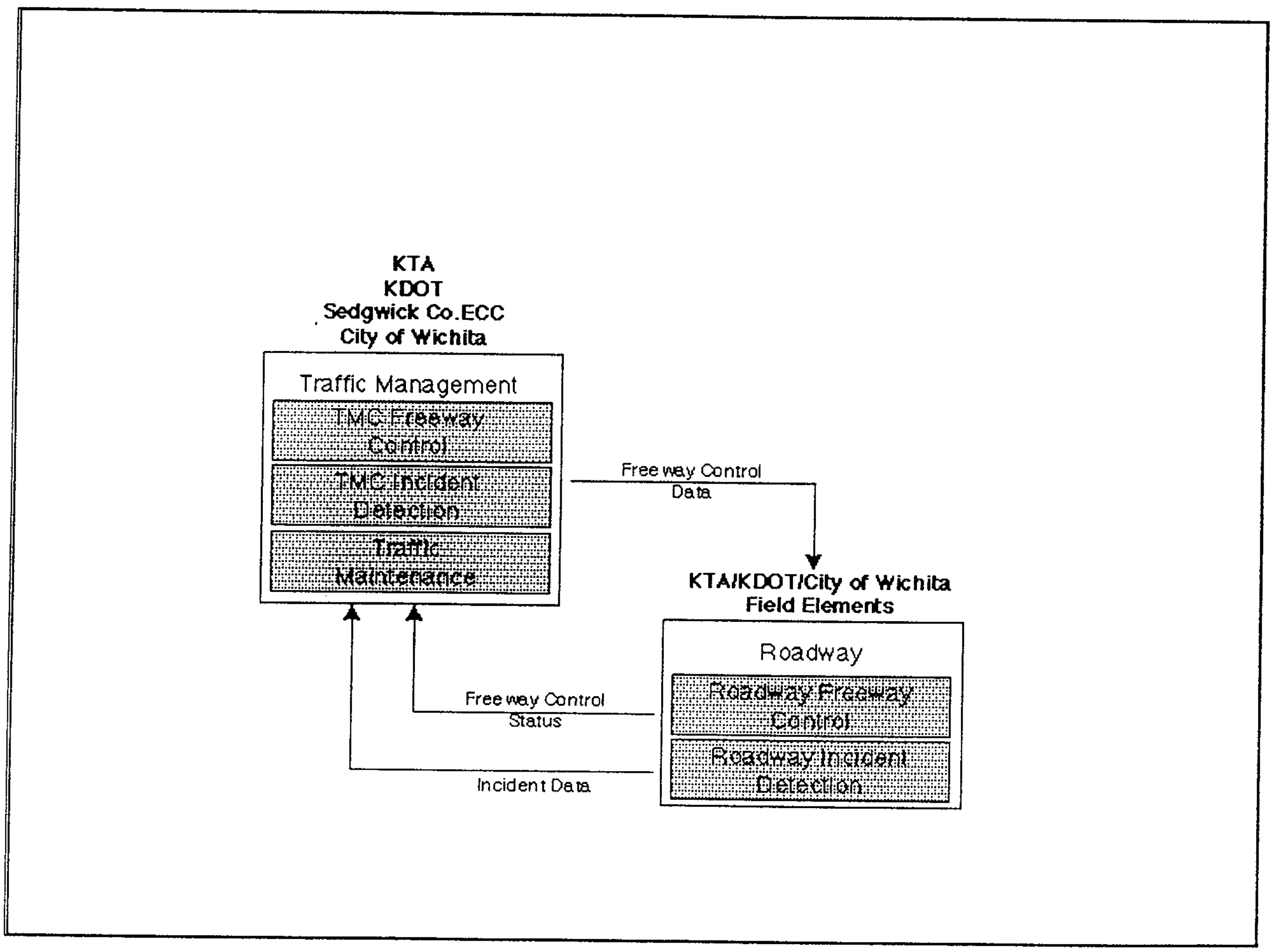
Figure 4-2 Surface Street Control Logical Architecture



Freeway Control

This market package provides the communications and roadside equipment to support ramp control, lane controls, and interchange control for freeways. Coordination and integration of ramp meters are included as part of this market package. This package is consistent with typical urban traffic freeway control systems. This package also incorporates the instrumentation included in the Network Surveillance Market Package to support freeway monitoring and adaptive strategies as an option. This market package also includes the capability to utilize surveillance information for detection of incidents. Typically, the processing would be performed at a traffic management center; however, developments might allow for point detection with roadway equipment. For example, a CCTV might include the capability to detect an incident based upon image changes. The equipment associated with incident detection that is distributed along the roadway and included within the Traffic Management Center is separately identified within the architecture so that incident detection may be considered and analyzed.

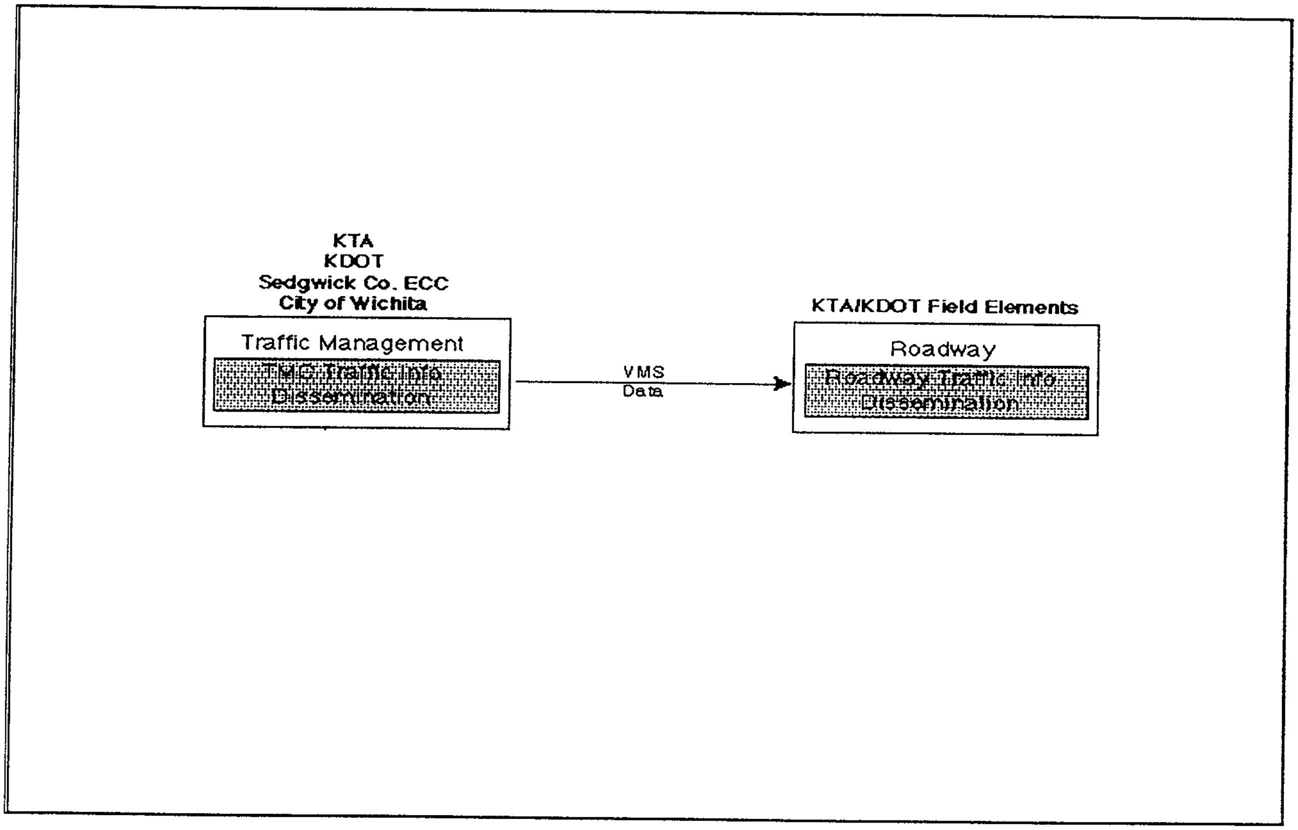
Figure 4-3 Freeway Control Logical Architecture



Traffic Information Dissemination

This market package allows traffic information to be disseminated using roadway equipment like changeable message signs or highway advisory radio. The emphasis is on provision of basic traffic information or other advisories by means which require minimal or no in-vehicle equipment to receive the information. This package provides a tool that can be used to notify drivers of incidents; careful placement of the roadway equipment provides the information at points in the network where the drivers have recourse and can tailor their routes to account for the new information. This package could also ensure that information is available in a format for media usage, such as a fax output or a direct tie-in to radio and television station computer systems.

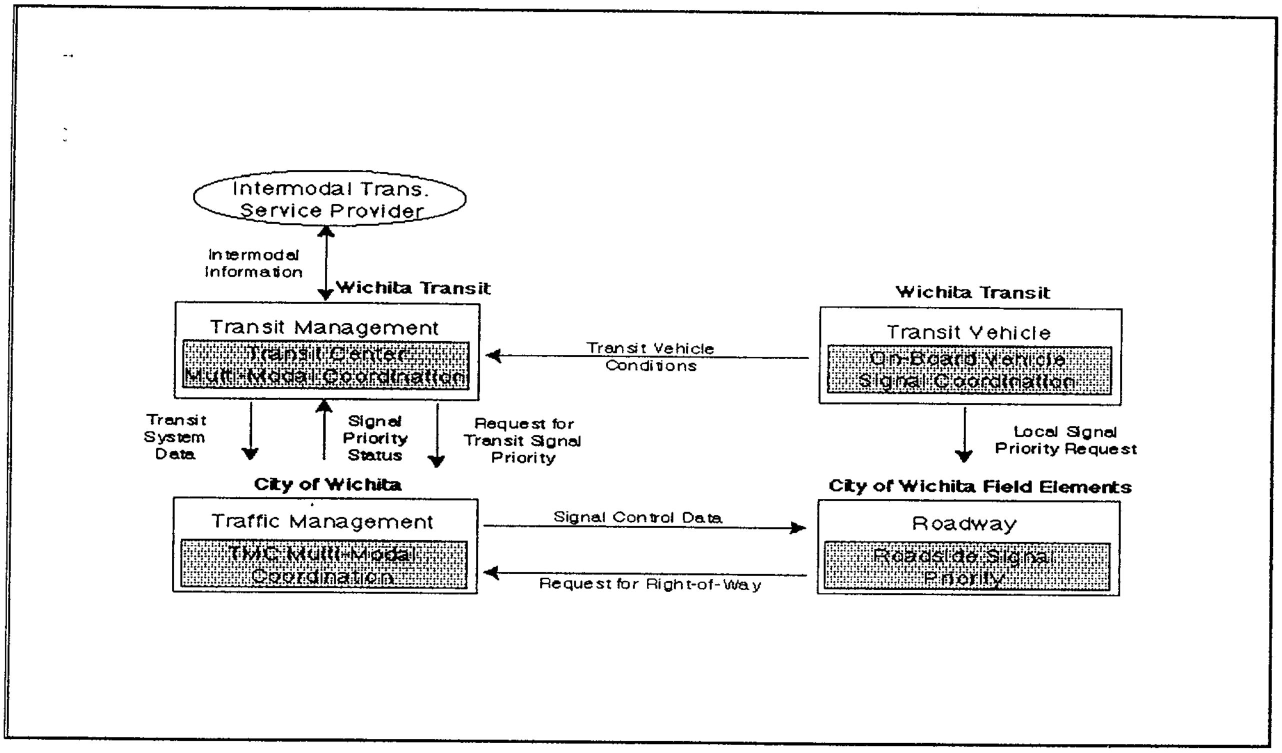
Figure 4-4 Traffic Information Dissemination Logical Architecture Functions



Multi-Modal Coordination

This market package establishes two way communications between multiple transit and traffic agencies to improve service coordination. Intermodal coordination between transit agencies can increase traveler convenience at transfer points and also improve operating efficiency. Coordination between traffic and transit management is intended to improve on-time performance of the transit system to the extent that this can be accommodated without degrading overall performance of the traffic network. More limited local coordination between the transit vehicle and the individual intersection for signal priority is also supported by this package.

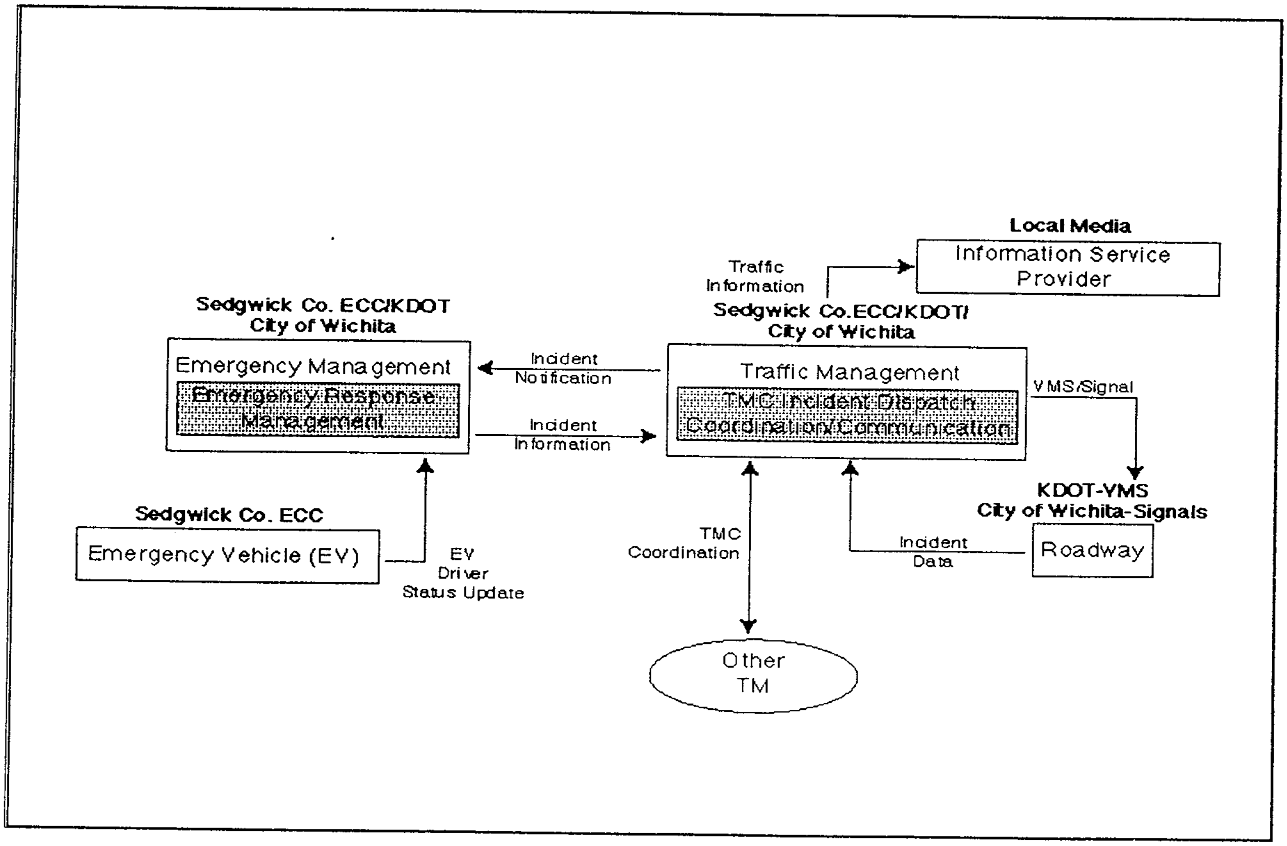
Figure 4-5 Multi-Modal Coordination Logical Architecture



Incident Management System

This market package manages both predicted and unexpected incidents so that the impact to the transportation network and traveler safety is minimized. Requisite incident detection capabilities are included in the freeway control market package and through the regional coordination with other traffic management and emergency management centers supported by this market package. Information from these diverse sources is collected and correlated by this market package to detect and verify incidents. This market package provides traffic management center equipment that supports traffic operations personnel in developing an appropriate response in coordination with emergency management and other incident response personnel to confirmed incidents. The response may include traffic control strategy modifications and presentation of information to affected travelers using the Traffic Information Dissemination market package. The same equipment assists the operator by monitoring incident status as the response unfolds. The coordination with emergency management might be through a CAD system or through other communication with emergency field personnel. The coordination can also extend to tow trucks and other field service personnel.

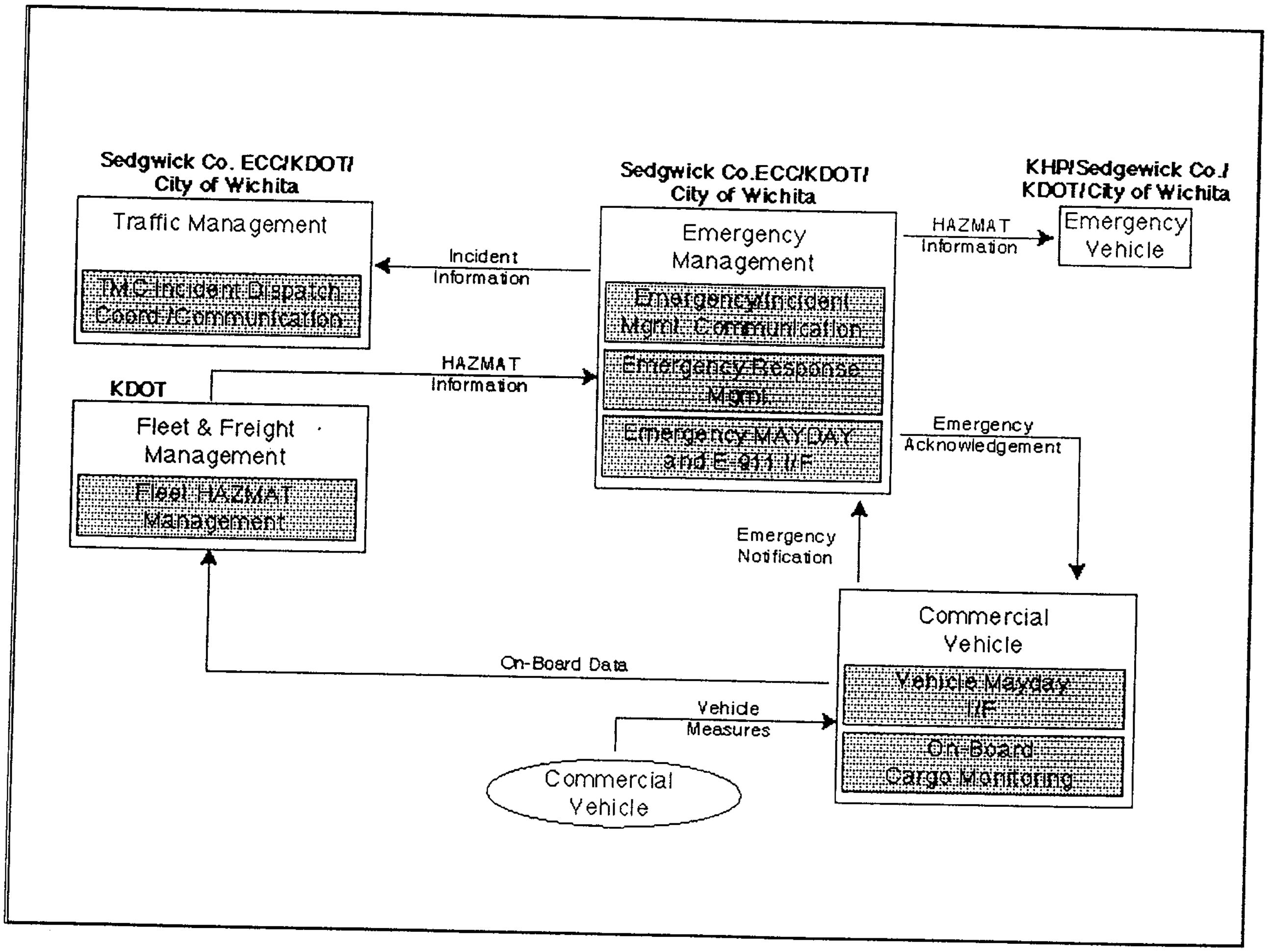
Figure 4-6 Incident Management System Logical Architecture



HAZMAT Management

This market package integrates incident management capabilities with commercial vehicle tracking to assure effective treatment of HAZMAT material and incidents. HAZMAT tracking is performed by the Fleet and Freight Management Subsystem. The Emergency Management subsystem is notified by the Commercial Vehicle if an incident occurs and coordinates the response. The response is tailored based on information that is provided as part of the original incident notification or derived from supplemental information provided by the Fleet and Freight Management subsystem. The latter information can be provided prior to the beginning of the trip or gathered following the incident depending on the selected policy and implementation.

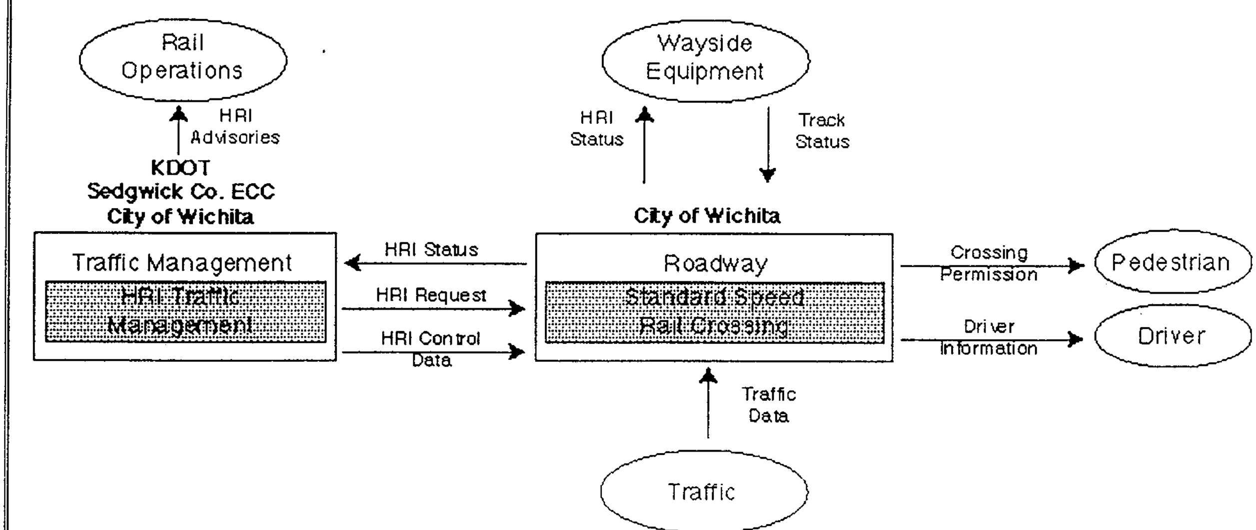
Figure 4-7 HAZMAT Management Logical Architecture



Standard Railroad Crossing

This market package manages highway traffic at highway-rail intersections (HRIs) where operational requirements do not dictate more advanced features (e.g., where rail operational speeds are less than 80 miles per hour). Both passive (e.g., the crossbuck sign) and active warning systems (e.g., flashing lights and gates) are supported. These traditional HRI warning systems may also be augmented with other standard traffic management devices. The warning systems are activated on notification by interfaced wayside equipment of an approaching train. The equipment at the HRI may also be interconnected with adjacent signalized intersections so that local control can be adapted to highway-rail intersection activities. Health monitoring of the HRI equipment and interfaces is performed; detected anomalies are reported to both highway and railroad officials through wayside interfaces and interfaces to the traffic management subsystem.

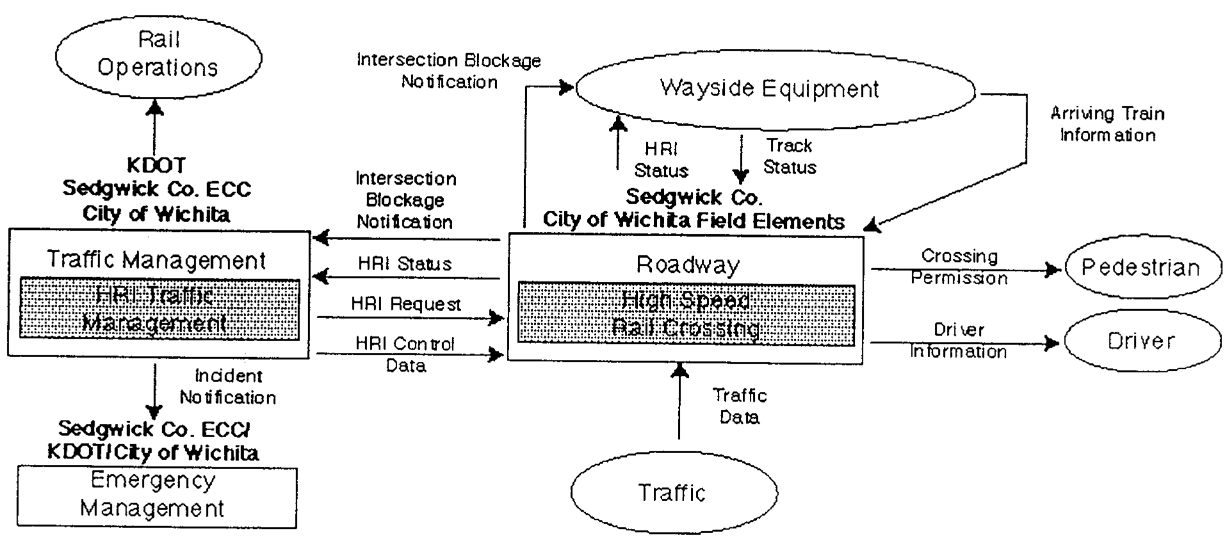
Figure 4-8 Standard Railroad Crossing Logical Architecture



Advanced Railroad Crossing

This market package manages highway traffic at highway-rail intersections (HRIs) where operational requirements demand advanced features (e.g., where rail operational speeds are greater than 80 miles per hour). This market package includes all capabilities from the Standard Railroad Grade Crossing Market Package and augments these with additional safety features to mitigate the risks associated with higher rail speeds. The active warning systems supported by this market package include positive barrier systems which preclude entrance into the intersection when the barriers are activated. Like the Standard Speed package, the HRI equipment is activated on notification by wayside interface equipment which detects, or communicates with the approaching train. In this market package, additional information about the arriving train is also provided by the wayside interface equipment so that the train's direction of travel, its estimated time of arrival, and the estimated duration of closure may be derived. This enhanced information may be conveyed to the driver prior to, or in context with, warning system activation. This market package also includes additional detection capabilities which enable it to detect an entrapped or otherwise immobilized vehicle within the HRI and provide an immediate notification to highway and railroad officials.

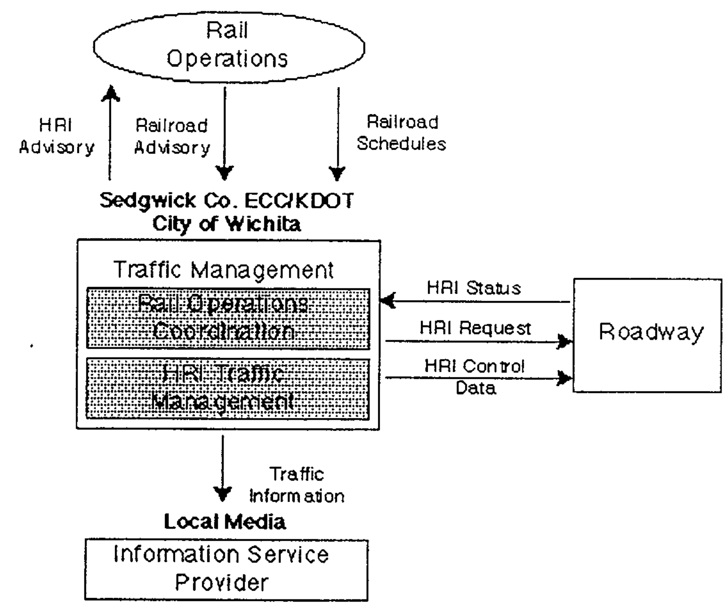
Figure 4-9 Advanced Railroad Crossing Logical Architecture



Railroad Operations Coordination

This market package provides an additional level of strategic coordination between rail operations and traffic management centers. Rail operations provides train schedules, maintenance schedules, and any other forecast events which will result in highway-rail intersection (HRI) closures. This information is used to develop forecast HRI closure times and durations which may be used in advanced traffic control strategies or to enhance the quality of traveler information.

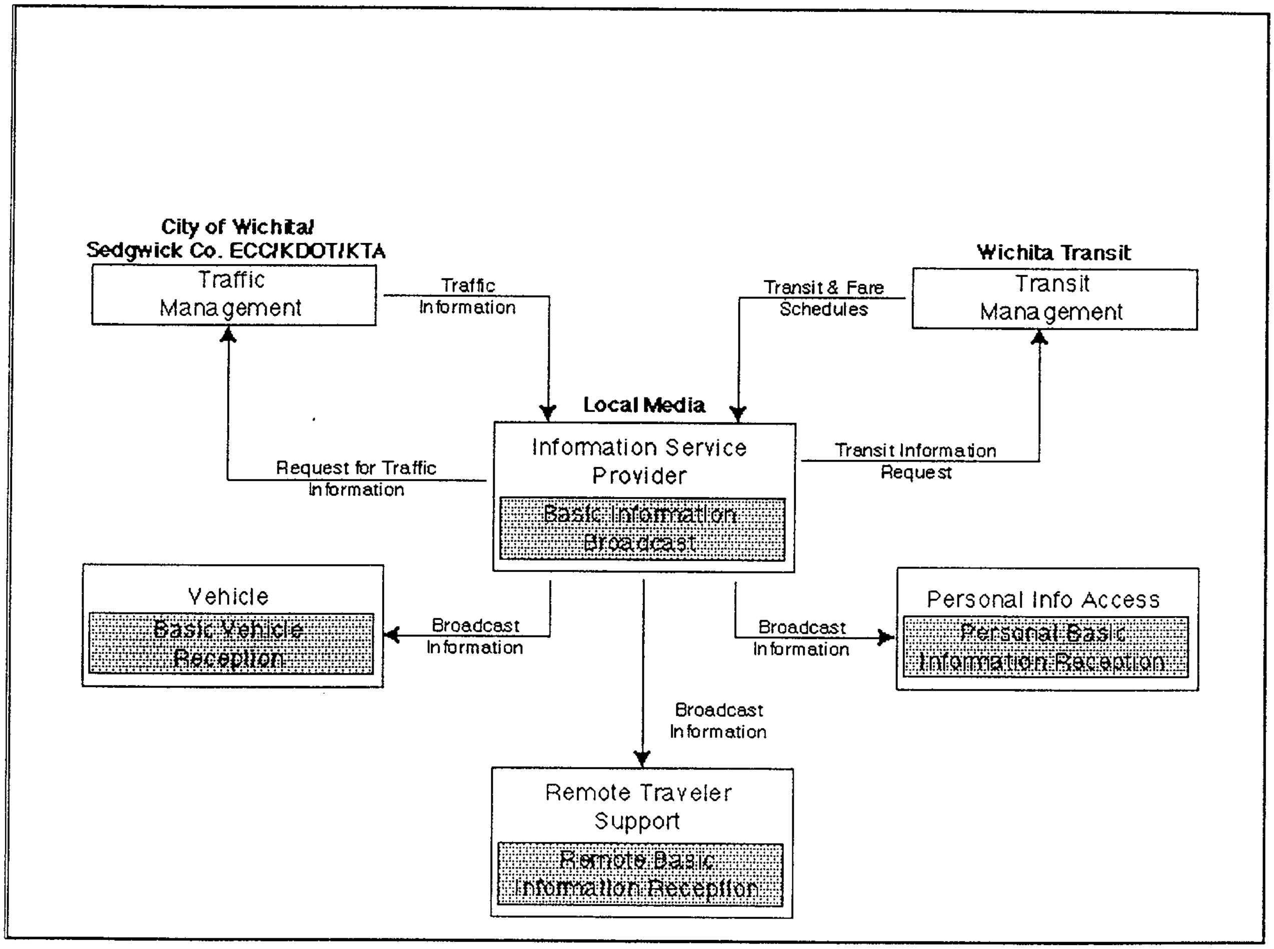
Figure 4-10 Railroad Operations Coordination Logical Architecture



Broadcast Traveler Information

This market package provides the user with a basic set of ATIS services. It involves the collection of traffic conditions, advisories, general public transportation and parking information and the near real time dissemination of this information over a wide area through existing infrastructures and low cost user equipment (e.g., FM subcarrier, cellular data broadcast). Different from the market package Traffic Information Dissemination market package which provides the more basic HAR and VMS information capabilities, this market package provides the more sophisticated digital broadcast service. Successful deployment of this market package relies on availability of real-time transportation data from roadway instrumentation, probe vehicles or other means.

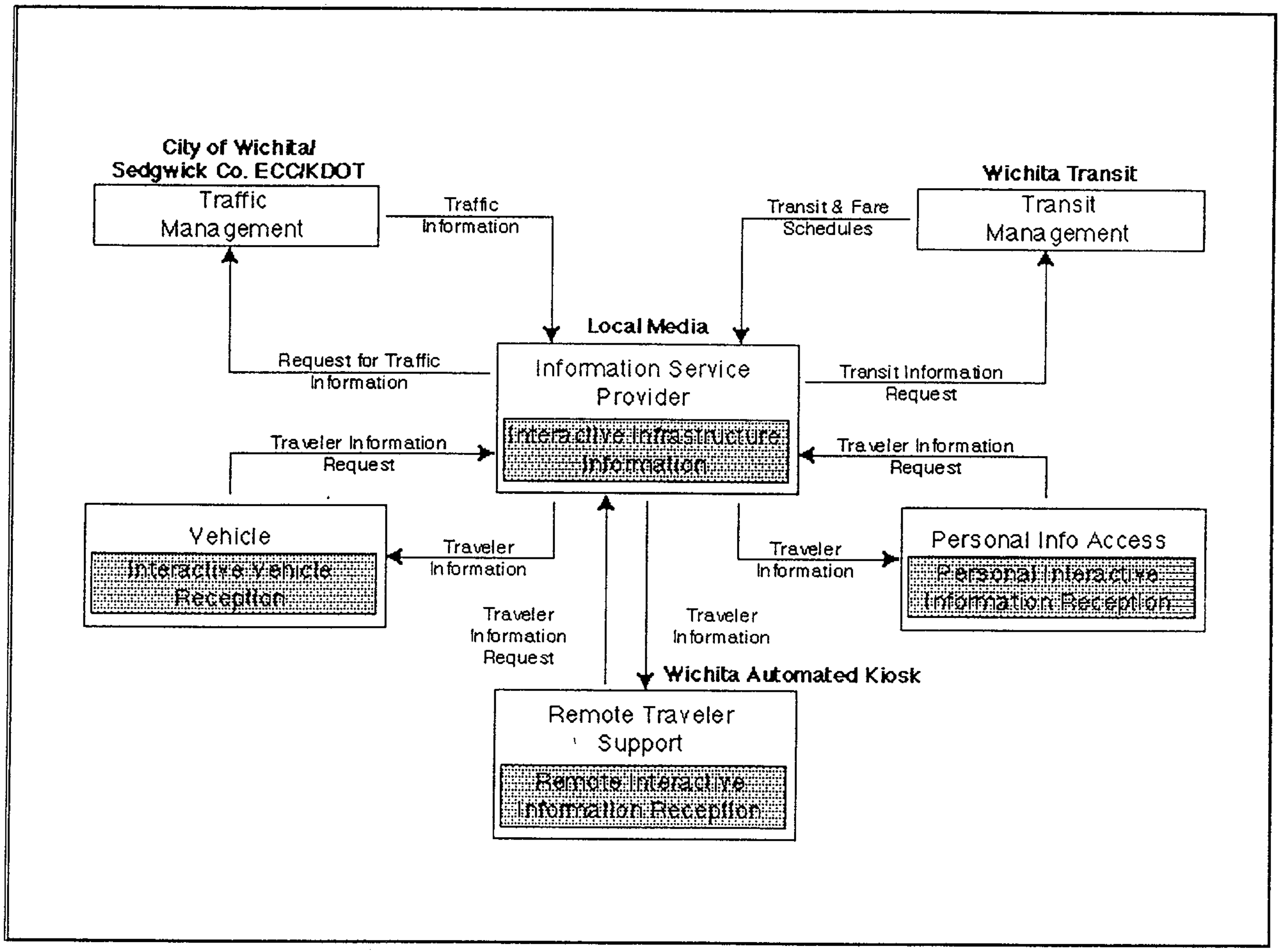
Figure 4-11 Broadcast Traveler Information Logical Architecture



Interactive Traveler Information

This market package provides tailored information in response to a traveler request. The user can request and obtain current information regarding traffic conditions, transit services, traveler services, ride share/ride match, parking management, and pricing information. A variety of interactive devices may be used by the traveler to access information prior to a trip or en-route to include phone, kiosk, Personal Digital Assistant, home computer, and a variety of in-vehicle devices. Successful deployment of this market package relies on availability of real-time transportation data from roadway instrumentation, probe vehicles or other means.

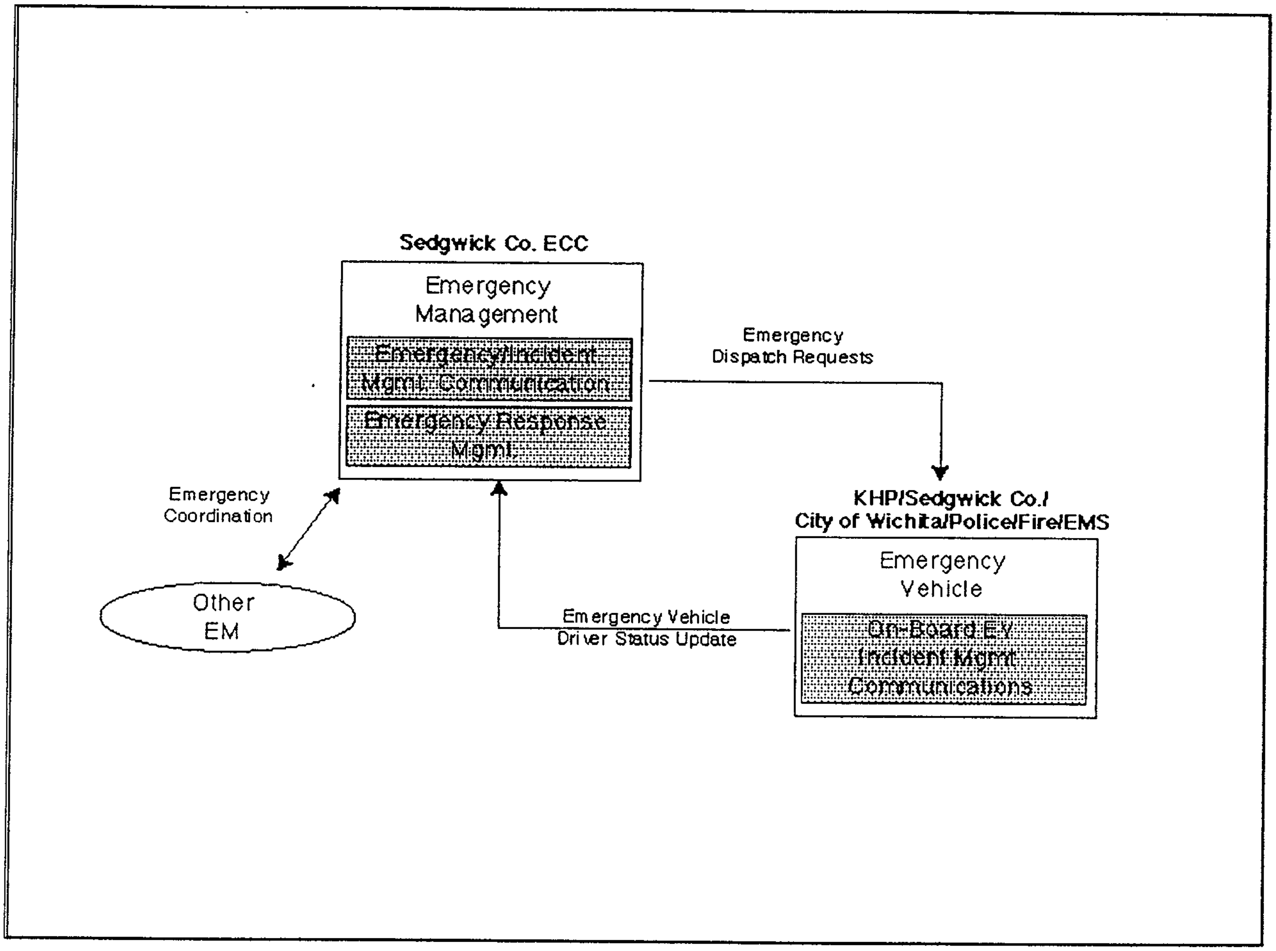
Figure 4-12 Interactive Traveler Information Logical Architecture



Emergency Response

This market package automates emergency vehicle notification upon verification of the location and nature of an incident by the Emergency Management subsystem. This package uses existing and emerging wireline interconnects to sensors, and vehicle position locators for incident detection. Coordination between Emergency Management Subsystems supports emergency notification and coordinated response between agencies. Existing wide area wireless communications would be utilized between the Emergency Management subsystem and an Emergency Vehicle enables coordination with the emergency fleet. The Emergency Management Center would include hardware and software for tracking the emergency vehicles. Law Enforcement would normally be an integral part of this package as well processing violation notifications and supporting incident clearing efforts.

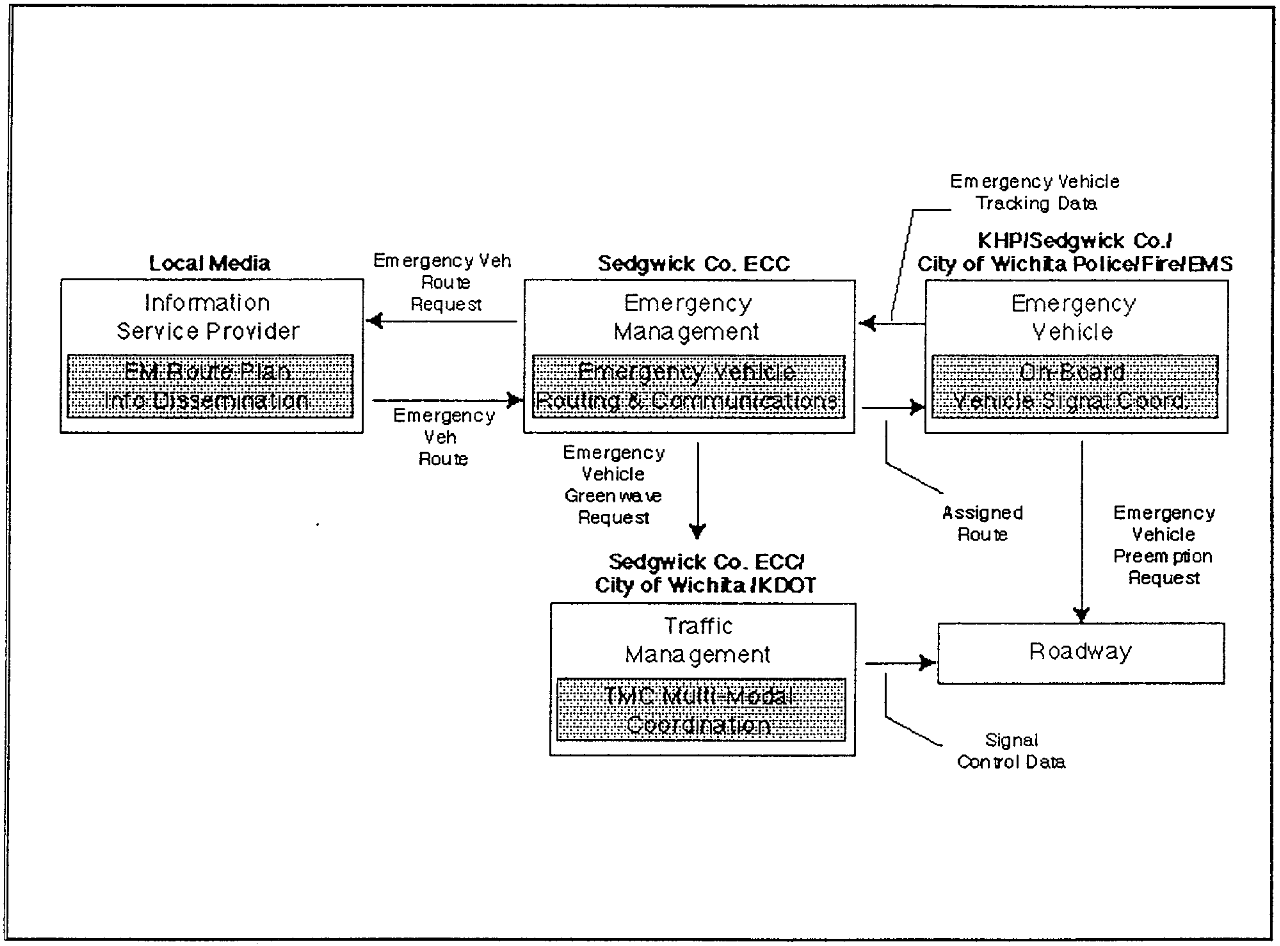
Figure 4-13 Emergency Response Logical Architecture



Emergency Routing

This market package supports dynamic routing of emergency vehicles and coordination with the Traffic Management subsystem for special priority on the selected route(s). The ISP provides the route planning function for the emergency fleet based on real-time traffic conditions and the emergency routes assigned to other responding vehicles. The Emergency vehicle would also have the option of being equipped with dedicated short range communications for local signal coordination.

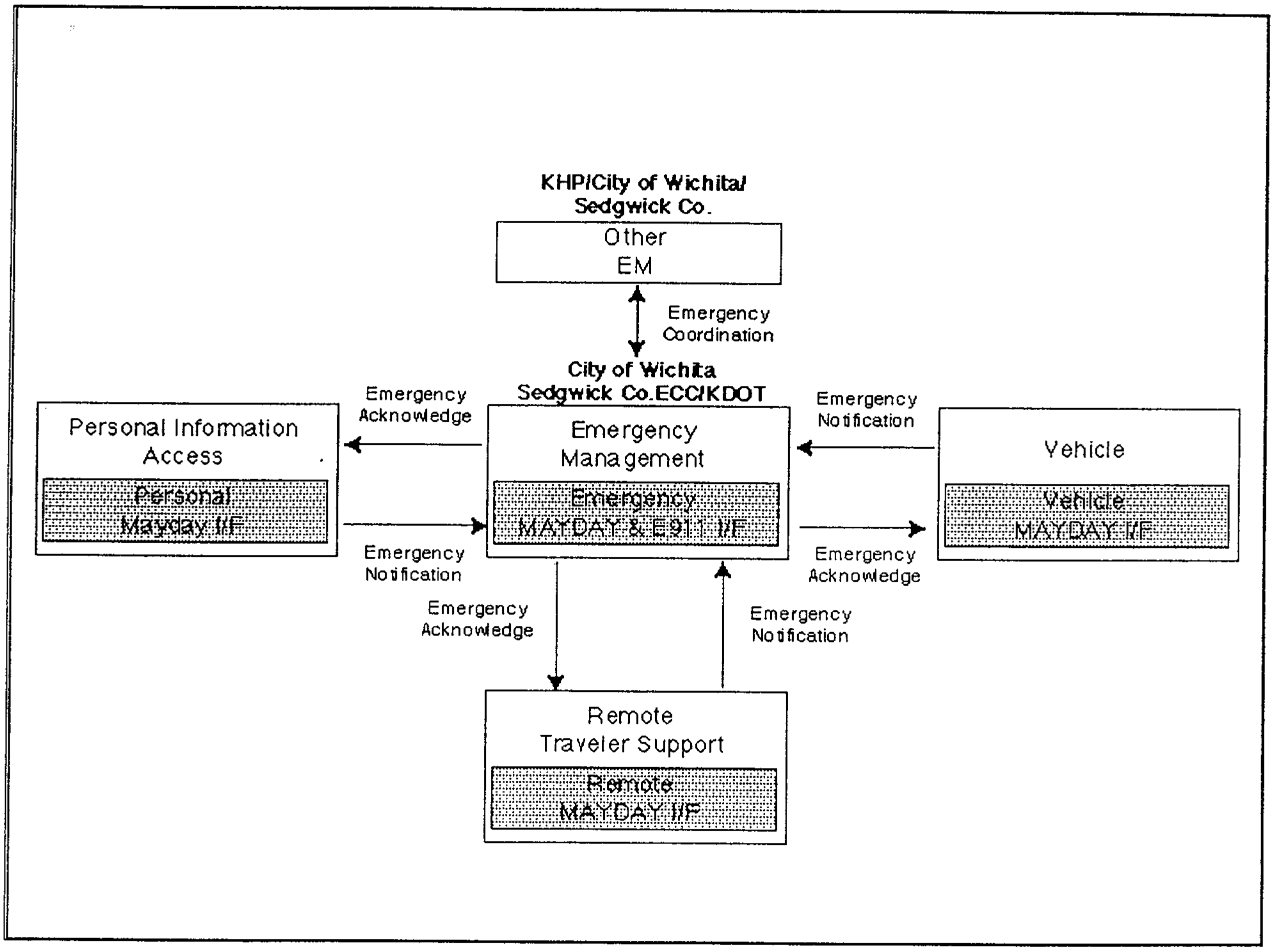
Figure 4-14 Emergency Routing Logical Architecture



Mayday Support

This package allows the user (driver or non-driver) to initiate a request for emergency assistance and enables the Emergency Management Subsystem to locate the user and determine the appropriate response. The Emergency Management Subsystem may be operated by the public sector or by a private sector provider. The request from the traveler needing assistance may be manually initiated or automated and linked to vehicle sensors. The data is sent to the Emergency Management subsystem using wide area wireless communications with voice as an option. Providing user location implies either a location technology within the user device or location determination within the communications infrastructure.

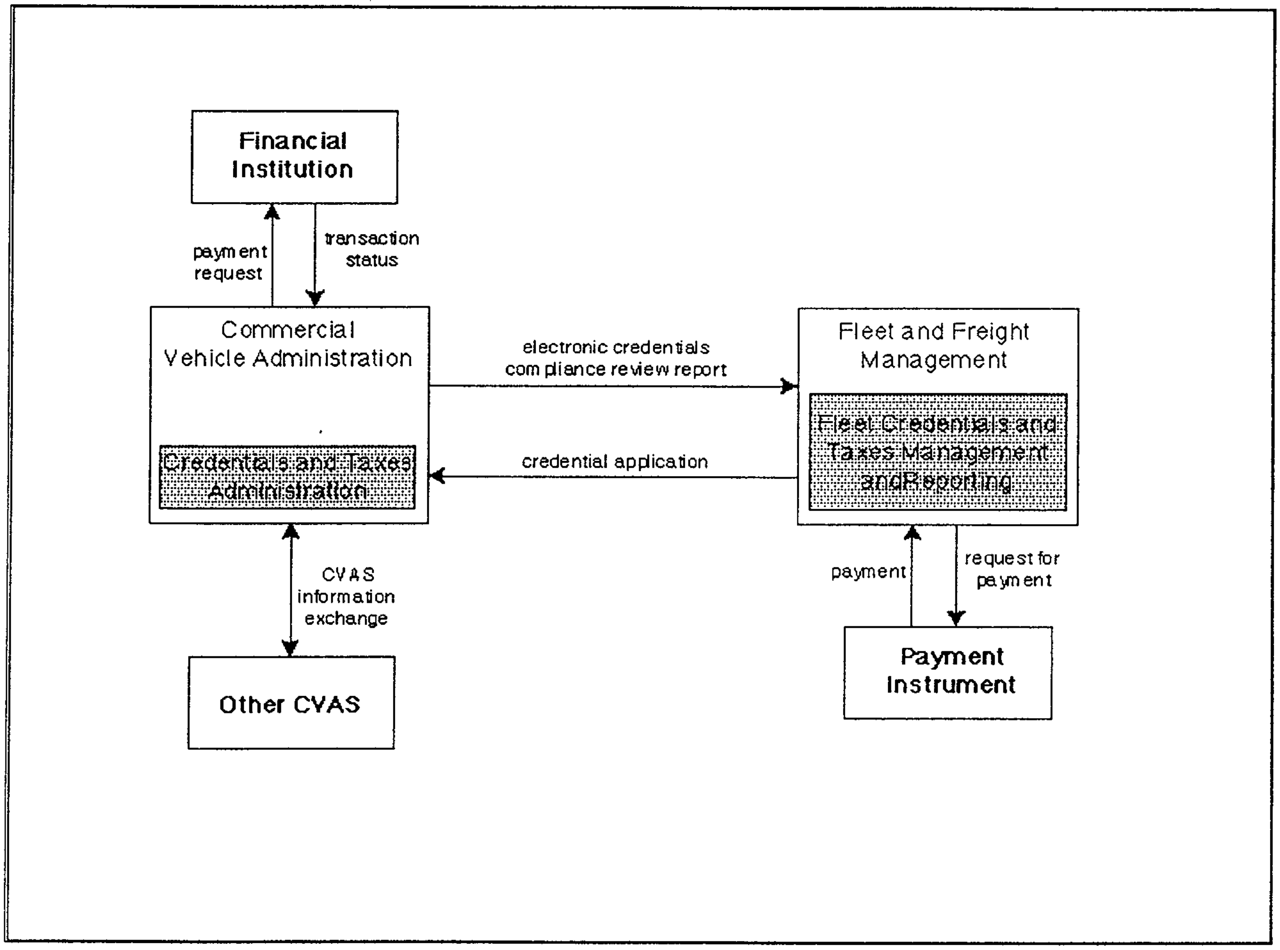
Figure 4-15 Mayday Support Logical Architecture



Commercial Vehicle Administrative Processes

This Market Package provides for electronic application, processing, fee collection, issuance, and distribution of CVO credential and tax filing. Through this process, carriers, drivers, and vehicles are enrolled in the electronic clearance program provided by a separate market package which allows commercial vehicles to be screened at mainline speeds at commercial vehicle check points. Through this enrollment process, current profile databases are maintained in the Commercial Vehicle Administration Subsystem and snapshots of this database are made available to the commercial vehicle check facilities at the roadside to support the electronic clearance process.

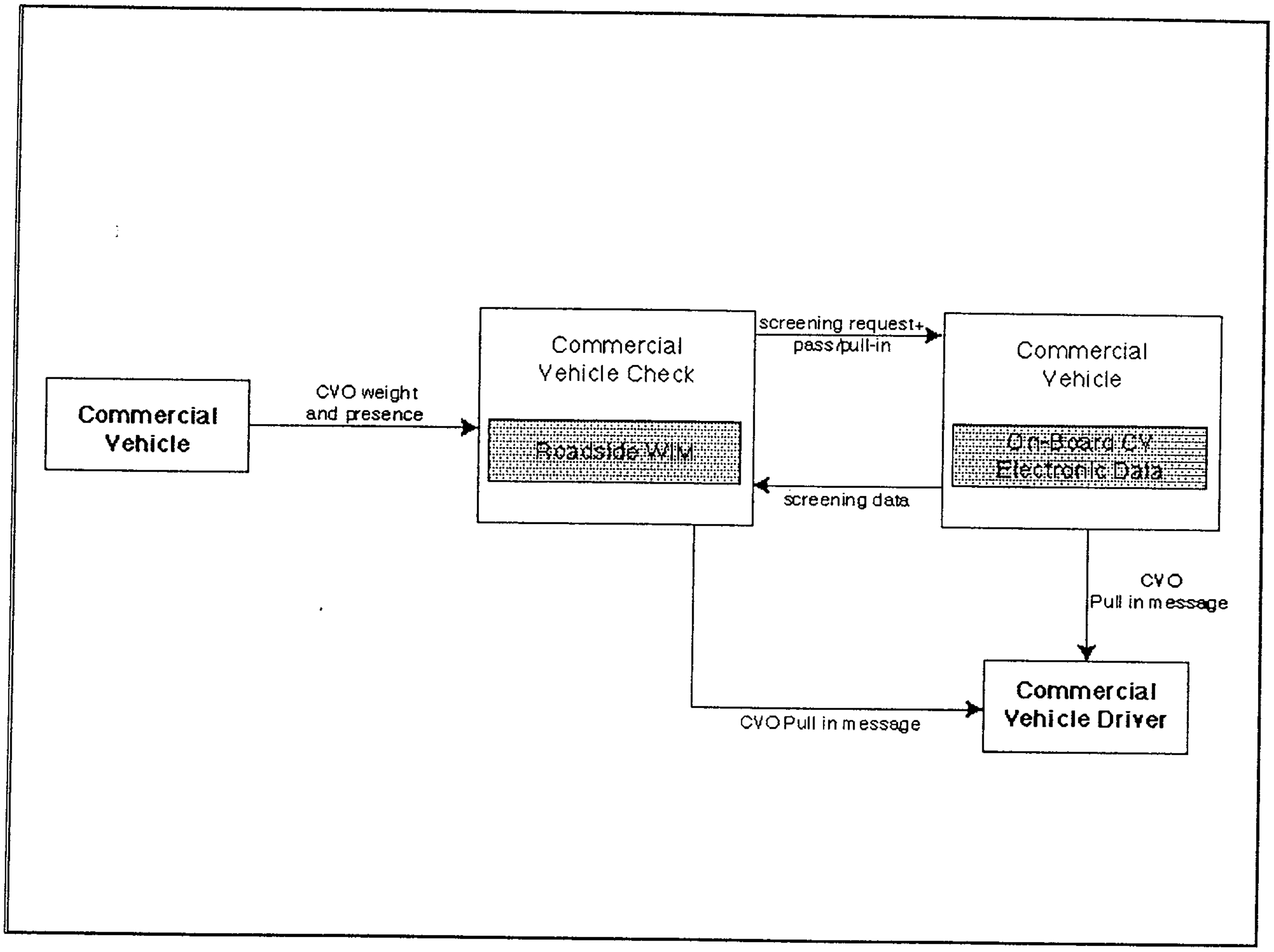
Figure 4-16 CV Administrative Processes Logical Architecture



Weigh-In-Motion

This market package provides for high speed weigh-in-motion with or without AVI attachment. Primarily this market package provides the roadside with additional equipment, either fixed or removable. Fixed implementations are typically thought to be an addition to the electronic clearance and would work in conjunction with the AVI and AVC equipment in place.

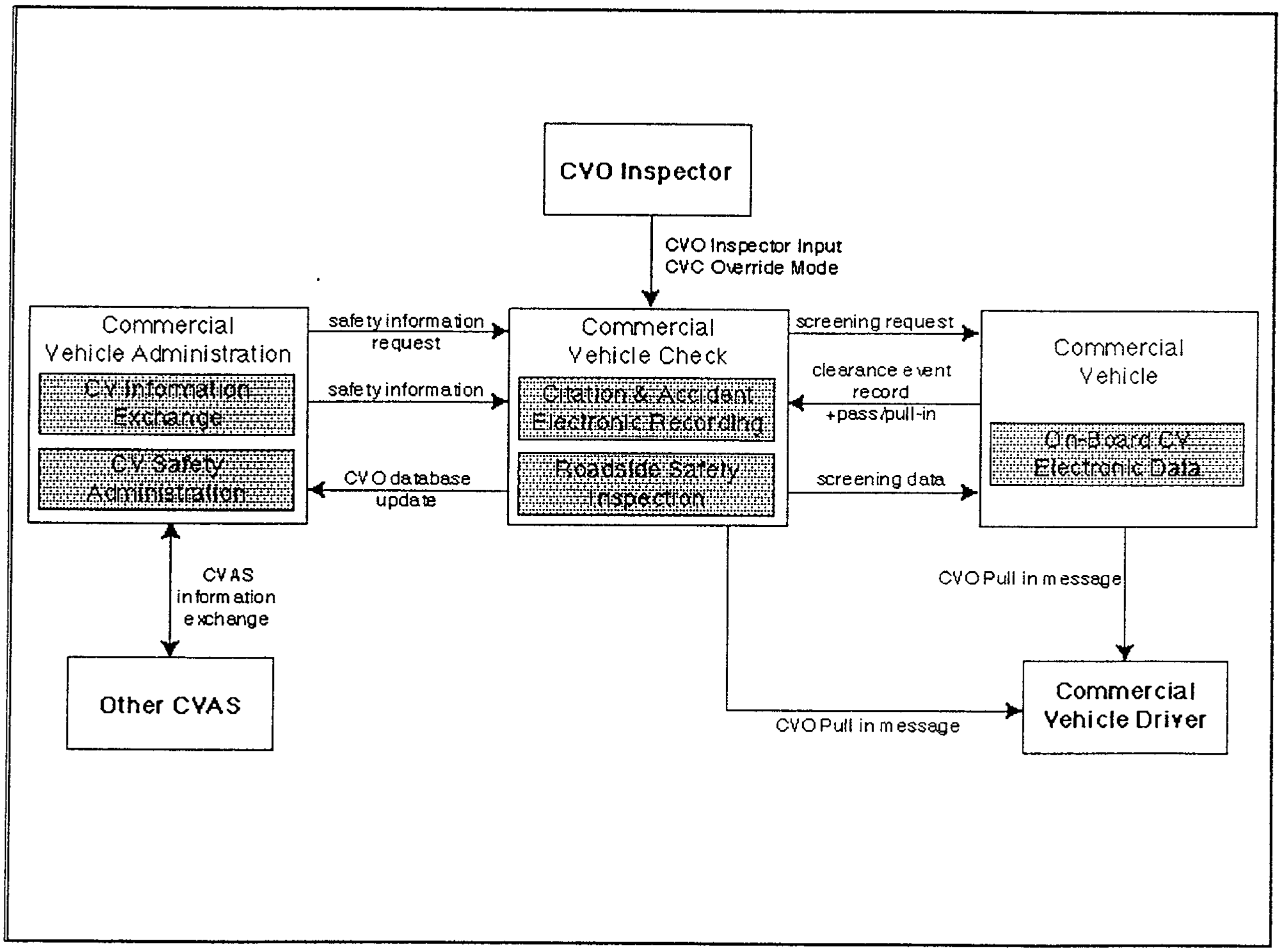
Figure 4-17 Weigh-In-Motion Logical Architecture



Roadside CVO Safety

This market package provides for automated roadside safety monitoring and reporting. It automates commercial vehicle safety inspections at the commercial vehicle check subsystem. The capabilities for performing the safety inspection are shared between this market package and the On-Board CVO Safety Market Package which enables a variety of implementation options. The basic option, directly supported by this market package, facilitates safety inspection of vehicles that have been pulled in, perhaps as a result of the automated screening process provided by the Electronic Clearance Market Package. In this scenario, only basic identification data and status information is read from the electronic tag on the commercial vehicle. The identification data from the tag enables access to additional safety data maintained in the infrastructure which is used to support the safety inspection, and may also inform the pull-in decision if system timing requirements can be met. More advanced implementations, supported by the On-Board CVO Safety market package, utilize additional vehicle safety monitoring and reporting capabilities in the commercial vehicle to augment the roadside safety check.

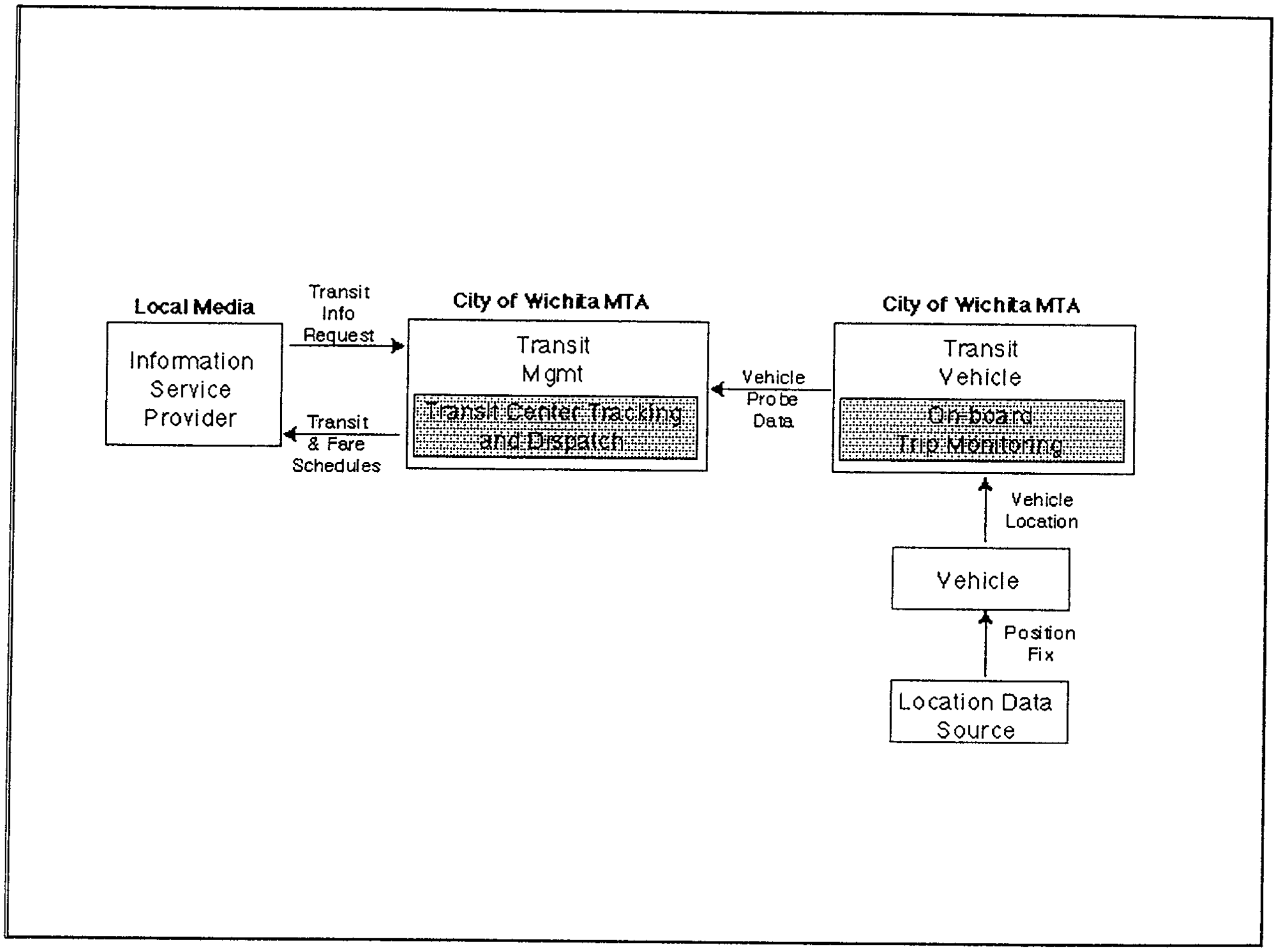
Figure 4-18 Roadside CVO Safety Logical Architecture



Transit Vehicle Tracking

This market package provides for an Automated Vehicle Location (AVL) system to track the transit vehicle's real time schedule adherence and updates the transit system's schedule in real-time. Vehicle position may be determined either by the vehicle (e.g., through GPS) and relayed to the infrastructure or may be determined directly by the communications infrastructure. A two-way wireless communication link with the transit management center is used for relaying vehicle position and control measures. Fixed route transit systems may also employ beacons along the route to enable position determination and facilitate communications with each vehicle at fixed intervals.

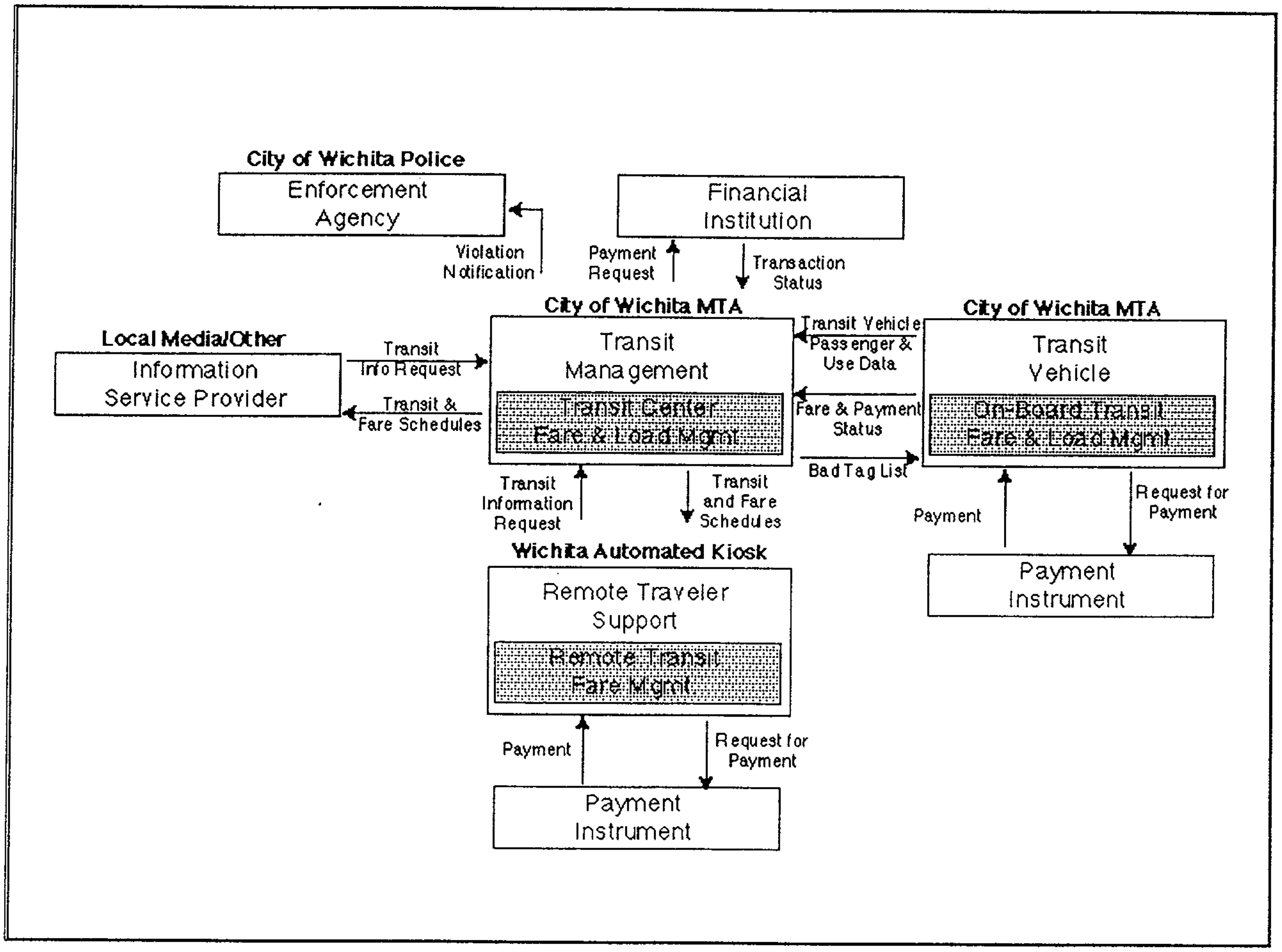
Figure 4-19 Transit Vehicle Tracking Logical Architecture



Transit Passenger and Fare Management

This market package allows for the management of passenger loading and fare payments on-board vehicles using electronic means. The payment instrument may be either a stored value or credit card. This package is implemented with sensors mounted on the vehicle to permit the driver and central operations to determine vehicle loads, and readers located either in the infrastructure or on-board the transit vehicle to allow fare payment. Data is processed, stored, and displayed on the transit vehicle and communicated as needed in the Transit Management Center using existing wireless infrastructure.

Figure 4-20 Transit Passenger and Fare Management Logical Architecture



4.2.3 Logical Architecture for Medium-Term Market Packages

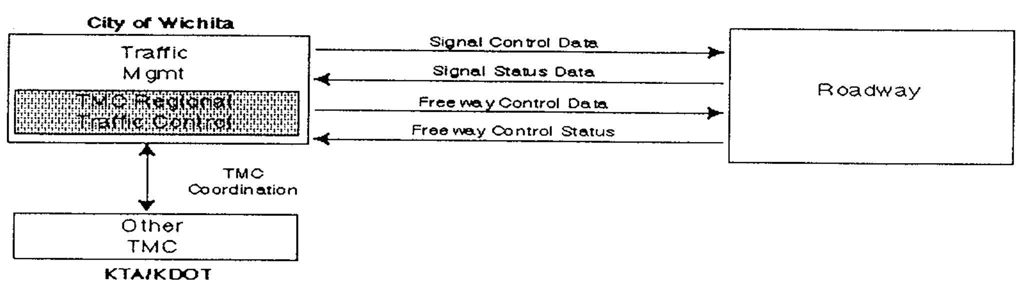
This section defines medium-term market packages as they are defined in the logical architecture. The following market packages are addressed in this section:

- Regional Traffic Control
- Probe Surveillance
- Traffic Network Performance Evaluation
- Demand-Response Transit Operations
- Dynamic Toll/Parking Fee Management
- Yellow Pages & Reservations
- Autonomous Route Guidance
- Dynamic Route Guidance
- Transit Fixed-Route Operations
- Transit Security
- Transit Maintenance
- Fleet Administration
- Electronic Clearance
- ITS Planning

Regional Traffic Control

This market package advances the Surface Street Control and Freeway Control market packages by allowing integrated interjurisdictional traffic control. This market package provides for the sharing of traffic information and control among traffic management centers to support a regional control strategy. The nature of optimization and extent of information and control sharing is determined through working arrangements between jurisdictions. This package relies principally on roadside instrumentation supported by the Surface Street Control and Freeway Control market packages and adds hardware, software, and wireline communications capabilities to implement traffic management strategies which are coordinated between neighboring Traffic Management Subsystems. Several levels of coordination are supported from sharing of information through sharing of control between traffic management subsystems.

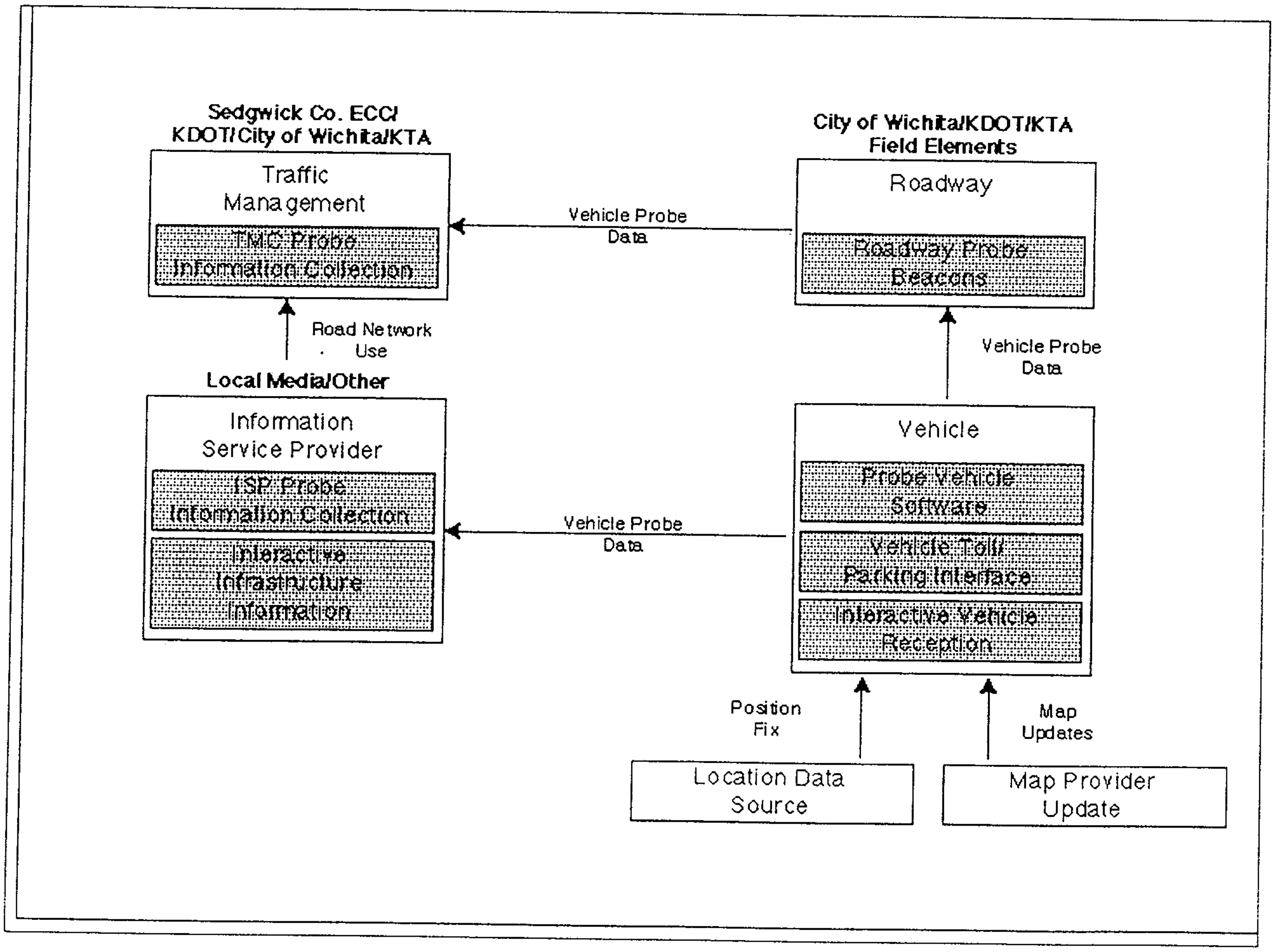
Figure 4-21 Regional Traffic Control Logical Architecture



Probe Surveillance

This market package provides an alternative approach for surveillance of the roadway network. Two general implementation paths are supported by this market package: 1) wide-area wireless communications between the vehicle and ISP are used to communicate current vehicle location and status, and 2) dedicated short range communications between the vehicle and roadside are used to provide equivalent information back to the traffic management subsystem. The first approach leverages wide area communications equipment that may already be in the vehicle to support personal safety and advanced traveler information services. The second approach utilizes vehicle equipment that supports toll collection, in-vehicle signing, and other short range communications applications identified within the architecture. The market package enables traffic managers to monitor road conditions, identify incidents, analyze and reduce the collected data, and make it available to users and private information providers.

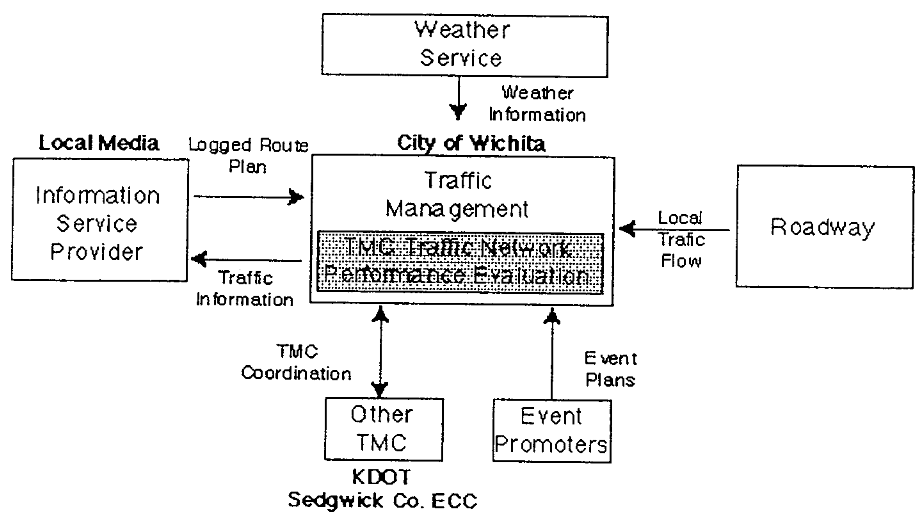
Figure 4-22 Probe Surveillance Logical Architecture



Traffic Network Performance Evaluation

This market package includes advanced algorithms, processing, and mass storage capabilities that support historical evaluation, real-time assessment, and forecast of traffic network performance. This includes the prediction of travel demand patterns to support better link travel times for route planning customers. The source data would come from the traffic management center itself as well as emergency management plans and predicted traffic loads derived from route plans supplied by the ISP. In addition, interface with transportation planners is required. This market package provides data that supports the implementation of TDM programs, and policies managing both traffic and the environment. Information on vehicle pollution levels, parking availability, usage levels, and vehicle occupancy are collected by monitoring sensors to support these functions.

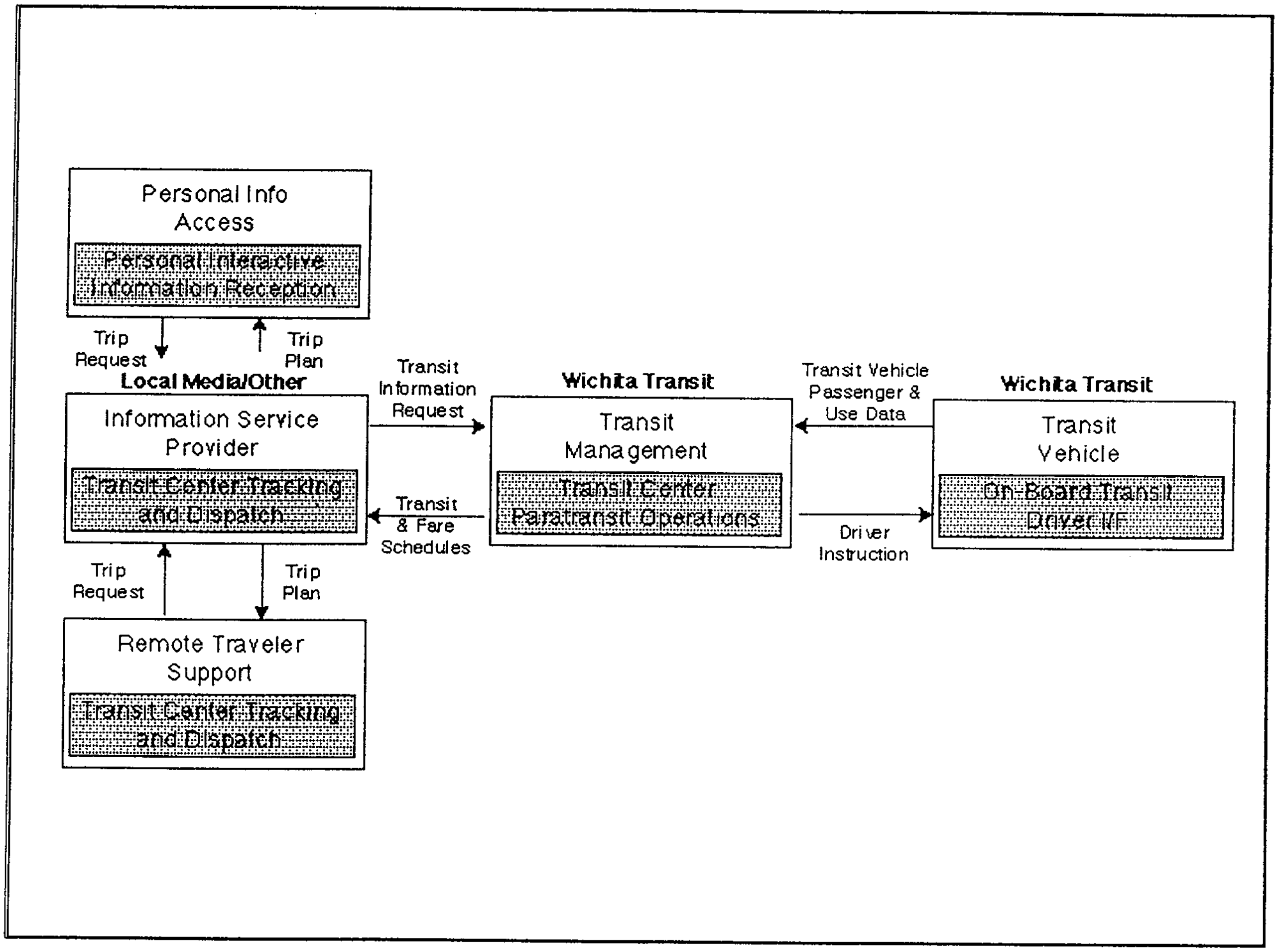
Figure 4-23 Traffic Network Performance Evaluation Logical Architecture



Demand-Response Transit Operations

This market package performs automatic driver assignment and monitoring as well as vehicle routing and scheduling for demand response transit services. This package uses the existing AVL database to monitor current status of the transit fleet and supports allocation of these fleet resources to service incoming requests for transit service. The Transit Management Subsystem provides the necessary data processing and information display to assist the transit operator in making optimal use of the transit fleet. Traveler equipment is also included within this market package to enable traveler requests for flexible route transit and paratransit service.

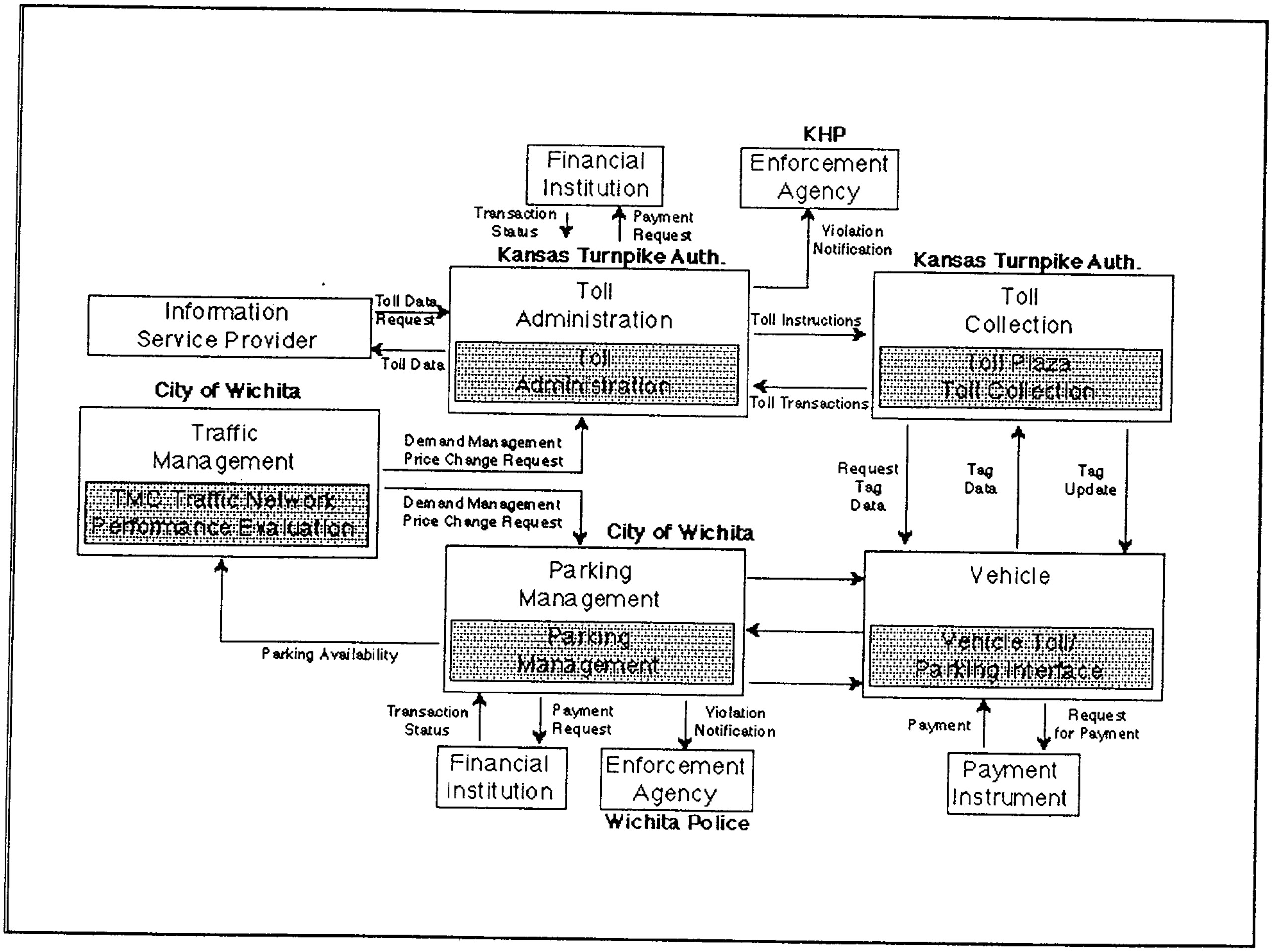
Figure 4-24 Demand-Response Transit Operations Logical Architecture



Dynamic Toll/Parking Fee Management

This market package provides toll operators with the ability to collect tolls electronically and detect and process violators. The network surveillance data which is a natural by-product of the toll collection process provides highway authorities with road use statistics. Variations in the fees that are collected enable implementation of demand management strategies. Dedicated short range communication between the roadway equipment and the vehicle is required as well as wireline interfaces between the toll collection equipment and transportation authorities and the financial infrastructure that supports fee collection. Vehicle tags of toll violators are read and electronically posted to vehicle owners. This market package also allows a parking facility to manage its parking operations, coordinate with the transportation authorities and collect parking fares in similar fashion.. This is performed by sensing/collecting parking data, sharing it with information providers and traffic management subsystems over the wireline infrastructure, and automatic fee collection using short range communications with the same in-vehicle equipment utilized for electronic toll collection.

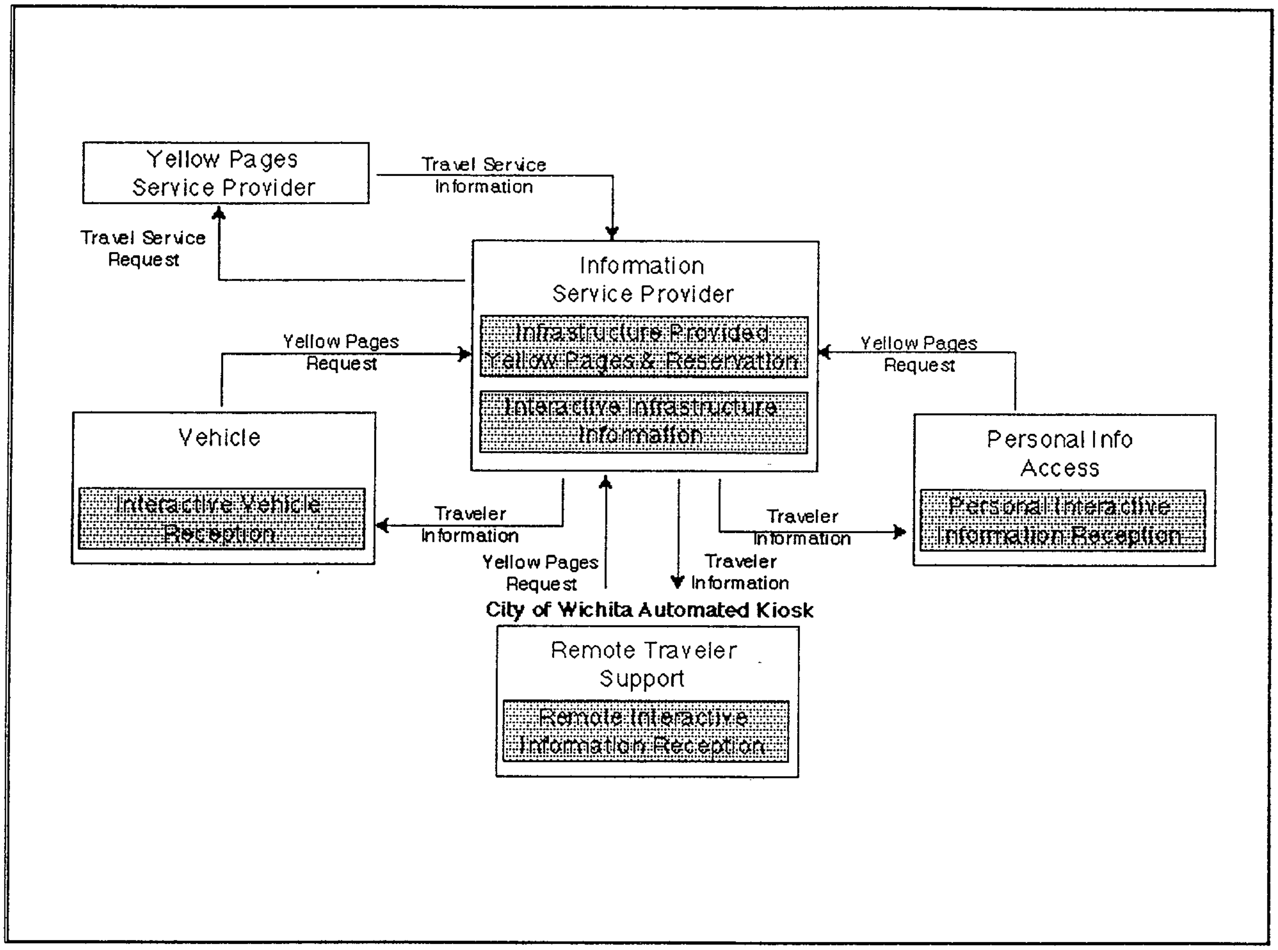
Figure 4-25 Dynamic Toll/Parking Logical Architecture



Yellow Pages and Reservations

This market package enhances the Interactive Traveler Information market package by adding infrastructure provided yellow pages and reservation capabilities. The same basic user equipment is included; service or advertising fees should allow recovery of the ISP investment. This market package provides different ways for accessing information, either while en-route in a vehicle, pre-trip via wireline connections, etc.

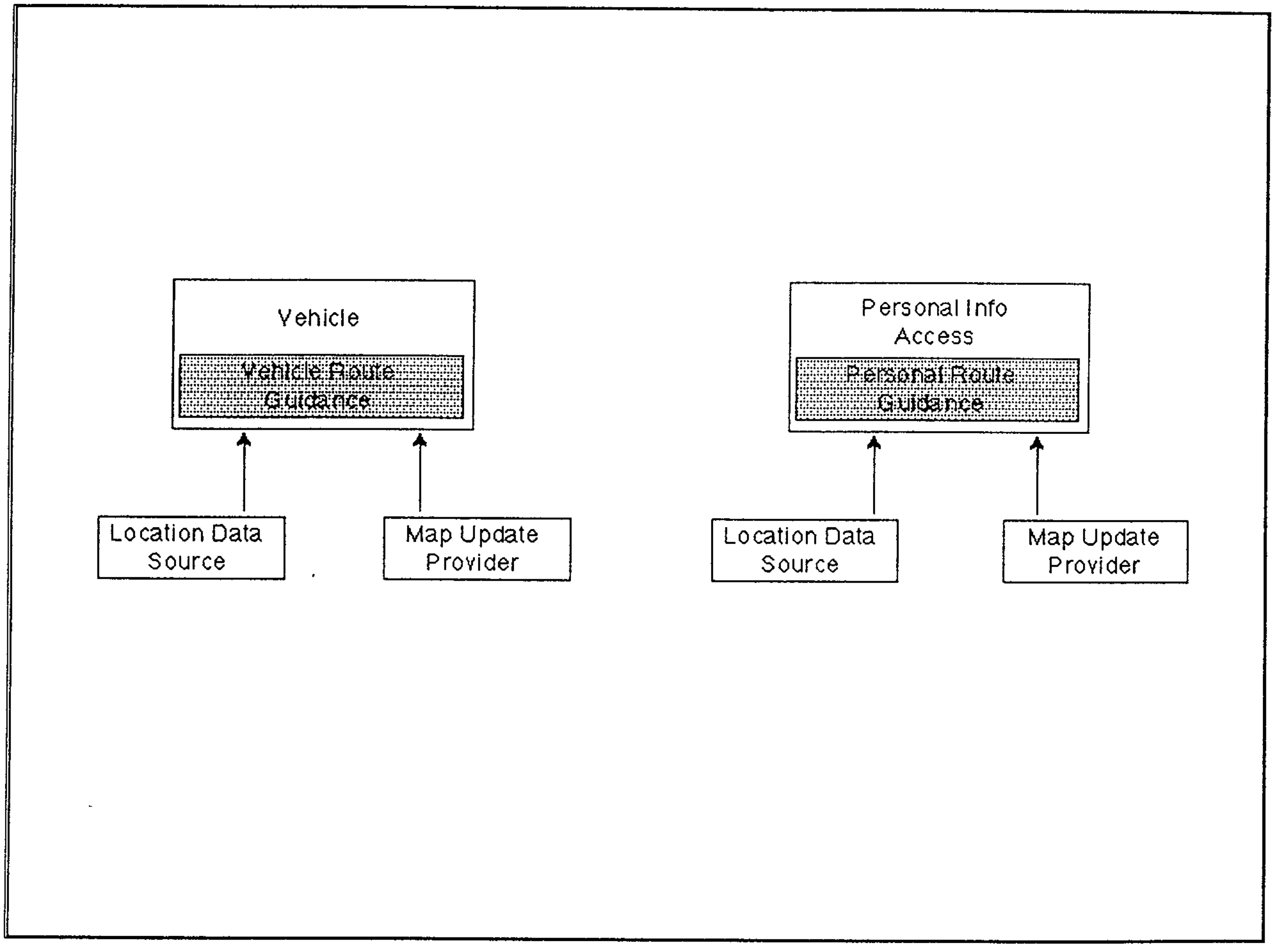
Figure 4-26 Yellow Pages and Reservations Logical Architecture



Autonomous Route Guidance

This market package relies on in-vehicle sensory, location determination, computational, map database, and interactive driver interface equipment to enable route planning and detailed route guidance based on static, stored information. No communication with the infrastructure is assumed or required. Identical capabilities are available to the traveler outside the vehicle by integrating a similar suite of equipment into portable devices.

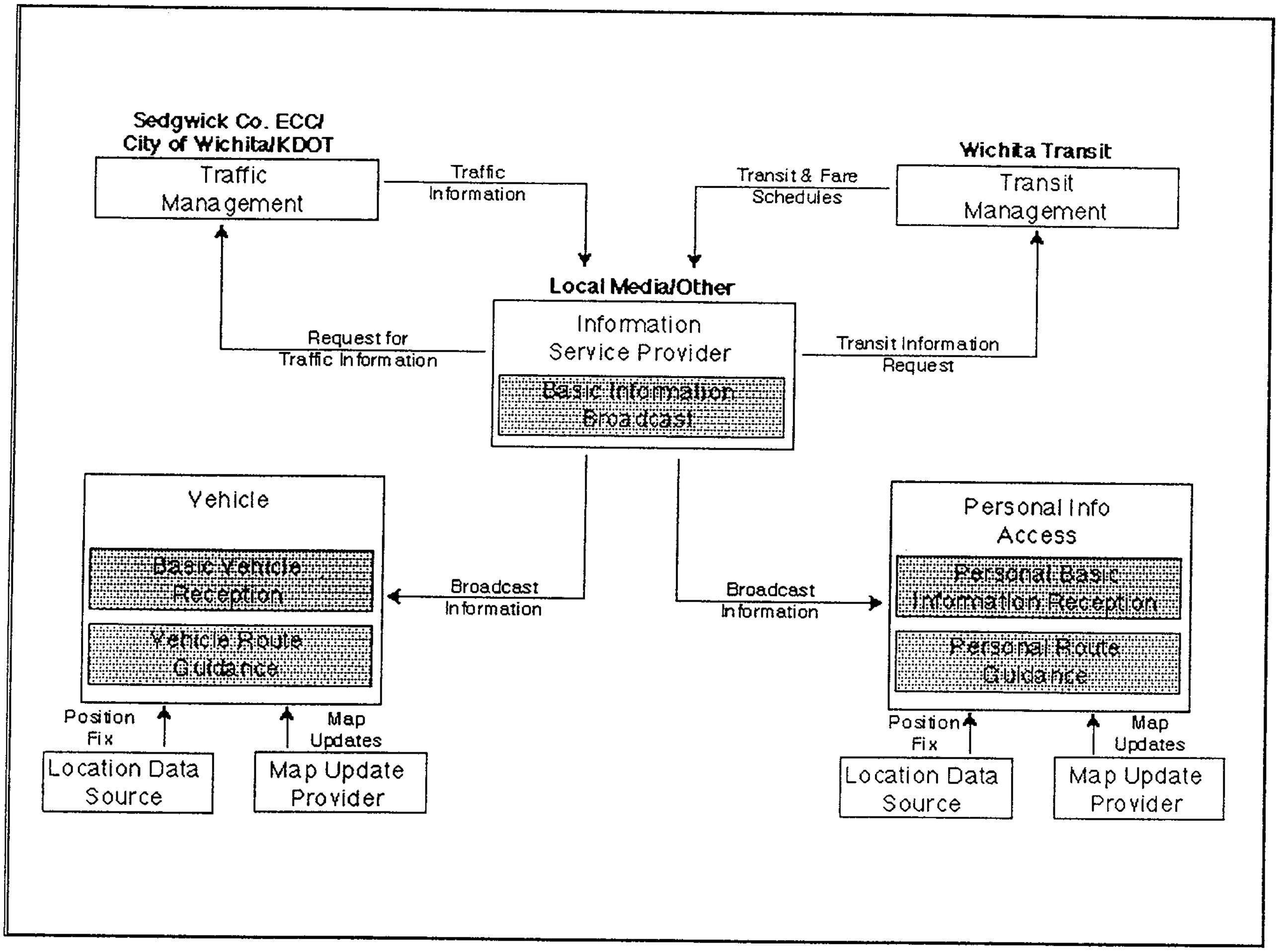
Figure 4-27 Autonomous Route Guidance Logical Architecture



Dynamic Route guidance

This market package offers the user advanced route planning and guidance which is responsive to current conditions. The package combines the autonomous route guidance user equipment with a digital receiver capable of receiving real-time traffic, transit, and road condition information which is considered by the user equipment in provision of route guidance.

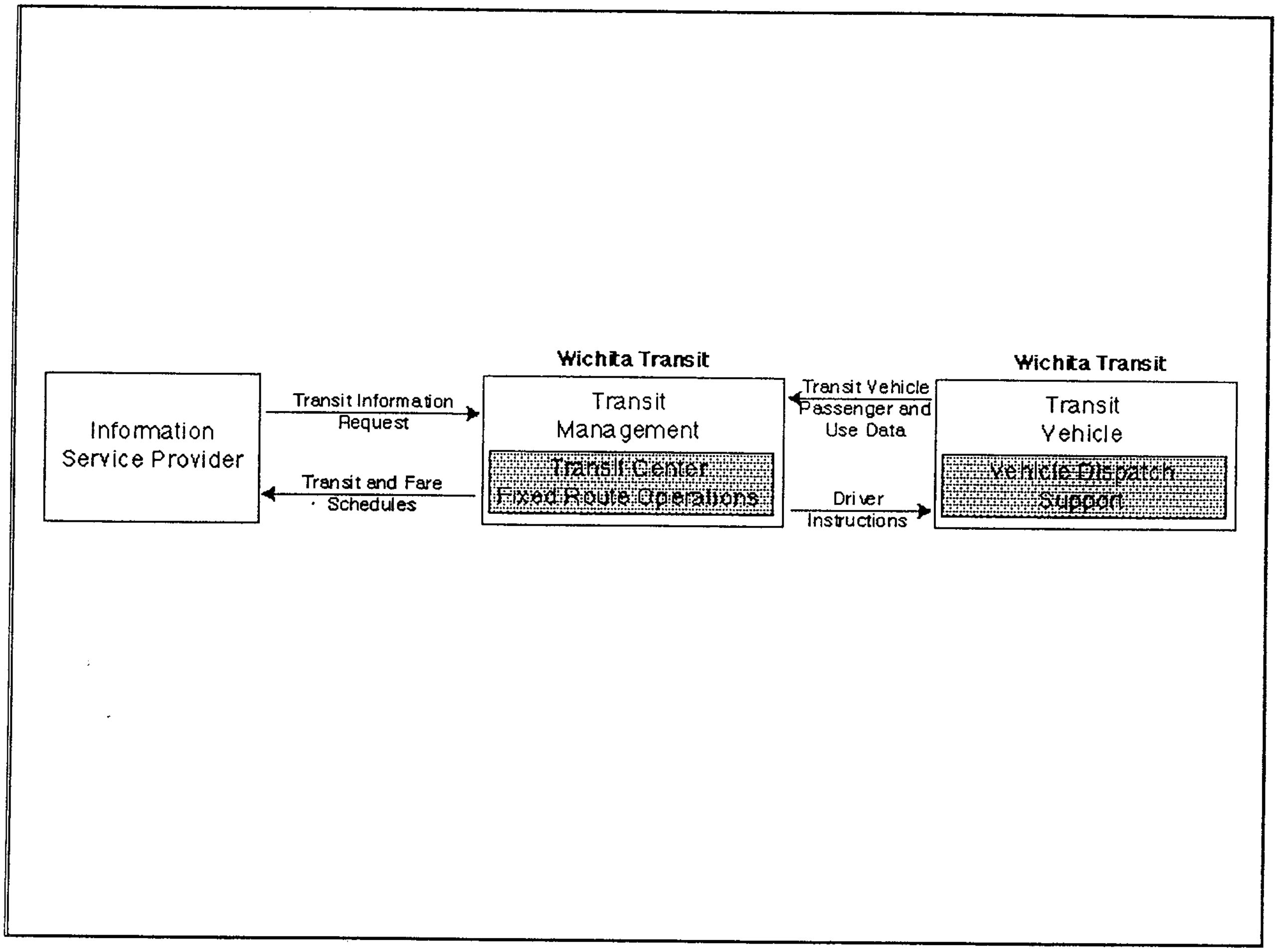
Figure 4-28 Dynamic Route Guidance Logical Architecture



Transit Fixed-Route Operations

This market package performs automatic driver assignment and monitoring, as well as, vehicle routing and scheduling for fixed-route services. This service uses the existing AVL database as a source for current schedule performance data, and is implemented through data processing and information display at the transit management subsystem. This data is exchanged using the existing wireline link to the information service provider where it is integrated with that from other transportation modes (e.g. rail, ferry, air) to provide the public with integrated and personalized dynamic schedules.

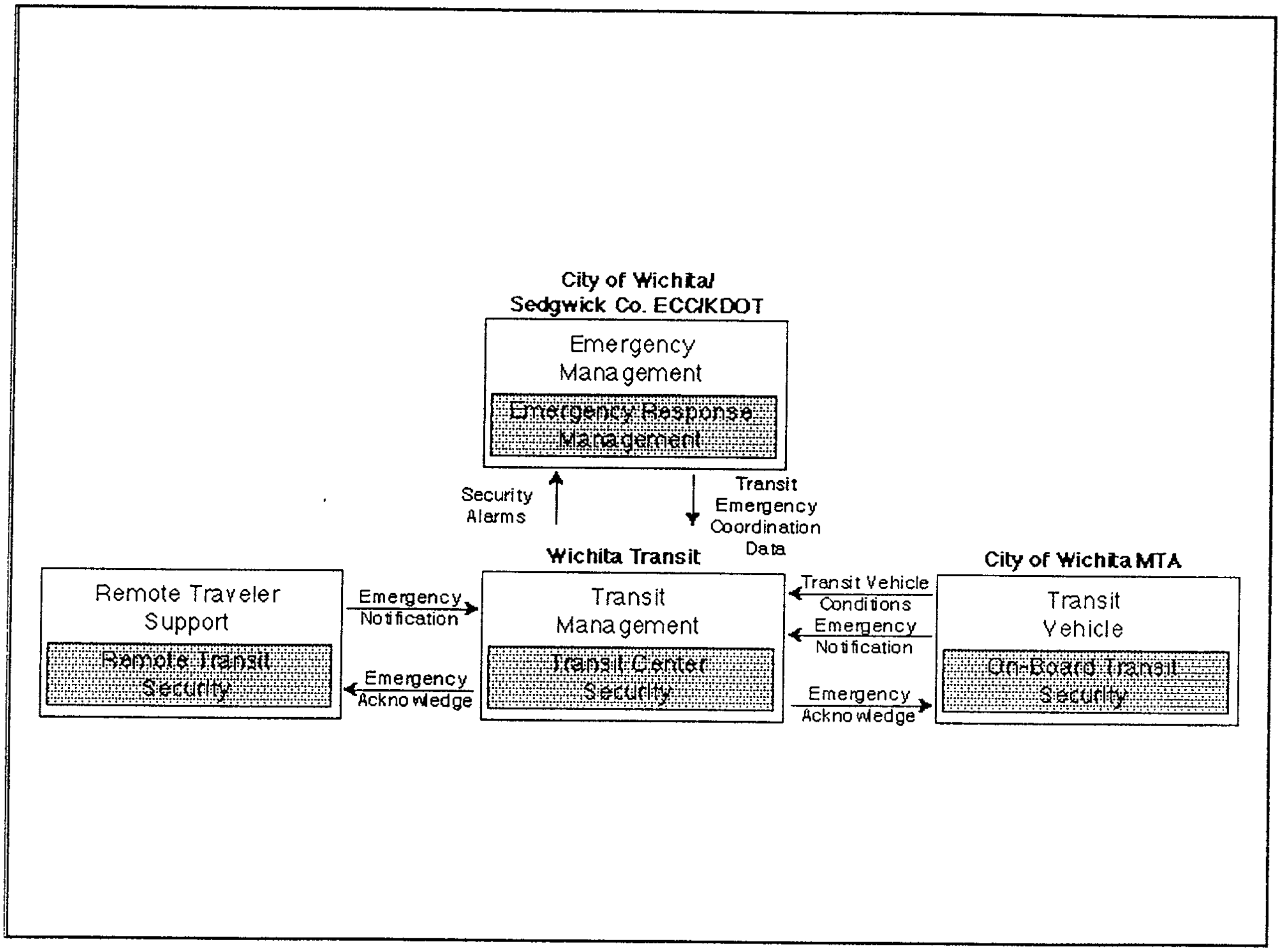
Figure 4-29 Transit Fixed-Route Operations Logical Architecture



Transit Security

This market package provides for the physical security of transit passengers. An on-board security system is deployed to perform surveillance and warn of potentially hazardous situations. Transit areas (e.g. stops, park and ride lots, stations) are also monitored. Information is communicated to the Transit Management Center using the existing or emerging wireless (vehicle to center) or wireline (area to center) infrastructure. Security related information is also transmitted to the Emergency Management Center when an emergency is identified that requires an external response.

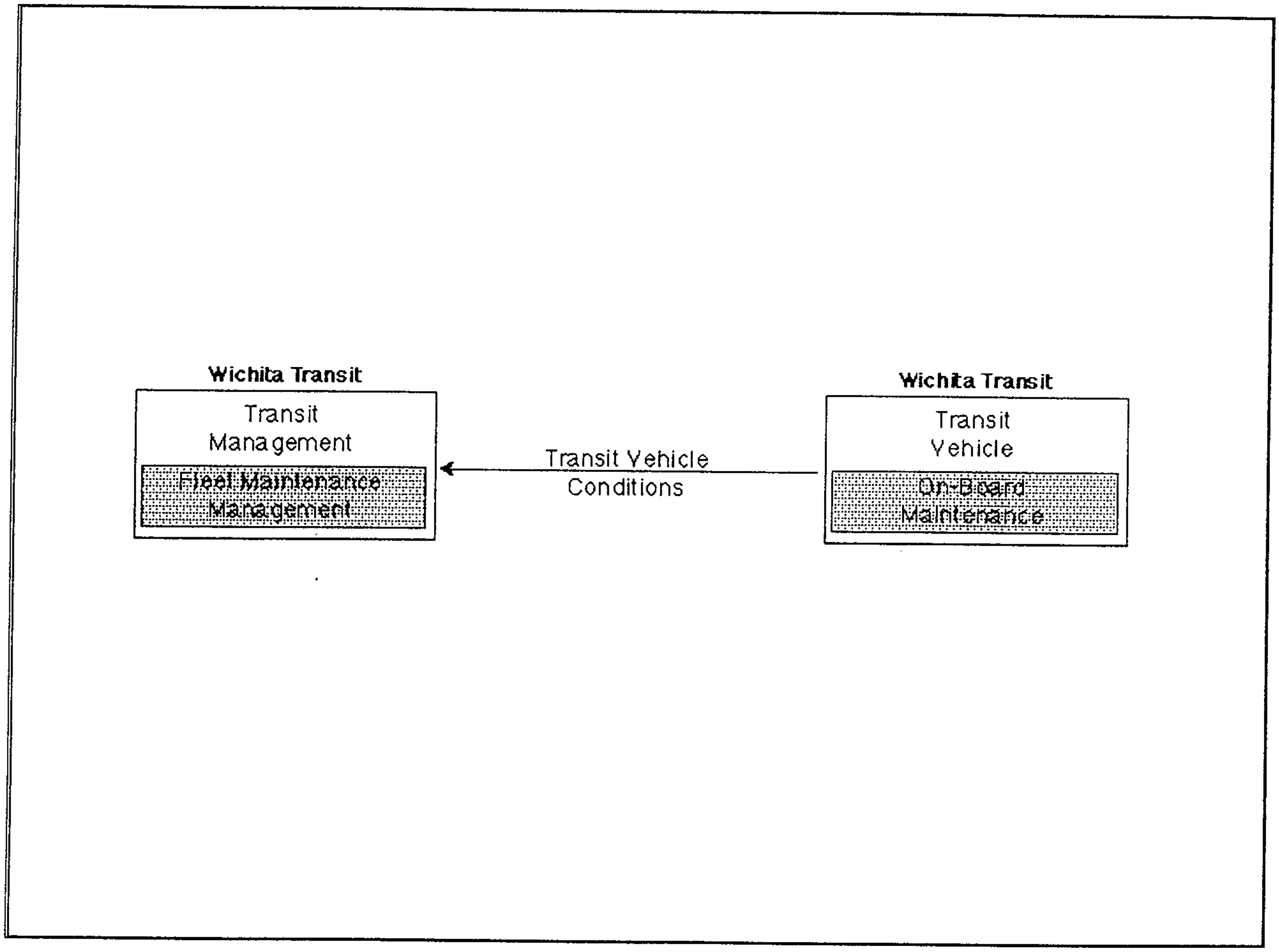
Figure 4-30 Transit Security Logical Architecture



Transit Maintenance

This market package supports automatic maintenance scheduling and monitoring. On-board condition sensors monitor critical system status and transmit critical status information to the transit management center. Hardware and software in the transit management center processes this data and schedules maintenance activities.

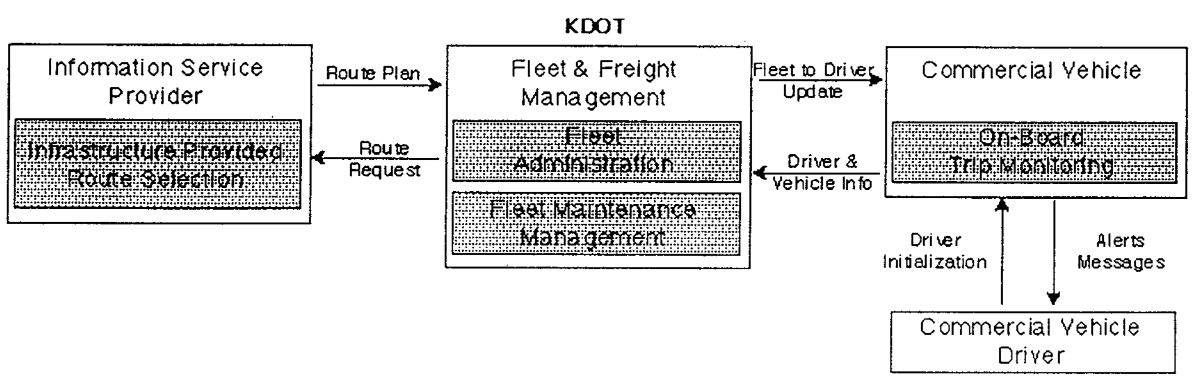
Figure 4-31 Transit Maintenance Logical Architecture



Fleet Administration

This market package keeps track of vehicle location itineraries, and fuel usage at the Flet and Freight Management Center using cell-based or satellite data link and condition of the existing wireless infrastructure. The vehicle has a processor to interface to its sensor (e.g., fuel gauge) and to the cellular data link. The Fleet and Freight Management Center can provide the vehicle with dispatch instructions and can process and respond to requests for assistance and general information from the vehicle via the cellular data link. The market package also provides the fleet manager with the connectivity to intermodal transportation provides using the existing wireline infrastructure.

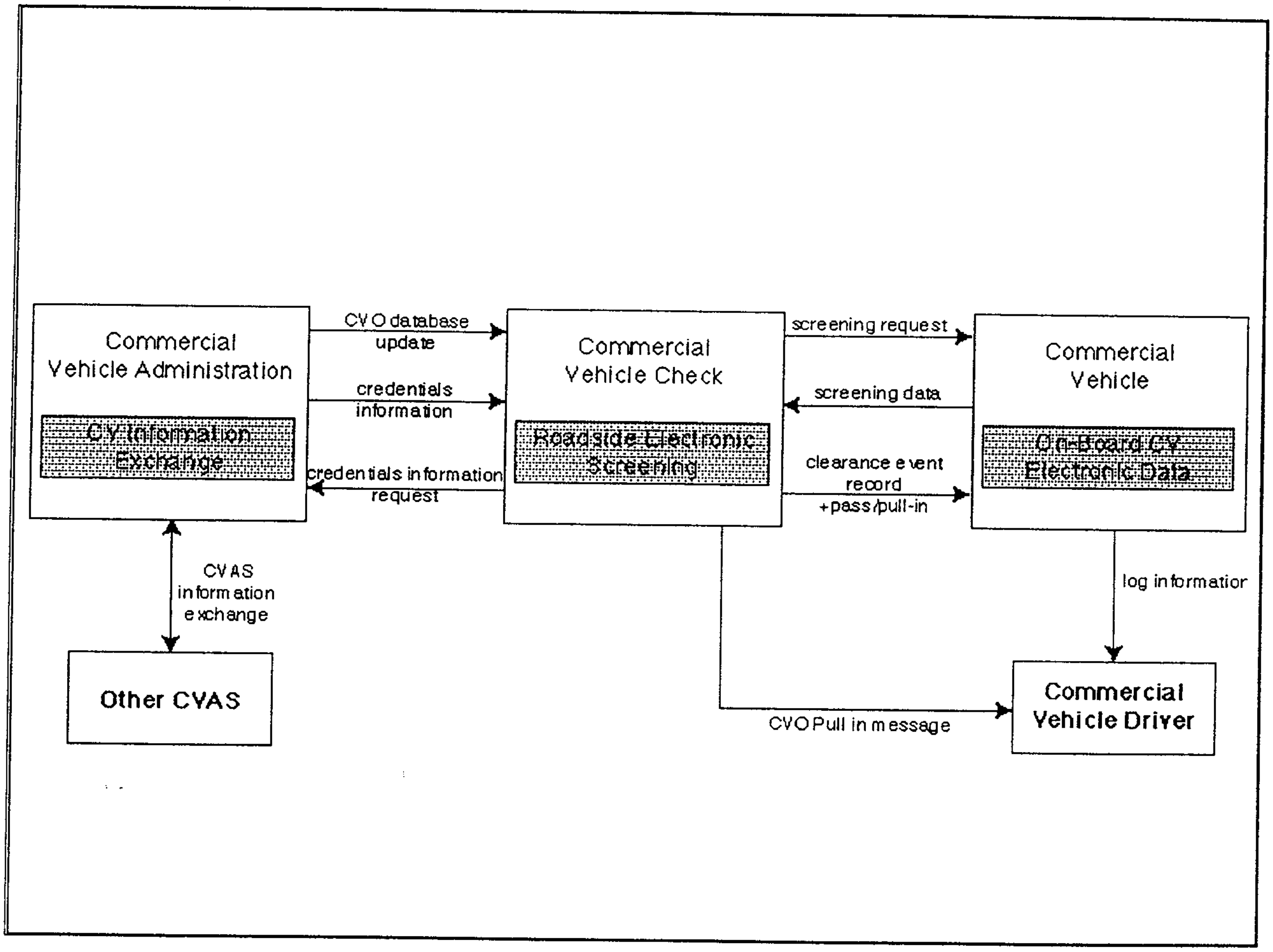
Figure 4-32 Fleet Administration Logical Architecture



Electronic Clearance

This market package provides for automated clearance at roadside check facilities. The roadside check facility communicates with the Commercial Vehicle Administration subsystem over wireline to retrieve infrastructure snapshots of critical carrier, vehicle, and driver data to be used to sort passing vehicles. This package allows a good driver/vehicle/carrier to pass roadside facilities at highway speeds using transponders and dedicated short range communications to the roadside. The roadside check facility may be equipped with Automatic Vehicle Identification (AVI), weighing sensors, transponder read/write devices, computer workstation processing hardware, software, and databases.

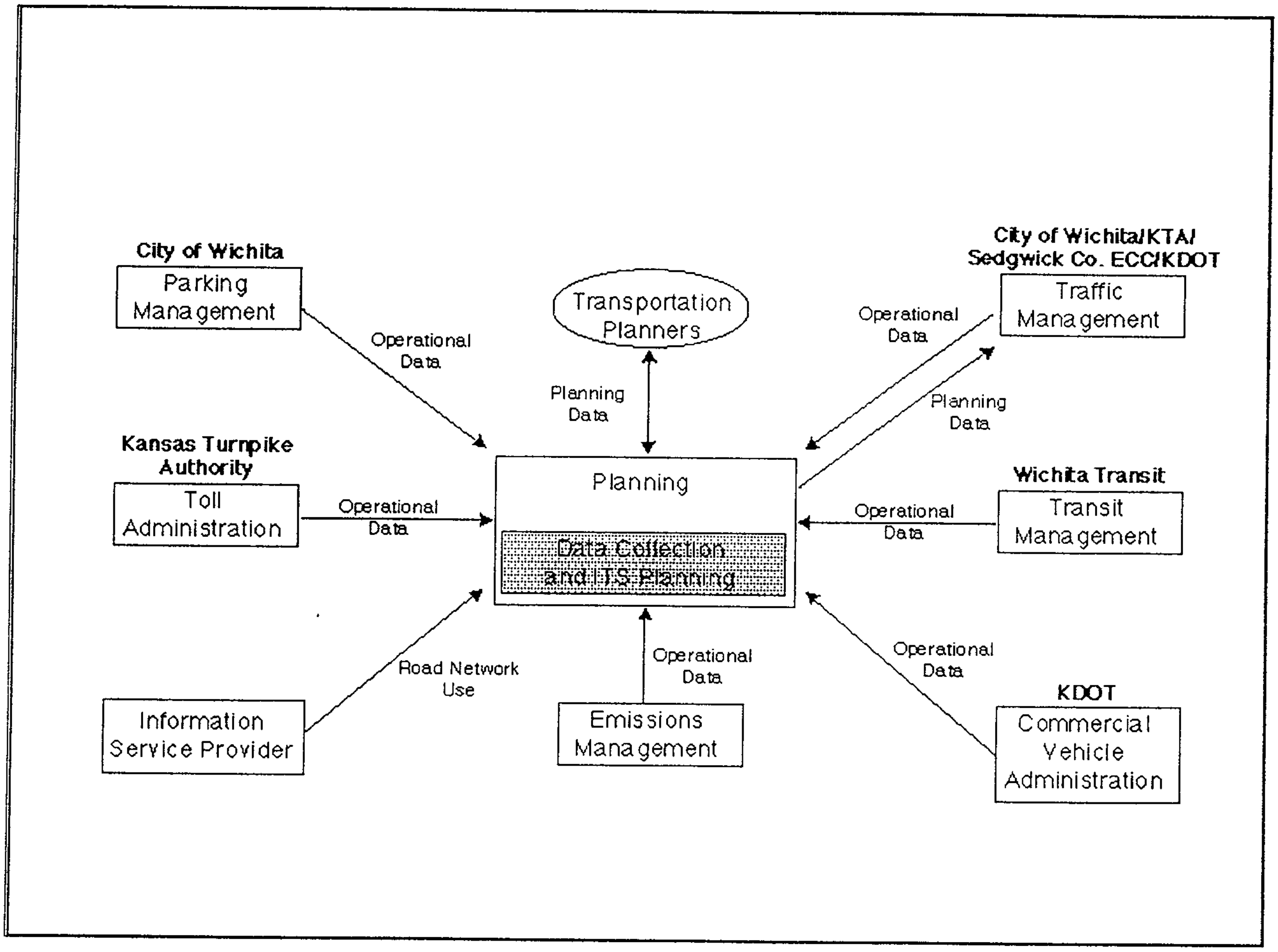
Figure 4-33 Electronic Clearance Logical Architecture



ITS Planning

This market package supports ITS planning functions. It accepts data from every center subsystem and uses this data to plan new deployments and new Market Packages. This data also supports policy decision making, allocation of funding, allocation of resources and other planning activities.

Figure 4-34 ITS Planning Logical Architecture



4.2.4 Logical Architecture for Long Term Market Packages

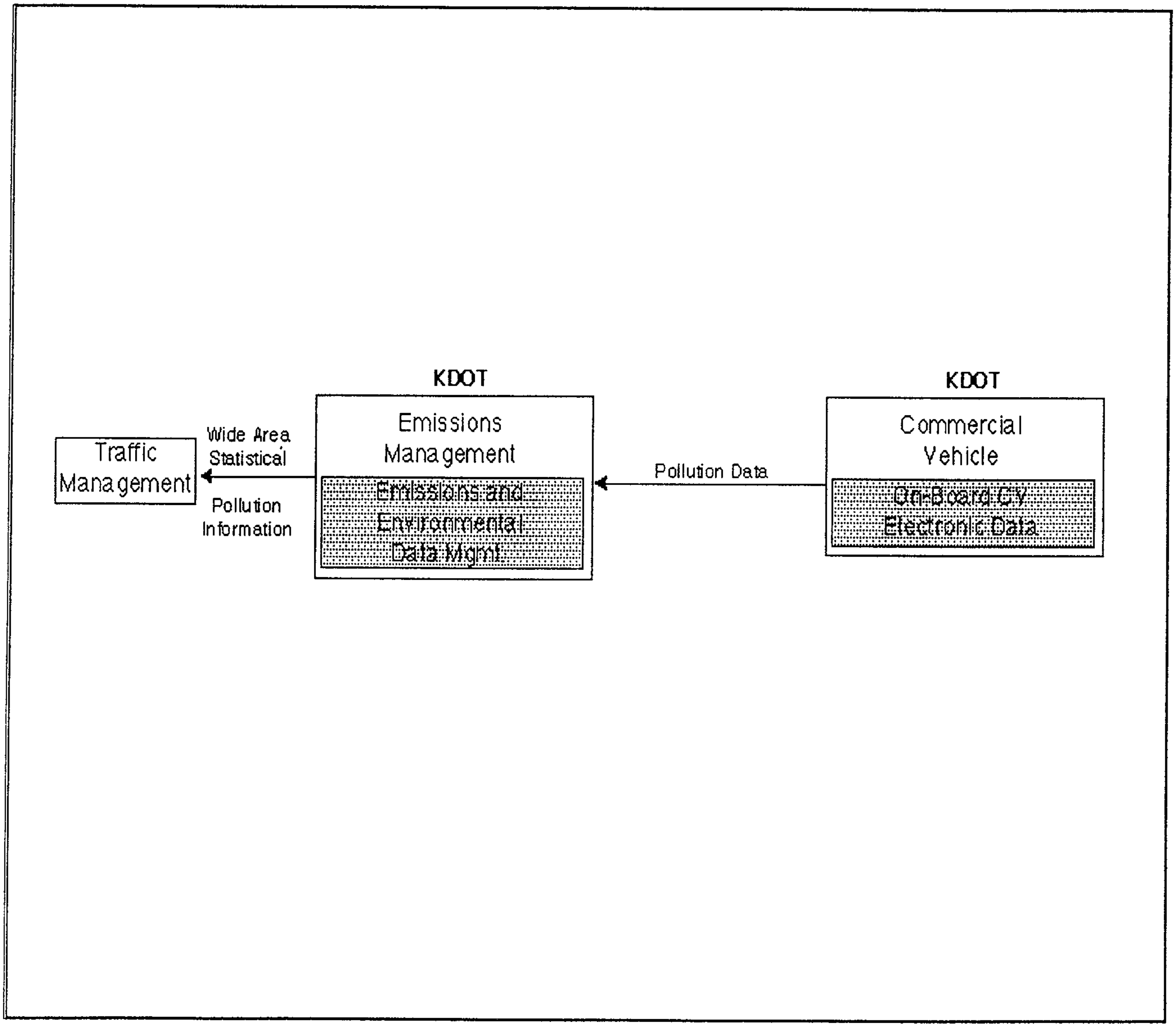
This section discusses logical architecture for long term market packages. The following market packages are addressed in this section:

Emissions and Environmental Hazards Sensing
ISP-Based Route Guidance
Integrated Transportation Management/Route Guidance
In-Vehicle Signing
On-Board CVO Safety
CVO Fleet Maintenance

Emissions and Environmental Hazards Sensing

This market package provides monitoring of the emissions levels using roadway sensors to collect the data. The data are transmitted to a center for processing and used by traffic management. It may include machine vision-based equipment to identify violators' license plates for appropriate actions. This market package also includes sensors to detect environmental hazards such as icy road conditions and dense fog, and communications equipment to transmit data to a center. The gathered information can be used to implement environmentally sensitive TDM programs, policies, and regulations.

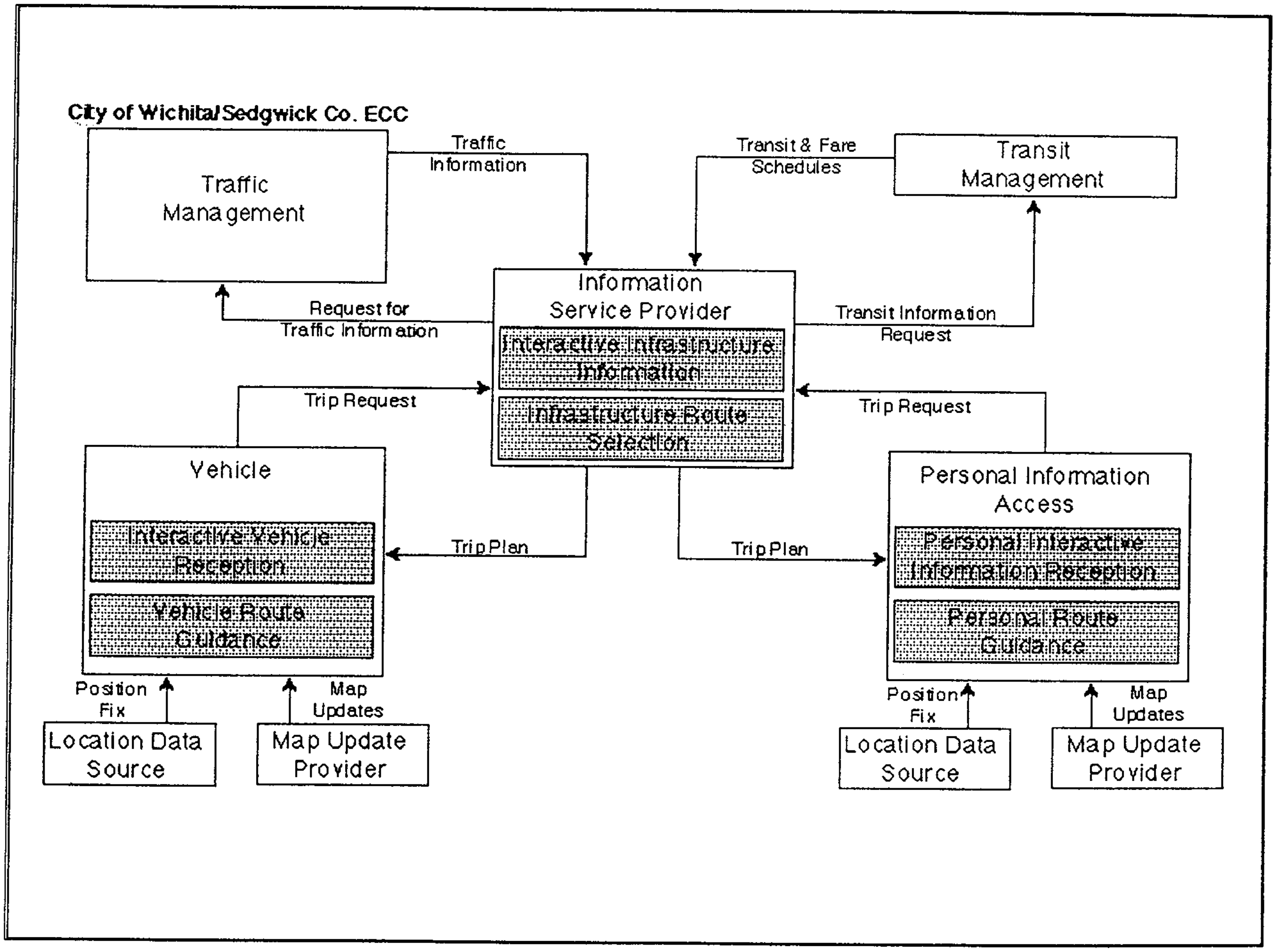
Figure 4-35 Emissions and Environmental Hazards Sensing Logical Architecture



ISP – Based Route Guidance

This market package moves the route planning function from the user device to the information service provider. This approach simplifies the user equipment requirements and can provide the infrastructure better information on which to predict future traffic and appropriate control strategies. The package includes two way data communications and optionally also equips the vehicle with the data bases, location determination capability, and display technology to support turn by turn route guidance.

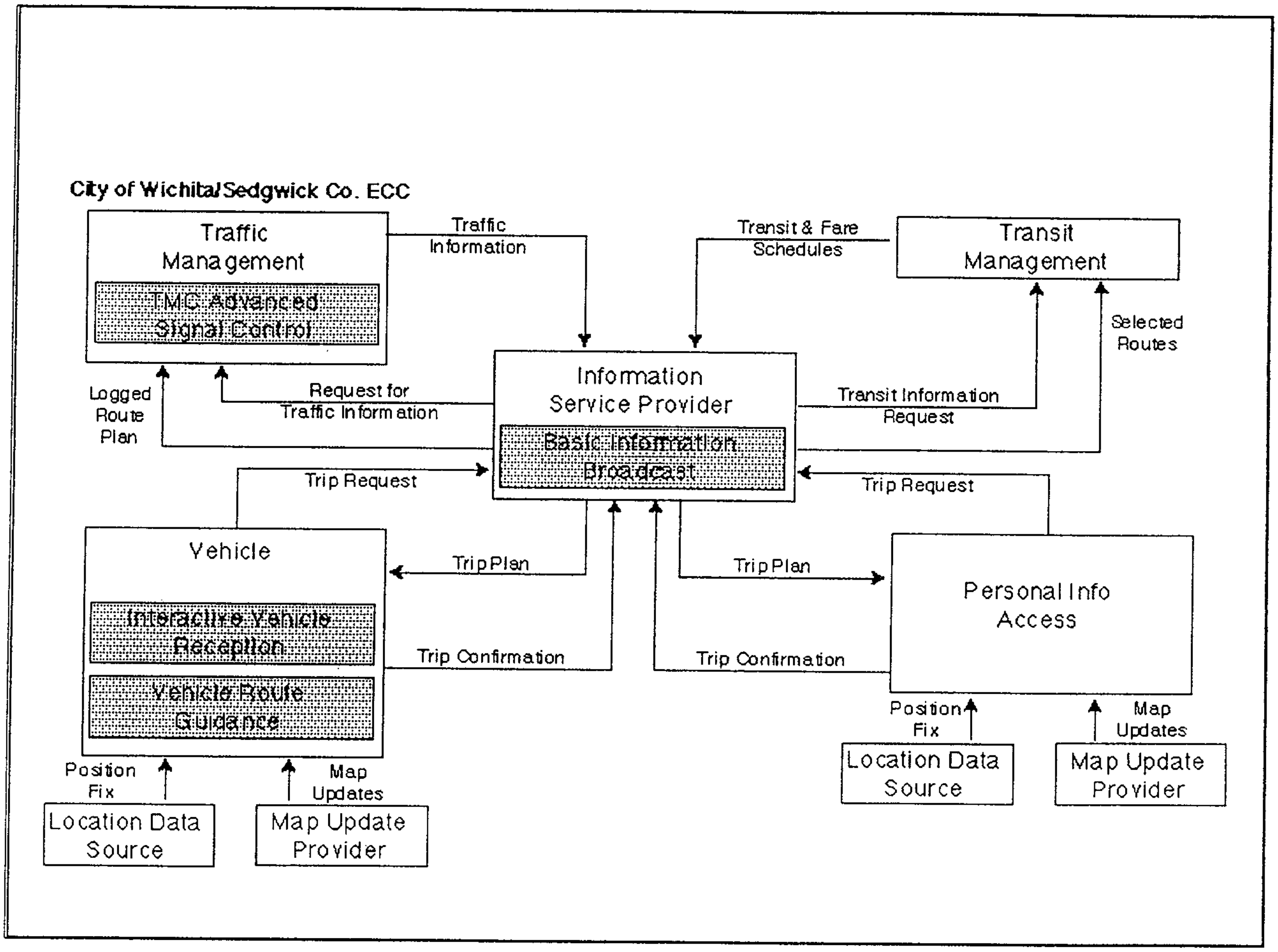
Figure 4-36 ISP – Based Route Guidance Logical Architecture



Integrate Transportation Management/Route Guidance

This market package allows a traffic management center to continuously optimize the traffic control strategy based on near-real time information on intended routes for a proportion of the vehicles within their network. It represents an extension to the ISP-Based Route Guidance market package which improves the level of coordination between ISP and Traffic Management Subsystem so that the planned routes can be factored in to near-future traffic management strategies. It would utilize the individual and ISP route planning information to optimize signal timing while at the same time providing updated signal timing information to allow optimized route plans. The use of predictive link times for this market package are possible through utilizing the Traffic Network Performance Evaluation market package at the traffic management center.

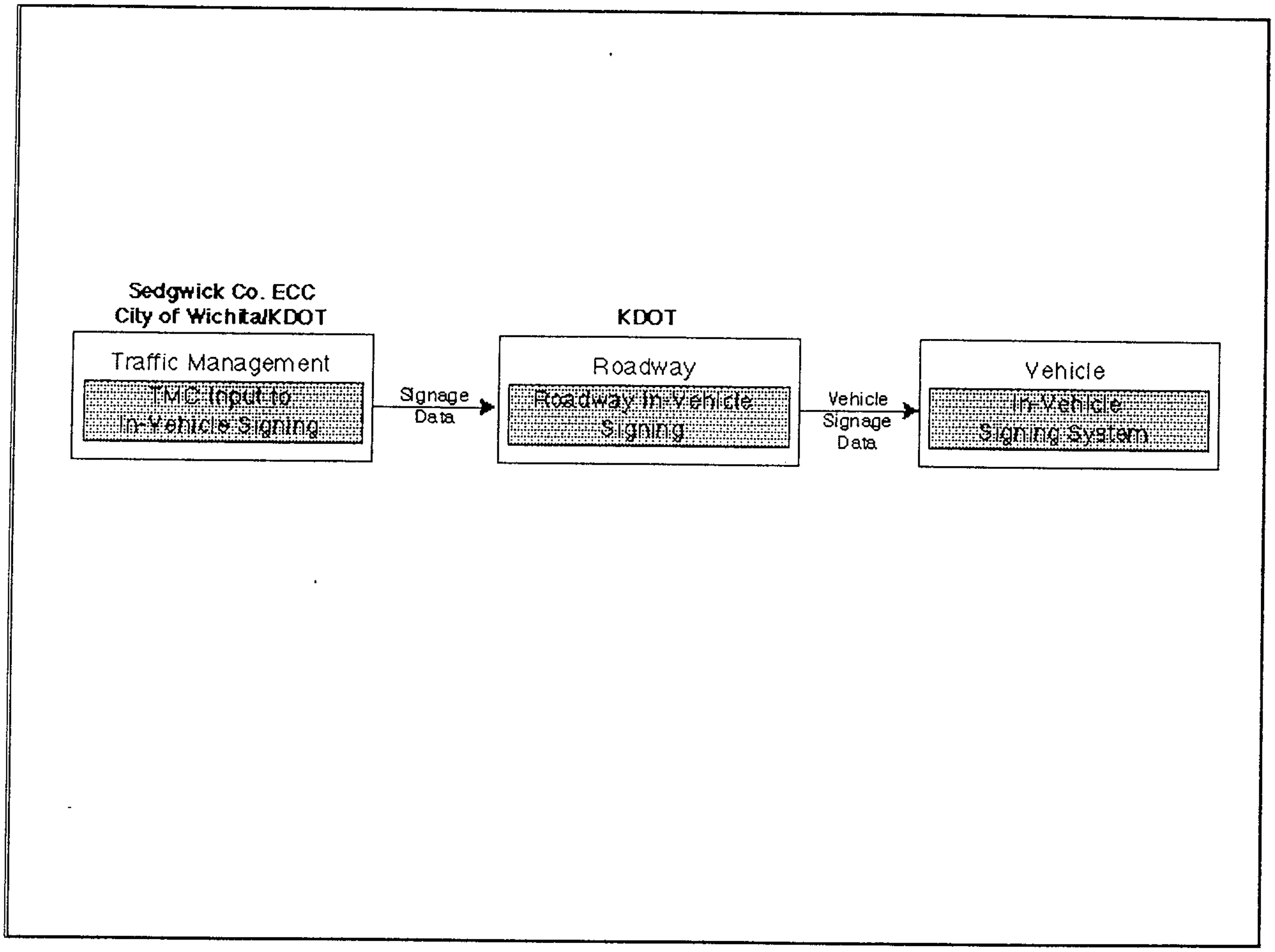
Figure 4-37 Integrate Transportation Management/Route Guidance Logical Architecture



In-Vehicle Signing

This market package supports distribution of advisory information to drivers through in-vehicle devices regarding road conditions and status. It includes short range communications to the vehicle and wireline connections to the TMS for coordination and control. This market package includes information distribution to inform the driver of both highway-highway and highway-rail intersection status.

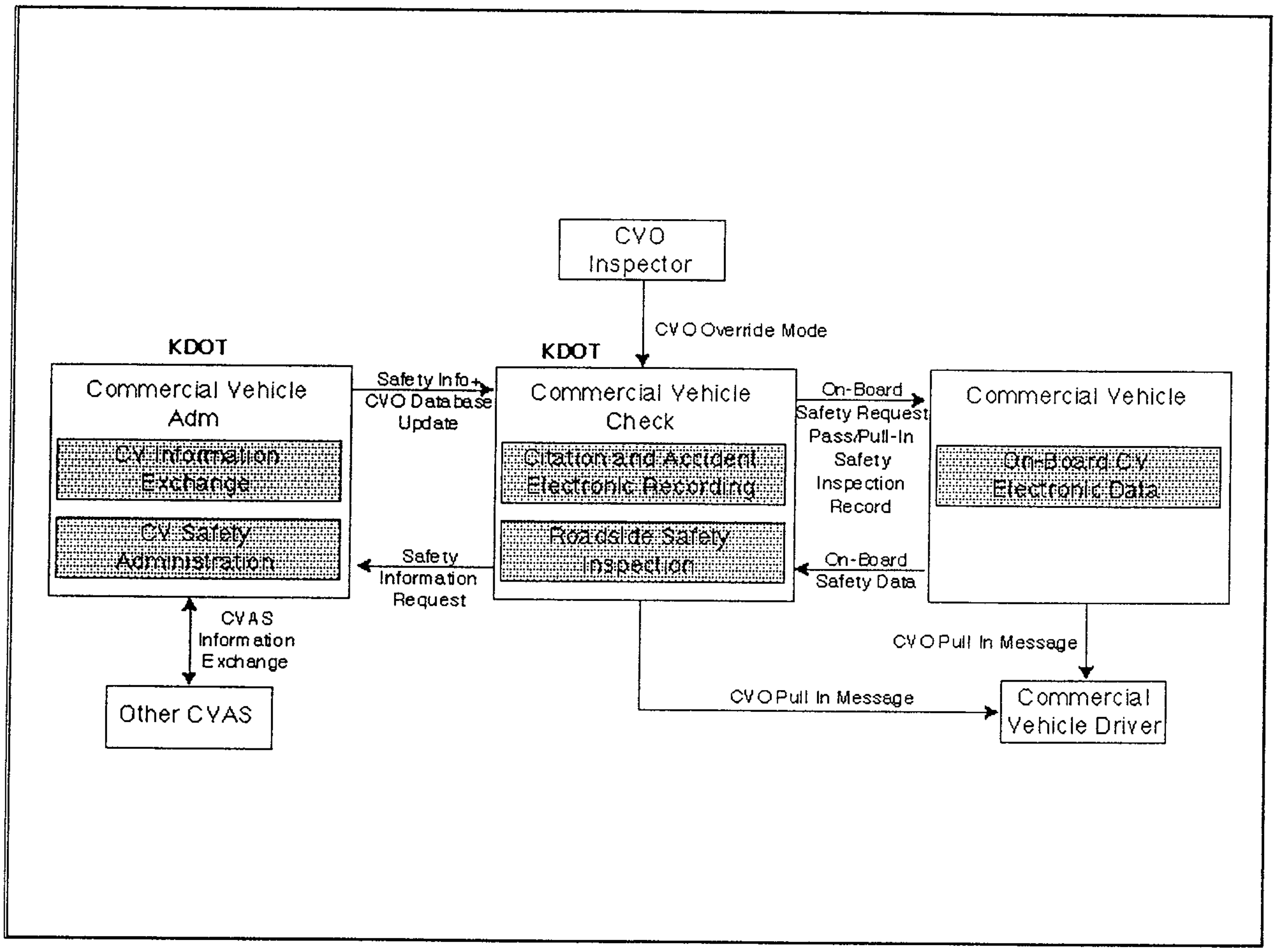
Figure 4-38 In-Vehicle Signing Logical Architecture



On-Board CVO Safety

This market package provides for on-board commercial vehicle safety monitoring and reporting. It is an enhancement of the Roadside CVO Safety market package and includes roadside support for reading on-board safety data via tags. This market package uses the same communication links as the Roadside CVO Safety market package, and provides the commercial vehicle with a cellular link (data and possibly voice) to the Fleet and Freight Management and the Emergency Management Centers. Safety warnings are provided to the driver as a priority with secondary requirements to notify the Fleet and Freight Management and Commercial Vehicle Check roadside elements.

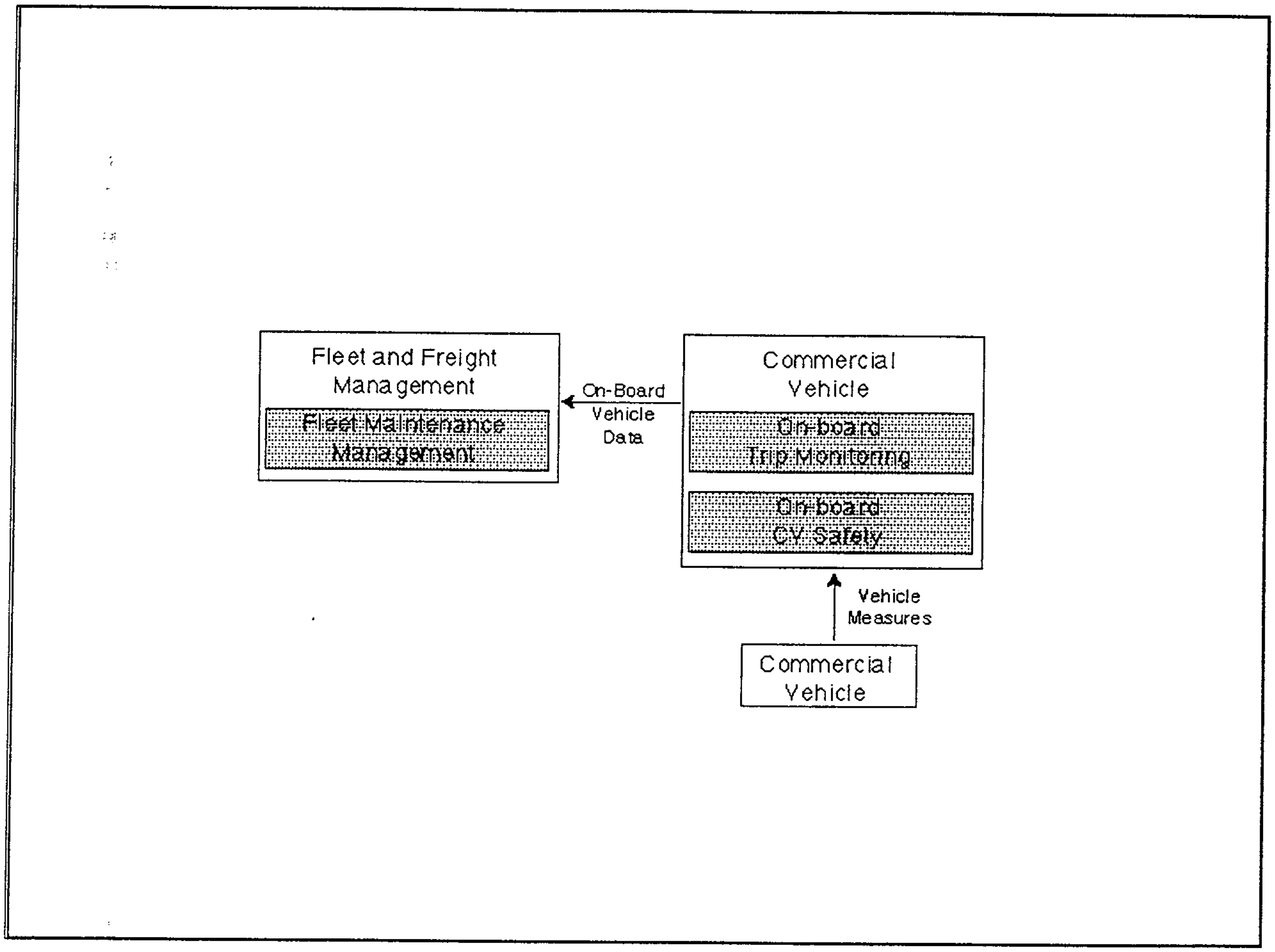
Figure 4-39 On-Board CVO Safety Logical Architecture



CVO Fleet Maintenance

This market package supports maintenance of CVO fleet vehicles through close interface with on-board monitoring equipment and AVLS capabilities with in the Fleet and Freight Management Center. Records of vehicle mileage, repairs, and safety violations are maintained to assure safe vehicles on the highway.

Figure 4-40 CVO Fleet Maintenance Logical Architecture



4.3 PHYSICAL ARCHITECTURE

This section provides an overview of the role of the physical architecture within the National Architecture framework, a brief description of the role of each system and subsystem, and diagrams showing the physical architecture for each implementation phase for the Wichita area.

4.31 Overview of ITS Physical Architecture

The Physical Architecture partitions the functions defined by the Logical Architecture into systems, and at a lower level, subsystems, based on their functional similarities and the location where the functions are being performed.

As indicated previously, the National ITS architecture defines four systems: Traveler, Center, Roadside, and Vehicle. These four systems consist of nineteen subsystems. The specific choice of nineteen subsystems represents a lower level of partitioning of functions that is intended to capture all anticipated subsystem boundaries for short-, medium-, and long term implementation. Subsystems are composed of equipment packages with specific functional attributes (see Technical Memorandum Number 3, Functional Requirements). Equipment packages are defined to support analyses and deployment, and they represent the smallest units within a subsystem that might be purchased. In deployments, the character of a subsystem deployment is determined by the specific equipment packages chosen. For example, one municipal deployment of a Traffic Management Subsystem may select *Collect Traffic Surveillance* and *Basic Signal Control* equipment packages, while a state Traffic Management Center may select *Collect Traffic Surveillance* and *Freeway Control* packages. In addition, subsystems may be deployed individually or in "aggregations" or combinations that will vary by geography and time based on local deployment choices. A Traffic Management Center may include a Traffic Management Subsystem, Information Provider Subsystem, and Emergency Management Subsystem, all within one building, while another Traffic Management Center may concentrate only on the management of traffic with the Traffic Management Subsystem.

4.3.2 Physical Architecture Systems and Subsystems

Subsystems for each of the major physical architecture systems are outlined below under the corresponding system. For a more detailed description of individual subsystem functions see Technical Memorandum Number 3, Functional Requirements.

4.3.3 Center Subsystems

Center Subsystems deal with those functions normally assigned to public/private administrative, management, or planning agencies. The nine Center Subsystems are described below:

- Commercial Vehicle Administration - Sells credentials and administers taxes, keeps records of safety and credential check data, and participates in information exchange with other commercial vehicle administration subsystems and CVO Information Requesters.

- Fleet and Freight Management - Monitors and coordinates vehicle fleets including coordination with intermodal freight depots or shippers.

- Toll Administration - Provides general payment administration capabilities to support electronic assessment of tolls and other transportation usage fees.

- Transit Management - Collects operational data from transit vehicles and performs strategic and tactical planning for drivers and vehicles.

- Emergency Management - Coordinates response to incidents, including those involving hazardous materials (HAZMAT).

- Emissions Management - Collects and processes pollution data and provides demand management input to Traffic Management.

- Planning - Aids in optimal planning for ITS deployment. Collects and processes operational data from other Center subsystems, as well as the Parking Management Subsystem, and provides the results to Transportation Planners.

- Traffic Management - Processes traffic data and provides basic traffic and incident management services through the Roadside and other subsystems. The Traffic Management Subsystem may share traffic data with Information Service Providers. Different equipment packages provide a focus on surface streets or highways (freeways and interstates) or both. It also coordinates transit signal priority and emergency vehicle signal preemption.

- Information Service Provider - This subsystem may be deployed alone (to generally serve drivers and/or travelers) or be combined with Transit Management (to specifically benefit transit travelers), Traffic Management (to specifically benefit drivers and their passengers), Emergency Management (for emergency vehicle routing), Parking Management (for brokering parking reservations), and/or Commercial Vehicle Administration (for commercial vehicle routing) deployments. ISPs can collect and process transportation data from the aforementioned centers, and broadcast general information products (e.g., link times), or deliver personalized information products (e.g., personalized or optimized routing) in response to individual information requests. Because the ISP may know where certain vehicles are, it may use them as "probes" to help determine highway conditions, levels of congestion, and aid in the determination of travel or link times. This probe data may be shared with the Traffic Management Subsystem. The ISP is a key element of pre-trip travel information, infrastructure based route guidance, brokering demand-responsive transit and ridematching, and other traveler information services.

Roadside Subsystems

These subsystems include functions that require convenient access to a roadside location for the development of sensors, signals, programmable signs, or other interfaces with travelers and vehicles of all types. The four Roadside Subsystems are described below:

- Roadway – Provides traffic management surveillance, signals, and signage for traveler information. This subsystem also includes the devices at roadway intersections and multi-modal intersections to control traffic.

- Toll Collection – Interacts with vehicle toll tags to collect tolls and identify violators. Parking Management – Collects parking fees and manages parking lot occupancy/availability.

- Commercial Vehicle Check – Collects credential and safety data from vehicle tags, determines conformance to requirements, posts results to the driver (and in some safety exception cases, the carrier), and records the results for the Commercial Vehicle Administration Subsystem.

Vehicle Subsystems

These subsystems are installed in a vehicle. The four vehicle subsystems are described below:

- Vehicle – Functions that may be common across all vehicle types are located here (e.g., navigation, tolls, etc.) so that specific vehicle deployments may include aggregations of this subsystem with one of the other three specialized vehicle types. The Vehicle Subsystem includes the user services of Advanced Vehicle Control and Safety Systems user service bundle.

- Transit Vehicle – Provides operational data to the Transit Management Center, receives transit network status, provides enroute traveler information to travelers, and provides passenger and driver security functions.

- Commercial Vehicle – Stores safety data, identification numbers (driver, vehicle, and carrier) last check event data, and supports in-vehicle signage for driver pass/pull-in messages.

- Emergency Vehicle – Provides vehicle and incident status to the Emergency Management Subsystem.

Traveler Subsystems

These subsystems represent platforms for the ITS functions of interest to travelers or carriers (e.g., commercial vehicle operators) in support of multi-modal traveling. They may be fixed (e.g., kiosks or home/office computers) or portable (e.g., a palm-top computer), and may b., through kiosks) or be individuals (e.g., through cellular phones or personal computers). The Traveler Subsystems are described below:

- Remote Traveler Support – Provides traveler information at public kiosks. This subsystem includes traveler security functions.

- Personal Information Access – provides traveler information and supports emergency requests for travelers using personal computers/telecommunication equipment at the home, office, or while on travel.

4.3.4 Wichita Physical Architecture

This section provides the physical architecture for the market packages recommended for Wichita, based on phase of implementation. Physical Architecture for existing conditions is also provided. Figures 4-7 through 4-10 show physical architecture for existing conditions and short, medium, and long term implementation phase, respectively.

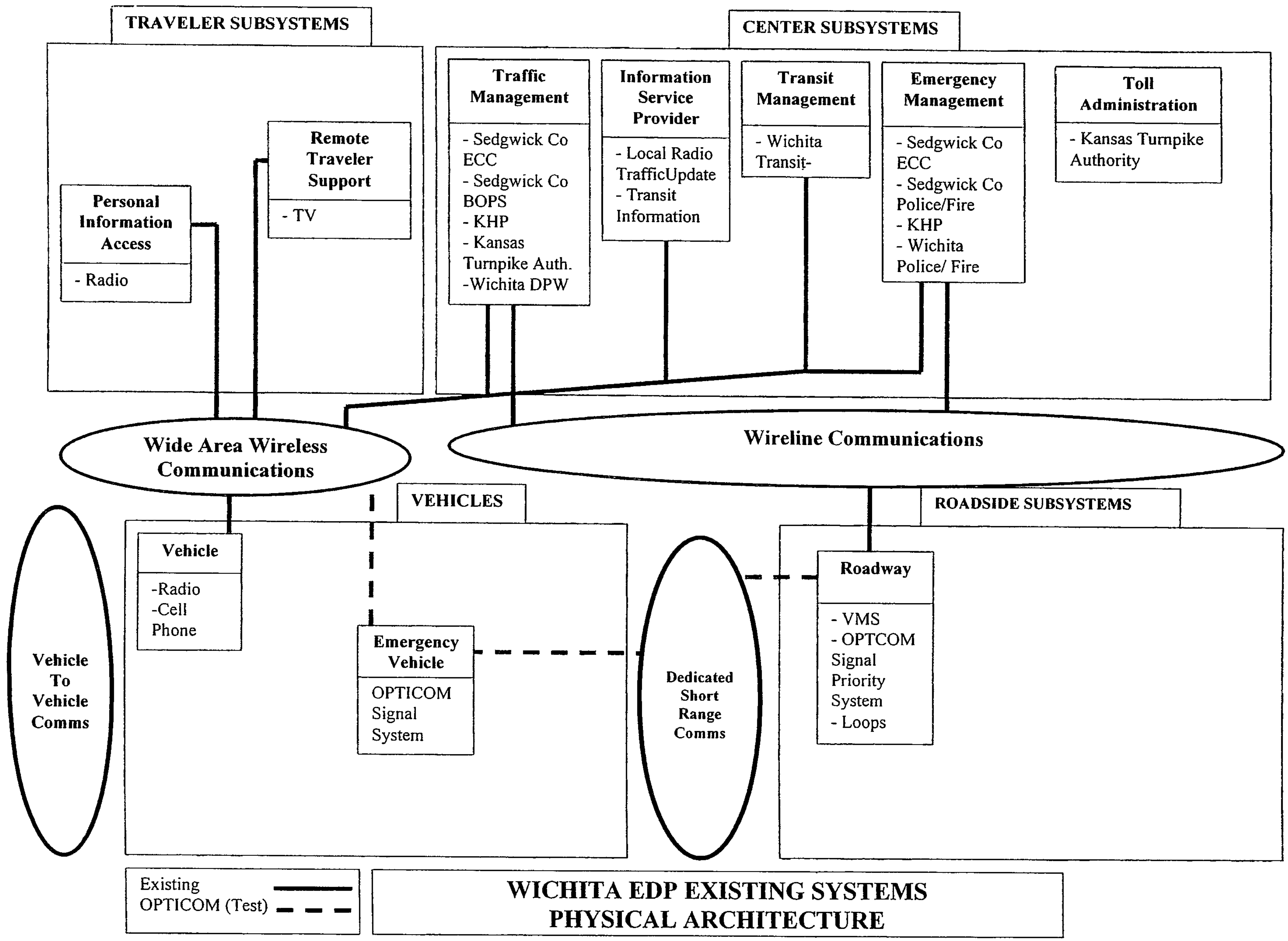


Figure 4-41 Wichita Physical Architecture – Existing Conditions

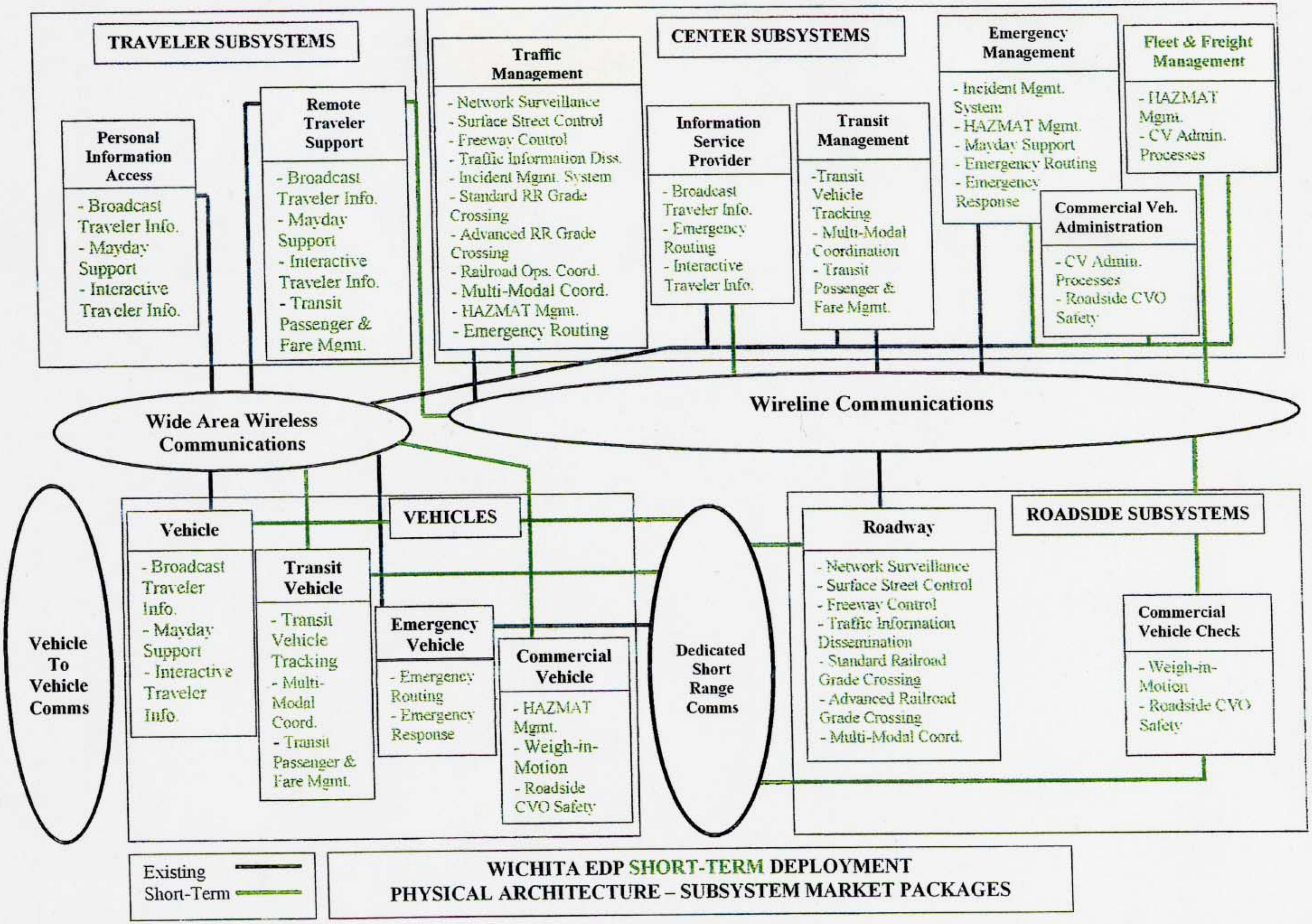


Figure 4-42 Wichita Physical Architecture – Short Term Market Packages

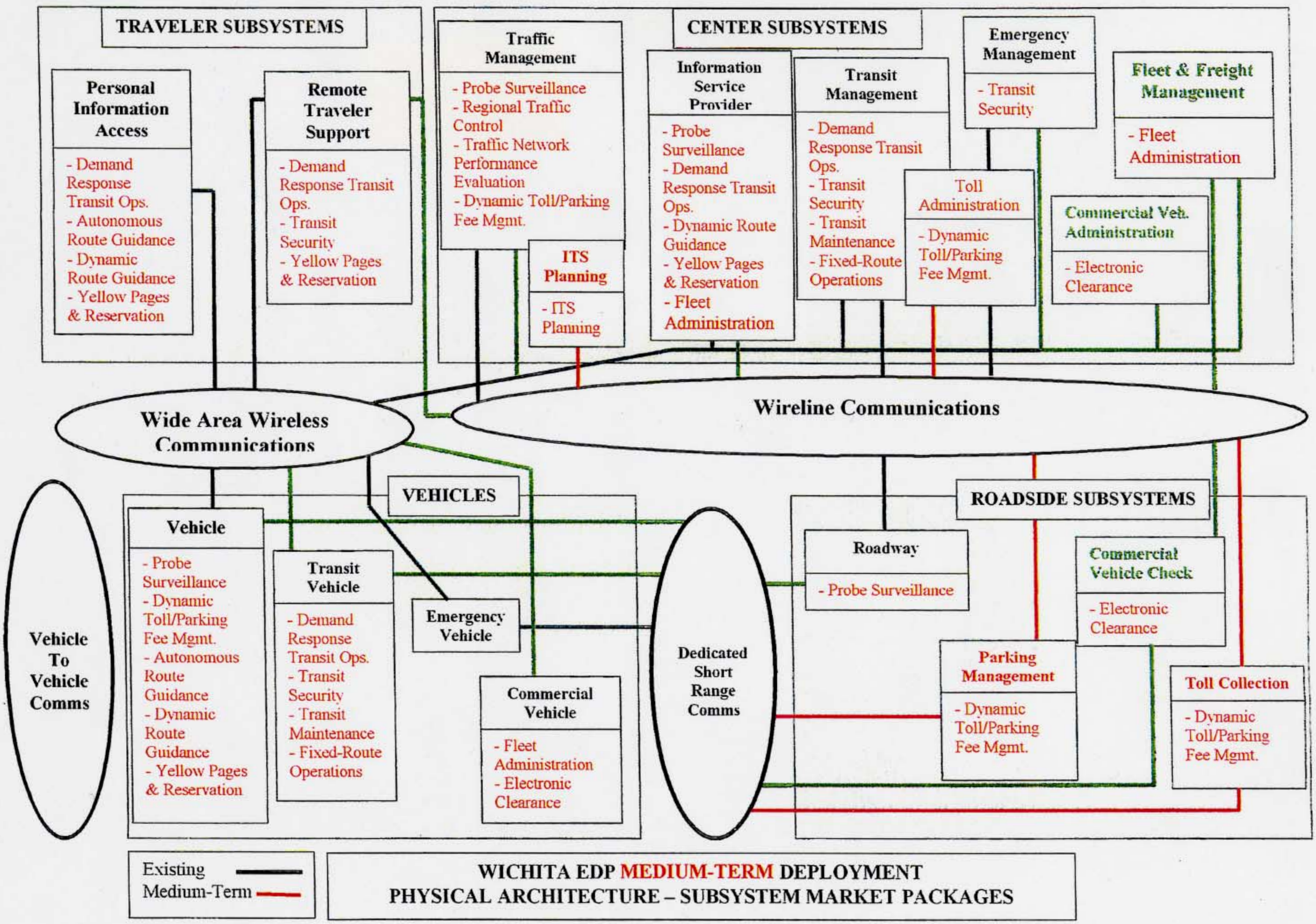


Figure 4-43 Wichita Physical Architecture – Medium Term Market Packages

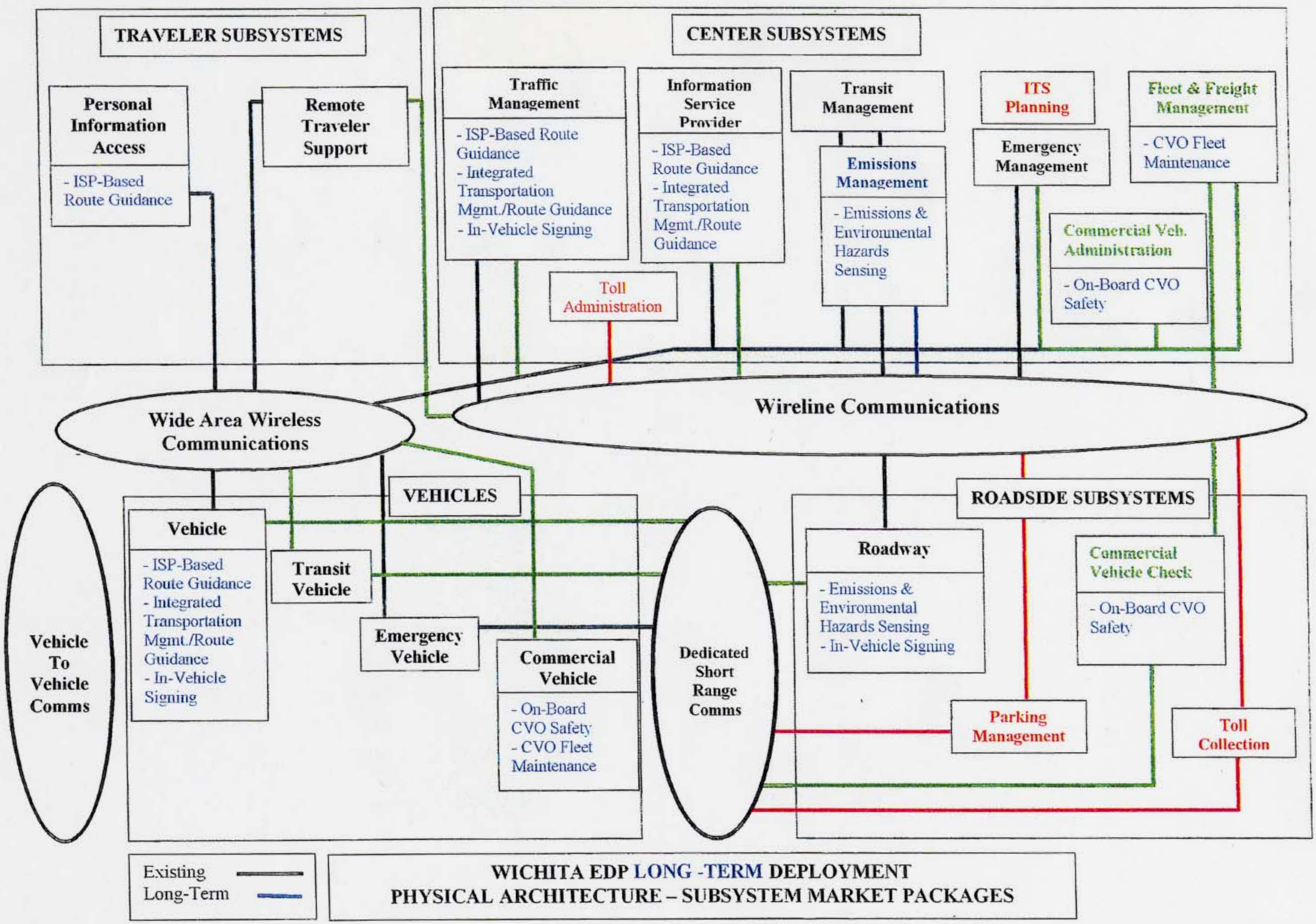


Figure 4-44 **Wichita Physical Architecture – Long Term Market Packages**

4.4 CENTER SUBSYSTEM CONFIGURATION ALTERNATIVES

4.4.1 Regional Center Subsystem Configuration

Following selection of the ITS services to be deployed in the Wichita region, the regional framework in which these services will be deployed must be defined. Center subsystem configuration is the key element in Wichita's future transportation system. Adoption of a regional center subsystem configuration hinges on continued coordination and consensus among involved stakeholders in the area. In many cases, the regional policy decisions, such as agreeing on the level of coordination or connectivity desired, will be more difficult than development of a technical framework that supports the desired systems integration over time. Both technical and non-technical implications of potential center subsystem configurations for the Wichita region are addressed in this section.

The National Architecture defines a series of peer-to-peer interfaces between center subsystems that support the sharing of both information and control. Based on the interface chosen, three basic architecture configurations may be derived from the National Architecture for implementation in the Wichita region:

- Centralized,
- Distributed, or
- Hybrid.

The remaining parts of this section present a brief description of each alternative architecture configuration along with the advantages and disadvantages of each alternative.

Centralized Subsystem Configuration

The centralized subsystem configuration centralizes the main subsystem functions proposed for the Wichita region: freeway management, signal system management, emergency management, and transit management at one location. Data management would be in the form of a centralized database repository that each subsystem (agency) could access. Likewise, directions affecting a number of agency functions would emanate from the center (e.g., City of Wichita signal control, KDOT VMS and Highway Patrol, and Sedgwick County EMS). Table 4-11 presents the projected staffing for a centralized traffic management center for the Wichita region

Table 4-11 Projected Centralized Subsystem Configuration Staffing Requirements

STAFFING FOR CENTRALIZED CENTER		
STAFF POSITION	NUMBER	ANNUAL $*
Secretary/Clerical - Provides administrative support at half-time level to center operations	0.5	$16,000
Signal System Operator - Monitors signal system activities, adjusts as necessary.	1	$46,800
Traffic Management Systems Operator - Monitors/operates traffic control systems Supports signal system operations	2	$93,600
Incident/Transit Management Systems Operator - Detects/ verifies incidents, implements incident management procedures. Provides dispatch/support to transit operations	2	$93,600
Assistant Manager - Provides day-to-day supervision of control room staff. Fills "empty seats" as needed	1	$53,800
TMC Manager - Supervises all center functions performs agency/public liaison	1	$66,560
TOTALS	**7.5**	**$370,000**

* Costs based on current regional salary rates and include 50% for fringe benefits

Advantages of Centralized Subsystem Configuration

A high level of systems integration, inherently provided by a centralized subsystem configuration, has the potential to increase the benefits of the ITS services selected for implementation in the Wichita region. There are a number of recent studies that look at the benefits of closely integrating different traffic management functions such as freeway control and arterial signal control (City of Irvine and Orange County in California), route guidance and signal control (FAST-TRAC in Detroit, Michigan), and different traffic signal systems (San Jose, California). Integration, especially of traffic, transportation, and transit operation centers, may result in the following benefits:

- <u>Improved data collection and utilization</u> - an integrated transportation management system could reduce costs of obtaining, processing, and disseminating data, because of reduced duplication of effort and increased sharing of information.

- <u>Improved system performance</u> - traffic congestion, energy consumption, and air pollution could be reduced as a result of synchronized operations, such as smoother traffic flow, faster incident response, and coordinated traffic diversion plans.

- <u>Increased reliability of the overall transportation system</u> - an integrated system facilitates the development of a set of coordinated plans and procedures to handle different incident situations.

- <u>Enhanced opportunities for cooperation</u> - productive, cooperative partnerships between public sectors, and between public and private sectors, could be promoted by having a common forum in which to discuss and resolve issues.

A centralized subsystem configuration could also provide benefits by coordinating modal information and operations. Intermodal services, by definition, require the coordination of various transportation modes. A closely integrated system could reap benefits in the following ways:

- Increased accessibility to all modes - utilization of underused transportation modes (e.g., transit) can be promoted by improving modal connectivity. This results in more attractive modal choices, increased travel flexibility, higher travel quality, and greater travel convenience.

- Reduction in travel cost - better utilization of transit reduces per passenger costs and

- reduces vehicle delay during congested periods by moving commuters out of cars and into transit vehicles, thus reducing the number of vehicles using the roads.

- Enhanced opportunities for cooperation - increased coordination is likely to enhance awareness of further opportunities for cooperation and to provide a structure for realizing these opportunities.

Disadvantages of the Centralized Subsystem Configuration

The system integration required for a centralized subsystem configuration includes a number of challenges, mainly involving policy and operations. These include:

- Space requirements/location – regional stakeholders would need to identify a location large enough to house the necessary hardware and the staff that would operate the center.

- Potential changes to existing communications infrastructure – some existing wireline communications would probably need to be changed to accommodate signal control and possibly other systems.

- Organizational issues - Adoption of a centralized subsystem configuration will require transportation stakeholders in the Wichita region to reach compromises regarding hardware, software, and management choices, all within financial constraints. In addition, new staff positions may need to be created within or relocated to the participating organizations for center staff.

- Operational changes – new operational procedures have to be developed for a centralized facility. Staff may require extensive training depending on the staffing and operational procedures selected. Operating procedures that call for staff to be able to man any of the center's subsystems (one person – many systems) would require more extensive training than procedures specifying that each staff person operate only one system (one person – one system).

- Current/Ongoing development - Wichita Transit has recently broken ground on a new maintenance and administration facility. Transferring transit management functions from this new facility to a centralized location would not be practical from a policy or cost perspective.

The most difficult challenge of transportation systems integration may be the diversity of involved stakeholders and the range of interdisciplinary activities that must be coordinated to develop, deploy, and operate a centralized operation. These activities can be initiated and pursued by a variety of public and private sector institutions and influenced by variety of stakeholders, special interest groups, and the general public, which is the ultimate customer of ITS services

Distributed Subsystem Configuration

The distributed subsystem configuration is essentially the opposite of the centralized configuration. The main subsystem functions would be performed at isolated locations, essentially the way these operations are currently performed in the region. Data management would be handled independently as the respective databases would not be interconnected. Agency functions would also be directed from separate locations. Table 4-12 presents projected staffing for a distributed subsystem configuration for the Wichita region, respectively. The duplication of effort inherent with this configuration is illustrated in this table.

Table 4-12 Projected Distributed Subsystem Configuration Staffing Requirements

STAFFING FOR DISTRIBUTED SUBSYSTEM CONFIGURATION		
STAFF POSITION*	**NUMBER**	**ANNUAL $**
SIGNAL SYSTEMS (City of Wichita DPW)		
Signal System Operator	1	$46,800
FREEWAY AND EMERGENCY MANAGEMENT (KDOT)		
Traffic Management Systems Operator	1	$46,800
Incident Management Systems Operator	1	$46,800
Secretary/Clerical	0 5	$16,000
Operations Manager	1	$53,800
TRAFFIC AND EMERGENCY MANAGEMENT (ECC)		
Traffic Management Systems Operator	1	$46,800
Incident Management Systems Operator	1	$46,800
Secretary/Clerical	0.5	$16,000
Operations Manager	1	$53,800
TRANSIT MANAGEMENT (WICHITA TRANSIT)		
Transit Dispatch	2	$84,800
TOTALS	**10**	**$458,000**

* See Table 4-1 for description of staff positions

** Costs based on current regional salary rates and include 50% for fringe benefits.

Advantages of Distributed Subsystem Configuration

The main advantage of the distributed subsystem configuration is that it involves less change than a centralized configuration. Stakeholder agency operations and infrastructure are in place and organized to support current operations. Other advantages associated with the distributed subsystem configuration include:

- Uses existing infrastructure for communication systems – a distributed subsystem configuration will use infrastructure elements that are already in place and functioning.

- Organizational structures already in place – as mentioned earlier in this section, the organizational structures within each agency are already in place to support a distributed subsystem configuration as this is essentially the configuration currently in place in the Wichita region.

- Current procedures and appropriate skills already in place – there would be little need to make changes to stakeholder agency organizations as their structure is designed to support the current, distributed system. In addition, agencies already have staff with appropriate skills and capabilities necessary to operate the current system, eliminating the need for training or creation of new staff positions.

- No requirement for new or larger space – adopting a distributed subsystem configuration would eliminate the need to locate and acquire a new, larger building that would probably be required for a centralized.

Disadvantages of Distributed Subsystem Configuration

The main disadvantage associated with a distributed subsystem configuration is the failure to take advantage of the potential benefits offered by a centralized configuration, as enumerated in the *Advantages of Centralized Subsystem Configuration* section. Disadvantages of a distributed configuration for the Wichita region include:

- Less efficient use of resources – each agency in a distributed transportation management configuration obtains, processes, and disseminates data independently, typically resulting in duplication of effort and less efficient sharing of information. In addition, it is more difficult for agencies operating from separate locations to quickly prioritize multiple traffic or incident management needs and allocate resources accordingly.

- Slower response time to traffic incidents – distributed data and control functions slow decision making process as agencies are forced to collect data from other agencies in order to assemble what they believe to be a complete and accurate picture of a traffic incident and then initiate a coordinated, multi-agency response.

- Less opportunity for inter-agency cooperation – a centralized system facilitates opportunities for cooperation by providing a structure for developing common goals. In a distributed configuration, agency staff do not have the opportunity to interact on a daily basis and thus gain a greater understanding of the other agencies' operational requirements, procedures, and organizational culture.

- <u>Need for communications between subsystems</u> – the distributed subsystem configuration requires communications between each of the various stakeholder agencies in the region. Multiple hardline/video data links will be required for a distributed subsystem configuration. Maintaining compatibility between multiple agency communication systems is also a major challenge.

- <u>Fragmented media response</u> – in a distributed subsystem configuration each agency or subsystem must provide information to the media, sometimes without the benefit of current or more up-to-date information from other agencies. This can lead to misleading, incomplete, or erroneous reporting by the media, which is typically trying to get information to the general public as quickly as possible.

Hybrid Subsystem Configuration

A hybrid subsystem configuration can consist of any number of combinations of the centralized and distributed subsystem configurations. The hybrid subsystem alternative for Wichita is most closely aligned to the centralized subsystem. The main difference between hybrid subsystem configuration and the centralized configuration is that transit management functions would not be integrated with the other management functions at a centralized location in the hybrid configuration. Table 4-13 presents the projected staffing for a hybrid traffic management center for the Wichita region.

Advantages of the Hybrid Subsystem Configuration

The hybrid subsystem has essentially the same advantages as the centralized subsystem configuration except that transit management functions would not be co-located with other management functions and thus benefits gained through coordination of modal information and traffic operations would be lost. However, the effect of not having transit functions performed at a centralized facility may be mitigated somewhat by the recent start of a new transit facility. Construction of the transit facility at this stage in the region's transportation planning process has created a much higher level of awareness at Wichita Transit on the need for system connectivity. This increased awareness should translate into future system connectivity and operational integration receiving a high priority during the design and procurement process of the new building and associated support systems. Refer to the *Advantages of Centralized Subsystem Configuration* section for a list of the potential benefits of a hybrid subsystem configuration.

Disadvantages of the Hybrid Subsystem Configuration

The hybrid subsystem configuration shares essentially the same list of disadvantages associated with the centralized subsystem configuration. The main difference between the two is any organizational or operational changes specifically associated with inclusion of transit management functions at a centralized facility would be eliminated. The main disadvantages of the hybrid subsystem configuration are listed in the Disadvantages of the Hybrid Subsystem Configuration section . In addition, other disadvantages might include:

- <u>Maintaining connectivity</u> – maintaining communication system compatibility between the traffic management center and the transit management center will need to be considered when selecting communication systems and will result in additional expense.

- Response efficiency – traffic management activities may lose some efficiency for incidents involving transit compared to those directed from a centralized center. Nevertheless, the synergy gained through the co-location of the other main traffic management functions would still yield a more efficient response than that possible in a distributed configuration.

Table 4-13 Projected Hybrid Subsystem Configuration Staffing Requirements

STAFFING FOR HYBRID CENTER		
STAFF POSITION	**NUMBER**	**ANNUAL $***
Secretary/Clerical - Provides administrative support at half-time level to center operations	0.5	$16,000
Signal System Operator - Monitors signal system activities, adjusts as necessary	1	$46,800
Traffic Management Systems Operator - Monitors/operates traffic control systems. Also supports signal system operations.	2	$93,600
Incident Management Systems Operator - Detects/ verifies incidents, implements incident management procedures.	1	$46,800
Assistant Manager - Provides day-to-day supervision of control room staff Fills "empty seats" as needed.	1	$53,800
TMC Manager - Supervises all center functions performs agency/public liaison	1	$66,560
HYBRID CENTER TOTAL	6 5	$324,000
Transit Dispatchers (at Wichita Transit)	2	$84,800
REGIONAL TOTALS	**8.5**	**$409,000**

4.5 RECOMMENDED SUBSYSTEM CONFIGURATION FOR WICHITA REGION

The advantages and disadvantages of various subsystem configurations were discussed at the project's steering committee meeting. Based on the results of these discussions as well as the policy and cost issues outlined in this report, a hybrid subsystem configuration is recommended as the center subsystem alternative for future transportation management functions in the Wichita region.

The centralized subsystem configuration offers the optimum means of utilizing the transportation systems recommended for the Wichita region. As indicated in the previous discussion, the advantages of a centralized subsystem configuration far outweigh those offered by a distributed subsystem configuration. However, given Wichita Transit's recent ground breaking on a new maintenance and administration center, inclusion of transit management functions at another facility in the near future would not serve the Wichita region's best interests from a policy or financial perspective. As noted above, the hybrid subsystem configuration offers almost all the benefits provided by a centralized subsystem configuration and requires the fewest number of operators.