# KAJIAN PELAN INDUK SISTEM PENGANGKUTAN PINTAR

## Development of ITS System Architecture for Malaysia

## Technical Note No. 3

October 2006

## Subsystems and Terminators

# Table Of Contents

# Section 1

# INTRODUCTION

## 1.1 Background

Based on the findings of the ITS Master Plan Study for Malaysia, a total of nine ITS sectors has been identified together with thirty-six user-services. As the requirements for these user-services have been defined, the logical architecture would be derived from them. Information provided under the logical architecture – data flows, data stores, process specifications, and terminators – are the actual components used in structure analysis in CASE (Computer Aided System Engineering) tools, when software system is designed. Therefore, developing the logical architecture is similar to performing software high-level design.

Logical architecture leads to physical architecture where architecture flow indicates one or more data flows. The various processes identified in the logical architecture are therefore assigned to each subsystem in the physical architecture. In addition, a customised diagram showing the relevant subsystems and communication channels can be generated to illustrate system overview.

With the definition of the physical architecture, one can then proceed with two subsequent activities – defining deployment packages and selecting ITS standards. Deployment packages allow the ITS system architecture developer to acquire the package from the market place while ITS standards ensures inter-operability of future systems.

This technical note gives the definitions and functions of the proposed lists of subsystems and terminators to be adopted in the construction of the proposed Malaysian ITS System Architecture. In Appendix A of this technical note, the architecture flows together with their descriptions have been listed for easy references.

## 1.2 Physical Architecture

The physical architecture identifies the physical subsystems and architecture flows between subsystems that will implement the processes and support the data flows of the ITS logical architecture. The physical architecture further identifies the system terminator input (sources) and system terminator outputs (destinations) for architecture flows into and out of the system.

The principal elements in the physical architecture are the subsystems and architecture flows that connect these subsystems and terminators into an overall structure. A physical architecture takes the processes identified in the logical architecture and assigns them to subsystems. In addition, the data flows (also from the logical architecture) are grouped together into architecture flows. These architecture flows and their communication requirements define the interfaces required between subsystems, which form the basis for much of the ongoing standards work in the ITS program.

## 1.3 Subsystems

Subsystems are the primary structural components of the physical architecture. There will be twenty-three subsystems in the proposed Malaysian ITS System Architecture, which are grouped into four general subsystem classes: Centres, Roadside, Vehicles, and Travellers.

## 1.4 Terminators

Terminators define the boundary of the proposed Malaysian ITS System Architecture. The terminators represent the humans, systems, and general environment that interface to ITS. The interfaces between terminators and the subsystems and processes within the proposed Malaysian ITS System Architecture are defined, but no functional requirements are allocated to terminators.

Both the logical and physical architectures will have exactly the same set of terminators. The only difference is that logical architecture processes communicate with terminators using data flows, while physical architecture subsystems use architecture flows.

## 1.5 Architecture Flows

In the physical architecture, architecture flows exchange information between subsystems, and between subsystems and terminators. Architecture flows indicate the type of information that is expected to be exchanged. Each of these architecture flows contains one or more data flows from the logical architecture. These architecture flows and their communication requirements define the interfaces, which form the basis for much of the ongoing standards work in the ITS program.

## 1.6 Data Flows

Data flows are the transfer of information between processes, or between a process and a terminator in the logical architecture. Data flows are aggregated together to form higher level architecture flows in the physical architecture.

# Section 2

# SUBSYSTEMS

## 2.1 Centres

This will be the first of the four general subsystem classes defined in the proposed ITS System Architecture. It provides management, administrative, and support functions for the transportation system. The centre subsystems communicate with one another and with other centres to enable coordination between modes and across jurisdictions.

The following subsystems are classified within this general subsystem class:

- Archived Data Management Subsystem
- Commercial Vehicle Administration Subsystem
- Emergency Management Subsystem
- Environment Management Subsystem
- Fleet and Freight Management Subsystem
- Information Service Provider Subsystem
- Maintenance Management Subsystem
- Public Transport Management Subsystem
- Toll Administration Subsystem
- Traffic Management Subsystem

### 2.1.1 Archived Data Management Subsystem

The Archived Data Management Subsystem collects, archives, manages, and distributes data generated from ITS sources for use in transportation administration, policy evaluation, safety, planning, performance monitoring, program assessment, operations, and research applications. The data received is formatted, tagged with attributes that define the data source, conditions under which it was collected, data transformations, and other information (i.e. meta data) necessary to interpret the data.

The subsystem can fuse ITS generated data with data from non-ITS sources and other archives to generate information products utilising data from multiple functional areas, modes, and jurisdictions. The subsystem prepares data products that can serve as inputs to federal, state, district and municipality data reporting systems. This subsystem may be implemented in many different ways. It may reside within an operational centre and provide focused access to a particular agency's data archives. Alternatively, it may operate as a distinct centre that collects data from multiple agencies and sources and provides a general data warehouse service for a particular corridor.

**Related Communications and Associated Architecture Flows are as follows:**

Archived Data Administrator ==> Archived Data Management Subsystem
- archive management requests

Archived Data Management Subsystem ==> Archived Data Administrator
- archive management data

Archived Data Management Subsystem ==> Archived Data User Systems
- archive analysis results
- archive request confirmation
- archived data products

Archived Data Management Subsystem ==> Commercial Vehicle Administration Subsystem
- archive requests
- archive status

Archived Data Management Subsystem ==> Emergency Management Subsystem
- archive requests
- archive status

Archived Data Management Subsystem ==> Environment Management Subsystem
- archive requests
- archive status

Archived Data Management Subsystem ==> Financial Institution

- payment request

Archived Data Management Subsystem ==> Government Reporting Systems

- government reporting system data

Archived Data Management Subsystem ==> Information Service Provider Subsystem

- archive requests
- archive status

Archived Data Management Subsystem ==> Intermodal Terminal Subsystem

- archive requests
- archive status

Archived Data Management Subsystem ==> Maintenance Management Subsystem

- archive requests
- archive status

Archived Data Management Subsystem ==> Malaysian Meteorological Services

- archive requests
- archive status

Archived Data Management Subsystem ==> Mapping Service Provider

- map update request

Archived Data Management Subsystem ==> Multimodal Transportation Service Provider

- archive requests
- archive status

Archived Data Management Subsystem ==> Other Archives

- archive coordination

Archived Data Management Subsystem ==> Other Data Sources

- archive requests
- archive status

Archived Data Management Subsystem ==> Parking Management Subsystem

- archive requests
- archive status

Archived Data Management Subsystem ==> Public Transport Management Subsystem

- archive requests
- archive status

Archived Data Management Subsystem ==> Roadway Subsystem

- sensor and surveillance control

Archived Data Management Subsystem ==> Toll Administration Subsystem

- archive requests
- archive status

Archived Data Management Subsystem ==> Traffic Management Subsystem

- archive requests
- archive status

Archived Data User Systems ==> Archived Data Management Subsystem

- archive analysis requests
- archived data product requests

Commercial Vehicle Administration Subsystem ==> Archived Data Management Subsystem

- commercial vehicle archive data

Emergency Management Subsystem ==> Archived Data Management Subsystem

- emergency archive data

Environment Management Subsystem ==> Archived Data Management Subsystem

- emissions archive data
- other environmental archive data

Financial Institution ==> Archived Data Management Subsystem

- transaction status

Government Reporting Systems ==> Archived Data Management Subsystem

- government reporting data receipt

Information Service Provider Subsystem ==> Archived Data Management Subsystem

- traveller archive data

Intermodal Terminal Subsystem ==> Archived Data Management Subsystem

- intermodal freight archive data

Maintenance Management Subsystem ==> Archived Data Management Subsystem

- construction and maintenance archive data
- maintenance archive data

Malaysian Meteorological Services ==> Archived Data Management Subsystem

- volume weather information

Mapping Service Provider ==> Archived Data Management Subsystem

- map updates

Multimodal Transportation Service Provider ==> Archived Data Management Subsystem

- multimodal archive data

Other Archives ==> Archived Data Management Subsystem

- archive coordination

Other Data Sources ==> Archived Data Management Subsystem

- other data source archive data

Parking Management Subsystem ==> Archived Data Management Subsystem

- parking archive data

Public Transport Management Subsystem ==> Archived Data Management Subsystem

- public transport archive data

Roadway Subsystem ==> Archived Data Management Subsystem

- roadside archive data

Toll Administration Subsystem ==> Archived Data Management Subsystem

- toll archive data

Traffic Management Subsystem ==> Archived Data Management Subsystem

- traffic archive data

### 2.1.2 Commercial Vehicle Administration Subsystem

This subsystem will operate at one or more fixed locations along a particular corridor. It performs administrative functions supporting credentials, taxes and fees, and safety regulations for the movement of commercial vehicles and their cargo across the country and through international crossings. It issues credentials, collects fees and taxes, and supports enforcement of credential requirements. It also receives applications for, and issues special Oversize/Overweight and HAZMAT permits in co-ordination with other cognizant agencies.

This subsystem communicates with the Fleet and Freight Management Subsystem associated with the motor carriers to process credentials applications and collect state royalties, customs and excise taxes, and other taxes and fees associated with commercial vehicle operations.

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 hazardously.

**Related Communications and Associated Architecture Flows are as follows:**

Archived Data Management Subsystem ==> Commercial Vehicle Administration Subsystem

- archive requests
- archive status

Commercial Vehicle Administration Subsystem ==> Archived Data Management Subsystem

- commercial vehicle archive data

Commercial Vehicle Administration Subsystem ==> Commercial Vehicle Check Subsystem

- credentials information
- CVO database update
- international border crossing data
- safety information

Commercial Vehicle Administration Subsystem ==> CVO Information Requestor

- credentials and safety information response

Commercial Vehicle Administration Subsystem ==> Enforcement Agency

- request for information on violators
- violation notification

Commercial Vehicle Administration Subsystem ==> Financial Institution

- payment request

Commercial Vehicle Administration Subsystem ==> Fleet and Freight Management Subsystem

- activity reports
- compliance review report
- electronic credentials

Commercial Vehicle Administration Subsystem ==> Government Administrators

- tax-credentials-fees request

Commercial Vehicle Administration Subsystem ==> Road Transport Department

- licence request

Commercial Vehicle Check Subsystem ==> Commercial Vehicle Administration Subsystem

- citation data
- credentials information request
- international border crossing data update

- roadside log update
- safety information request

CVO Information Requestor ==> Commercial Vehicle Administration Subsystem

- credentials and safety information request

Enforcement Agency ==> Commercial Vehicle Administration Subsystem

- information on violators

Financial Institution ==> Commercial Vehicle Administration Subsystem

- transaction status

Fleet and Freight Management Subsystem ==> Commercial Vehicle Administration Subsystem

- credential application
- information request
- tax filing, audit data

Government Administrators ==> Commercial Vehicle Administration Subsystem

- regulations

Road Transport Department ==> Commercial Vehicle Administration Subsystem

- registration

### 2.1.3 Emergency Management Subsystem

This subsystem operates in various emergency centres supporting public safety, emergency response and rescue operations, including Fire and Rescue Department, municipalities, highway concessionaires, Royal Malaysian Police, Special Malaysian Disaster Assistance and Rescue Team (SMART), and HAZMAT response teams. SMART is a special team under the Crisis and Disaster Management Unit of the National Security Division under the Prime Minister's Department.

This subsystem interfaces with other Emergency Management Subsystems to support co-ordinated emergency response involving

multiple agencies. This subsystem creates, stores, and utilises emergency response plans to facilitate co-ordinated response. It supports disaster response through an interface with the Disaster Command Agency Terminator to co-ordinate disaster response activities and status. 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 Centre Subsystems is used to further aids 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 co-ordination in tailoring traffic control to support en-route emergency vehicles. Interface with the Public Transport Management Subsystem allows co-ordinated use of public transport vehicles to facilitate response to major emergencies.

**Related Communications and Associated Architecture Flows are as follows:**

Archived Data Management Subsystem ==> Emergency Management Subsystem

- archive requests
- archive status

Disaster Command Agency ==> Emergency Management Subsystem

- disaster response coordination
- disaster response status
- shelter availability
- shelter location

Emergency Management Subsystem ==> Archived Data Management Subsystem

- emergency archive data

Emergency Management Subsystem ==> Disaster Command Agency

- disaster response coordination
- incident information for disaster

Emergency Management Subsystem ==> Emergency System Operator

- emergency operations status

Emergency Management Subsystem ==> Emergency Telecommunications System

- incident notification response

Emergency Management Subsystem ==> Emergency Vehicle Subsystem

- emergency dispatch requests
- incident command information
- suggested route

Emergency Management Subsystem ==> Event Organisers

- event confirmation

Emergency Management Subsystem ==> Fleet and Freight Management Subsystem

- HAZMAT information request

Emergency Management Subsystem ==> Information Service Provider Subsystem

- incident information

Emergency Management Subsystem ==> Mapping Service Provider

- map update request

Emergency Management Subsystem ==> Media

- incident information for media

Emergency Management Subsystem ==> Medical Facility

- medical facility request

Emergency Management Subsystem ==> Other Emergency Management

- incident report
- incident response coordination

Emergency Management Subsystem ==> Personal Information Access Subsystem

- emergency acknowledge

Emergency Management Subsystem ==> Public Transport Management Subsystem

- public transport emergency coordination data

Emergency Management Subsystem ==> Remote Traveller Support Subsystem

- emergency acknowledge

Emergency Management Subsystem ==> Traffic Management Subsystem

- emergency traffic control request
- incident information
- incident response status
- remote surveillance control
- resource request

Emergency Management Subsystem ==> Vehicle Subsystem

- emergency acknowledge
- emergency data request

Emergency System Operator ==> Emergency Management Subsystem

- emergency operations request

Emergency Telecommunications System ==> Emergency Management Subsystem

- incident notification

Emergency Vehicle Subsystem ==> Emergency Management Subsystem

- emergency dispatch response
- emergency vehicle tracking data
- incident command request
- incident status

Event Organisers ==> Emergency Management Subsystem

- event plans

Fleet and Freight Management Subsystem ==> Emergency Management Subsystem

- HAZMAT information

Information Service Provider Subsystem ==> Emergency Management Subsystem

- incident information request

Maintenance Management Subsystem ==> Emergency Management Subsystem

- incident information

Malaysian Meteorological Services ==> Emergency Management Subsystem

- volume weather information

Mapping Service Provider ==> Emergency Management Subsystem

- map updates

Media ==> Emergency Management Subsystem

- media information request

Medical Facility ==> Emergency Management Subsystem

- medical facility availability

Meteorological Service Provider ==> Emergency Management Subsystem

- road weather prediction

Other Emergency Management ==> Emergency Management Subsystem

- incident report
- incident response coordination

Personal Information Access Subsystem ==> Emergency Management Subsystem

- emergency notification

Public Transport Management Subsystem ==> Emergency Management Subsystem

- public transport emergency data

Remote Traveller Support Subsystem ==> Emergency Management Subsystem

- emergency notification

Traffic Management Subsystem ==> Emergency Management Subsystem

- current network conditions
- emergency traffic control response
- incident information
- incident information request

- resource deployment status

Vehicle Subsystem ==> Emergency Management Subsystem

- emergency notification

### 2.1.4 Environment 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 ITS corridor preferences and priorities.

This subsystem provides the capabilities for environmental quality managers to monitor and manage air quality and other environmental data. 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 public transport 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.

This subsystem also provides the capabilities to monitor, collect and process other environmental data, such as wind velocity and visibility to

determine the safe travelling speeds under different environmental conditions.

**Related Communications and Associated Architecture Flows are as follows:**

Archived Data Management Subsystem ==> Environment Management Subsystem

- archive requests
- archive status

Environment Management Subsystem ==> Archived Data Management Subsystem

- environmental archive data

Environment Management Subsystem ==> Information Service Provider Subsystem

- environmental information

Environment Management Subsystem ==> Mapping Service Provider

- map update request

Environment Management Subsystem ==> Media

- environmental information

Environment Management Subsystem ==> Roadway Subsystem

- vehicle pollution criteria
- environmental state criteria

Environment Management Subsystem ==> Traffic Management Subsystem

- wide-area statistical environmental information

Environment Management Subsystem ==> Traffic Operations Personnel

- environmental data display

Environment ==> Environment Management Subsystem

- environmental levels

Mapping Service Provider ==> Environment Management Subsystem

- map updates

Roadway Subsystem ==> Environment Management Subsystem

- environmental data

Traffic Management Subsystem ==> Environment Management Subsystem

- environmental state data request

Traffic Operations Personnel ==> Environment Management Subsystem

- environmental state data parameters

### 2.1.5 Fleet and Freight Management Subsystem

This subsystem provides the capability for commercial vehicle 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. It supports regulatory functions and the capability to manage intermodal shipment of cargo. This includes the capability to dispatch and track intermodal containers. This subsystem also supports an interface with the Intermodal Terminal Subsystem for container pickup, delivery, and status. In addition, it can interface with Logistics Solutions Provider to provide management and tracking services on intermodal containers. Other intermodal capabilities include interfacing with the Freight Consolidation Station and with other Intermodal Fleet and Freight Management Subsystems for co-ordination of shipping between modes.

It shall be provided the capability to purchase credentials electronically, with automated and efficient connections to financial institutions and regulatory agencies, along with post-trip automated mileage and fuel usage reporting. It also provides the capability for commercial vehicle 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.

**Related Communications and Associated Architecture Flows are as follows:**

Commercial Vehicle Administration Subsystem ==> Fleet and Freight Management Subsystem

- activity reports
- compliance review report
- electronic credentials

Commercial Vehicle Manager ==> Fleet and Freight Management Subsystem

- fleet manager inquiry

Commercial Vehicle Subsystem ==> Fleet and Freight Management Subsystem

- driver and vehicle information
- intermodal status
- on-board vehicle data
- vehicle location

Emergency Management Subsystem ==> Fleet and Freight Management Subsystem

- HAZMAT information request

Fleet and Freight Management Subsystem ==> Commercial Vehicle Administration Subsystem

- credential application
- information request
- tax filing, audit data

Fleet and Freight Management Subsystem ==> Commercial Vehicle Manager

- fleet status

Fleet and Freight Management Subsystem ==> Commercial Vehicle Subsystem

- container transport assignment
- fleet to driver update
- intermodal status request
- location request

Fleet and Freight Management Subsystem ==> Emergency Management Subsystem

- HAZMAT information

Fleet and Freight Management Subsystem ==> Freight Consolidation Station

- container delivery request
- container pickup confirmation

Fleet and Freight Management Subsystem ==> Information Service Provider Subsystem

- route request

Fleet and Freight Management Subsystem ==> Intermodal Customer

- consignment contract
- shipment status

Fleet and Freight Management Subsystem ==> Intermodal Terminal Subsystem

- container delivery request
- container pickup confirmation
- intermodal CVO co-ordination

Fleet and Freight Management Subsystem ==> Logistics Solutions Provider

- container delivery confirmation
- container location
- container pickup confirmation
- container status

Fleet and Freight Management Subsystem ==> Other Intermodal Fleet Management System

- intermodal CVO co-ordination

Fleet and Freight Management Subsystem ==> Payment Instrument

- request for payment

Freight Consolidation Station ==> Fleet and Freight Management Subsystem

- container delivery confirmation
- container pickup request

Information Service Provider Subsystem ==> Fleet and Freight Management Subsystem

- route plan

Intermodal Customer ==> Fleet and Freight Management Subsystem

- container delivery confirmation
- freight consignment request
- shipment status request

Intermodal Terminal Subsystem ==> Fleet and Freight Management Subsystem

- container delivery confirmation
- container pickup request
- intermodal CVO co-ordination

Logistics Solutions Provider ==> Fleet and Freight Management Subsystem

- container location request
- container pickup request
- container status request

Other Intermodal Fleet Management System ==> Fleet and Freight Management Subsystem

- intermodal CVO co-ordination

Payment Instrument ==> Fleet and Freight Management Subsystem

- payment

### 2.1.6 Information Service Provider Subsystem

Information Service Provider (ISP) subsystem collects, processes, stores, and disseminates transportation information to system operators and the travelling public. The subsystem can play several different roles in an integrated ITS.

In one role, the ISP provides a general data warehousing function, collecting information from transportation system operators and redistributing this information to other system operators and other ISPs. In this information redistribution role, the ISP provides a bridge between the various transportation systems that produce the information and the other ISPs and their subscribers that use the information.

The second role of an ISP is focused on delivery of traveller information to subscribers and the public at large. Information provided includes basic advisories, real-time traffic condition and public transport schedule information, yellow pages information, ride-matching information, parking information, and weather information.

The subsystem also provides the capability to provide specific directions to travellers by receiving origin and destination requests from travellers, generating route plans, and returning the calculated plans to the users. In addition to general route planning for travellers, the ISP also supports specialised route planning for vehicle fleets. In this third role, the ISP function may be dedicated to, or even embedded within, the dispatch system. Reservation services are also provided in advanced implementations. The information is provided to the traveller through the Personal Information Access Subsystem, Remote Traveller Support Subsystem, and various Vehicle Subsystems through available communications links. Both basic one-way (broadcast) and personalised 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.

**Related Communications and Associated Architecture Flows are as follows:**

Archived Data Management Subsystem ==> Information Service Provider Subsystem

- archive requests
- archive status

Disaster Command Agency ==> Information Service Provider Subsystem

- disaster advisories
- shelter availability

- shelter location

Emergency Management Subsystem ==> Information Service Provider Subsystem

- incident information

Environment Management Subsystem ==> Information Service Provider Subsystem

- environmental information

Financial Institution ==> Information Service Provider Subsystem

- transaction status

Fleet and Freight Management Subsystem ==> Information Service Provider Subsystem

- route request

Information Service Provider Operator ==> Information Service Provider Subsystem

- ISP operating parameter updates

Information Service Provider Subsystem ==> Archived Data Management Subsystem

- traveller archive data

Information Service Provider Subsystem ==> Emergency Management Subsystem

- incident information request

Information Service Provider Subsystem ==> Financial Institution

- payment request

Information Service Provider Subsystem ==> Fleet and Freight Management Subsystem

- route plan

Information Service Provider Subsystem ==> Information Service Provider Operator

- ISP operating parameters

Information Service Provider Subsystem ==> Mapping Service Provider

- map update request

Information Service Provider Subsystem ==> Media

- traveller information for media

Information Service Provider Subsystem ==> Multimodal Transportation Service Provider

- multimodal information request
- service request

Information Service Provider Subsystem ==> Other Information Service Provider

- ISP coordination

Information Service Provider Subsystem ==> Parking Management Subsystem

- parking lot data request
- parking reservations request

Information Service Provider Subsystem ==> Personal Information Access Subsystem

- broadcast information
- traveller information
- trip plan
- yellow pages information

Information Service Provider Subsystem ==> Public Transport Management Subsystem

- demand responsive public transport request
- public transport information request
- public transport trip request
- selected routes

Information Service Provider Subsystem ==> Remote Traveller Support Subsystem

- broadcast information
- traveller information
- trip plan
- yellow pages information

Information Service Provider Subsystem ==> Toll Administration Subsystem

- toll data request

Information Service Provider Subsystem ==> Traffic Management Subsystem

- fare and price information
- logged special vehicle route
- request for traffic information
- road network use

Information Service Provider Subsystem ==> Vehicle Subsystem

- broadcast information
- traveller information
- trip plan
- yellow pages information

Information Service Provider Subsystem ==> Yellow Pages Service Providers

- provider profile confirmation
- travel service request

Maintenance Management Subsystem ==> Information Service Provider Subsystem

- roadway maintenance information

Malaysian Meteorological Services ==> Information Service Provider Subsystem

- volume weather information

Mapping Service Provider ==> Information Service Provider Subsystem

- map updates

Media ==> Information Service Provider Subsystem

- external reports
- media information request

Meteorological Service Provider ==> Information Service Provider Subsystem

- road weather prediction

Multimodal Transportation Service Provider ==> Information Service Provider Subsystem

- multimodal information

- service response

Other Information Service Provider ==> Information Service Provider Subsystem

- ISP coordination

Parking Management Subsystem ==> Information Service Provider Subsystem

- parking information
- parking lot reservation confirmation

Personal Information Access Subsystem ==> Information Service Provider Subsystem

- traveller profile
- traveller request
- trip confirmation
- trip request
- yellow pages request

Public Transport Management Subsystem ==> Information Service Provider Subsystem

- demand responsive public transport plan
- public transport and fare schedules
- public transport incident information
- public transport request confirmation
- public transport trip plan

Remote Traveller Support Subsystem ==> Information Service Provider Subsystem

- traveller request
- trip confirmation
- trip request
- yellow pages request

Toll Administration Subsystem ==> Information Service Provider Subsystem

- probe data
- toll data

Traffic Management Subsystem ==> Information Service Provider Subsystem

- request fare and price information
- traffic information

Vehicle Subsystem ==> Information Service Provider Subsystem

- traveller profile
- traveller request
- trip confirmation
- trip request
- vehicle probe data
- yellow pages request

Yellow Pages Service Providers ==> Information Service Provider Subsystem

- provider profile data
- travel service information

### 2.1.7 Maintenance Management Subsystem

This subsystem performs several functions relating to Operations and Maintenance of the roadway infrastructure. The first of these is management of fleets of maintenance, construction, or special service vehicles. These types of vehicles include power brooms and watering trucks. The subsystem receives vehicle location, vehicle status, and the output of sensors (such as environmental or road surface sensors) from maintenance vehicles. The subsystem performs vehicle dispatch, routing, and asset management.

The second main function of the subsystem is work zone management. This includes systems that gather, store, and disseminate information relating to work zones. As part of this it can participate in incident management by initiating incident notification, or by participating in incident response. It can manage traffic in the vicinity of the work zone and advise drivers of work zone status, either directly at the roadside or through an interface with the Information Service Provider (ISP) subsystem, or Traffic Management subsystem.

The subsystem can manage and track construction and maintenance activities, co-ordinating with other subsystems (such as Traffic Management). It can schedule and manage the location and usage of maintenance assets (such as portable dynamic message signs). These information systems are used by roadway maintenance personnel, roadway construction personnel, or other work crew personnel assigned to highway construction and maintenance. Co-ordination with these systems allows the ITS Architecture to rapidly correct deficiencies noted through its advanced surveillance capabilities and also improves the quality and accuracy of information available to travellers regarding closures and other roadway construction and maintenance activities.

**Related Communications and Associated Architecture Flows are as follows:**

Archived Data Management Subsystem ==> Maintenance Management Subsystem

- archive requests
- archive status

Disaster Command Agency ==> Maintenance Management Subsystem

- disaster advisories
- maintenance support request

Maintenance Management Operator ==> Maintenance Management Subsystem

- maintenance management operator inputs

Maintenance Management Subsystem ==> Archived Data Management Subsystem

- construction and maintenance archive data
- maintenance archive data

Maintenance Management Subsystem ==> Disaster Command Agency

- maintenance response status

Maintenance Management Subsystem ==> Emergency Management Subsystem

- incident information

Maintenance Management Subsystem ==> Information Service Provider Subsystem

- roadway maintenance information

Maintenance Management Subsystem ==> Maintenance Management Operator

- maintenance management operator data

Maintenance Management Subsystem ==> Maintenance Vehicle Subsystem

- maintenance vehicle dispatch

Maintenance Management Subsystem ==> Malaysian Meteorological Services

- road and weather data

Maintenance Management Subsystem ==> Meteorological Service Provider

- road and weather data

Maintenance Management Subsystem ==> Public Transport Management Subsystem

- roadway maintenance information

Maintenance Management Subsystem ==> Roadway Subsystem

- device control data
- roadway information system data
- sensor control

Maintenance Management Subsystem ==> Traffic Management Subsystem

- environmental sensor data
- equipment maintenance status
- incident information
- maintenance dispatch status
- maintenance resource response
- maintenance status
- resource response
- roadway maintenance information
- work zone status

Maintenance Vehicle Subsystem ==> Maintenance Management Subsystem

- maintenance status data
- maintenance vehicle status data

Malaysian Meteorological Services ==> Maintenance Management Subsystem

- volume weather information

Meteorological Service Provider ==> Maintenance Management Subsystem

- road weather prediction
- roadway micro prediction

Roadway Subsystem ==> Maintenance Management Subsystem

- device status
- environmental conditions
- fault reports
- roadway information system status
- surveillance data

Traffic Management Subsystem ==> Maintenance Management Subsystem

- closure coordination
- environmental sensor data
- incident information
- maintenance resource request
- traffic equipment status
- traffic information

### 2.1.8 Public Transport Management Subsystem

This subsystem manages public transport vehicle fleets and co-ordinates with other modes and transportation services. It provides operations, maintenance, traveller information, planning and management functions for the public transport property. It spans distinct central dispatch and garage management systems and supports the spectrum of fixed route, flexible route, and paratransit services. The subsystem's interfaces allow for communication between public transport system operators and with other operating entities such as emergency response services and traffic management systems. This subsystem receives special event and real-time incident data from the traffic management subsystem. It provides current public transport operations data to other centre subsystems.

The Public Transport Management Subsystem collects and stores accurate ridership levels and implements corresponding fare structures. It collects operational and maintenance data from public transport vehicles, manages vehicle service histories, and assigns drivers and maintenance personnel to vehicles and routes. It also provides the capability for automated planning and scheduling of public transport operations. It furnishes travellers with real-time travel information, continuously updated schedules, schedule adherence information, transfer options, and public transport routes and fares.

The subsystem supports the capability to manage its assets to support connection protection, either on a vehicle basis or, in very advanced applications, on an individual traveller basis. This connection protection can be further extended through co-ordination with other public transport agencies, or other modes of transportation. In addition, the monitoring of vehicle locations with both video and audio systems is provided with automatic alerting of operators and police of potential incidents including support for traveller activated alarms.

**Related Communications and Associated Architecture Flows are as follows:**

Archived Data Management Subsystem ==> Public Transport Management Subsystem

- archive requests
- archive status

Disaster Command Agency ==> Public Transport Management Subsystem

- disaster advisories
- evacuation support request
- shelter availability
- shelter location

Emergency Management Subsystem ==> Public Transport Management Subsystem

- public transport emergency coordination data

Financial Institution ==> Public Transport Management Subsystem

- transaction status

Information Service Provider Subsystem ==> Public Transport Management Subsystem

- demand responsive public transport request
- public transport information request
- public transport trip request
- selected routes

Maintenance Management Subsystem ==> Public Transport Management Subsystem

- roadway maintenance information

Malaysian Meteorological Services ==> Public Transport Management Subsystem

- volume weather information

Mapping Service Provider ==> Public Transport Management Subsystem

- map updates

Media ==> Public Transport Management Subsystem

- media information request

Meteorological Service Provider ==> Public Transport Management Subsystem

- road weather prediction

Multimodal Transportation Service Provider ==> Public Transport Management Subsystem

- multimodal information
- public transport multimodal information
- service response

Other Public Transport Management ==> Public Transport Management Subsystem

- Public Transport Management System co-ordination

Parking Management Subsystem ==> Public Transport Management Subsystem

- public transport parking coordination

Personal Information Access Subsystem ==> Public Transport Management Subsystem

- public transport information user request
- trip confirmation

Public Transport Fleet Manager ==> Public Transport Management Subsystem

- public transport fleet manager inputs

Public Transport Maintenance Personnel ==> Public Transport Management Subsystem

- maintenance status

Public Transport Management Subsystem ==> Archived Data Management Subsystem

- public transport archive data

Public Transport Management Subsystem ==> Disaster Command Agency

- evacuation status
- shelter status request

Public Transport Management Subsystem ==> Emergency Management Subsystem

- public transport emergency data

Public Transport Management Subsystem ==> Enforcement Agency

- violation notification

Public Transport Management Subsystem ==> Financial Institution

- payment request

Public Transport Management Subsystem ==> Information Service Provider Subsystem

- demand responsive public transport plan
- public transport and fare schedules
- public transport incident information
- public transport request confirmation
- public transport trip plan

Public Transport Management Subsystem ==> Mapping Service Provider

- map update request

Public Transport Management Subsystem ==> Media

- public transport incidents for media
- public transport information for media

Public Transport Management Subsystem ==> Multimodal Transportation Service Provider

- public transport information
- public transport multimodal information
- service request

Public Transport Management Subsystem ==> Other Public Transport Management

- Public Transport Management System co-ordination

Public Transport Management Subsystem ==> Parking Management Subsystem

- public transport parking lot response

Public Transport Management Subsystem ==> Personal Information Access Subsystem

- personal public transport information
- trip plan

Public Transport Management Subsystem ==> Public Transport Fleet Manager

- public transport operations planning data

Public Transport Management Subsystem ==> Public Transport Maintenance Personnel

- public transport work schedule

Public Transport Management Subsystem ==> Public Transport System Operators

- public transport operator display

Public Transport Management Subsystem ==> Public Transport Vehicle Driver

- route assignment

Public Transport Management Subsystem ==> Public Transport Vehicle Subsystem

- bad tag list
- driver instructions
- emergency acknowledge
- fare management information
- public transport schedule information
- public transport traveller information
- request for vehicle measures

Public Transport Management Subsystem ==> Remote Traveller Support Subsystem

- commuter information
- emergency acknowledge
- public transport fare payment responses
- secure area monitoring support
- trip plan

Public Transport Management Subsystem ==> Traffic Management Subsystem

- public transport demand management response
- public transport system data
- traffic control priority request

Public Transport System Operators ==> Public Transport Management Subsystem

- public transport operator management data

Public Transport Vehicle Driver ==> Public Transport Management Subsystem

- public transport vehicle driver availability

Public Transport Vehicle Subsystem ==> Public Transport Management Subsystem

- commuter information
- commuter request
- emergency notification
- fare and payment status
- public transport vehicle conditions
- public transport vehicle location data
- public transport vehicle passenger and use data
- public transport vehicle schedule performance
- request for bad tag list

Remote Traveller Support Subsystem ==> Public Transport Management Subsystem

- emergency notification
- public transport fare payment requests
- public transport information user request
- secure area surveillance data
- trip confirmation

Traffic Management Subsystem ==> Public Transport Management Subsystem

- public transport demand management request
- request public transport information
- traffic control priority status
- traffic information for public transport

### 2.1.9 Toll Administration Subsystem

This subsystem provides payment administration capabilities and supports electronic transfer of authenticated funds from the customer to the transportation system operator. This subsystem supports traveller enrolment and collection of both pre-payment and post-payment transportation fees in co-ordination with the existing, and evolving financial infrastructure supporting electronic payment transactions, including smart cards. The system may establish and administer escrow accounts depending on the clearinghouse scheme and the type of payments involved. This subsystem posts a transaction to the customer account and generates a bill (for post-payment accounts), debits an escrow account, or interfaces to the financial infrastructure to debit a customer designated account.

It supports communications with the Toll Collection Subsystem to support fee collection operations. The subsystem also sets and administers the pricing structures and includes the capability to implement road-pricing policies in co-ordination with the Traffic Management Subsystem. The electronic financial transactions in which this subsystem is an intermediary between the customer and the financial infrastructure shall be cryptographically protected and authenticated to preserve privacy and ensure authenticity and auditability.

**Related Communications and Associated Architecture Flows are as follows:**

Archived Data Management Subsystem ==> Toll Administration Subsystem

- archive requests
- archive status

Financial Institution ==> Toll Administration Subsystem

- transaction status

Information Service Provider Subsystem ==> Toll Administration Subsystem

- toll data request

Road Transport Department ==> Toll Administration Subsystem

- registration

Toll Administration Subsystem ==> Archived Data Management Subsystem

- toll archive data

Toll Administration Subsystem ==> Enforcement Agency

- violation notification

Toll Administration Subsystem ==> Financial Institution

- payment request

Toll Administration Subsystem ==> Information Service Provider Subsystem

- probe data
- toll data

Toll Administration Subsystem ==> Road Transport Department

- licence request

Toll Administration Subsystem ==> Toll Administrator

- toll revenues and summary reports

Toll Administration Subsystem ==> Toll Collection Subsystem

- toll instructions

Toll Administration Subsystem ==> Traffic Management Subsystem

- probe data
- toll demand management response

Toll Administrator ==> Toll Administration Subsystem

- toll administration requests

Toll Collection Subsystem ==> Toll Administration Subsystem

- toll transactions

Traffic Management Subsystem ==> Toll Administration Subsystem

- toll demand management request

### 2.1.10 Traffic Management Subsystem

The Traffic Management Subsystem operates within a traffic management centre or other fixed location. This subsystem communicates with the Roadway Subsystem to monitor and manage traffic flow. The subsystem supports road weather information systems which utilise inputs from environmental (or road surface) sensors and weather forecast information. Incidents are detected and verified, response plans are implemented, and incident information is provided to the Emergency Management Subsystem, travellers (through Roadway Subsystem Highway Advisory Radio and Dynamic Message Signs), and to third party providers. The subsystem supports HOV lane management and co-ordination, road-pricing, and other demand management policies that can alleviate congestion and influence mode selection. The subsystem communicates with Maintenance Management Subsystems for co-ordination of road closure and maintenance actions. The subsystem also manages reversible lane facilities, and processes probe vehicle information. The subsystem communicates with other Traffic Management Subsystems to co-ordinate traffic information and control strategies in neighbouring jurisdictions. It also co-ordinates 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 utilised for AHS traffic and vehicle control.

**Related Communications and Associated Architecture Flows are as follows:**

Archived Data Management Subsystem ==> Traffic Management Subsystem

- archive requests
- archive status

Disaster Command Agency ==> Traffic Management Subsystem

- disaster advisories
- road network status request

Emergency Management Subsystem ==> Traffic Management Subsystem

- emergency traffic control request
- incident information
- incident response status
- remote surveillance control
- resource request

Environment Management Subsystem ==> Traffic Management Subsystem

- wide-area statistical other environmental information

Event Organisers ==> Traffic Management Subsystem

- event plans

Information Service Provider Subsystem ==> Traffic Management Subsystem

- fare and price information
- logged special vehicle route
- request for traffic information
- road network use

Maintenance Management Subsystem ==> Traffic Management Subsystem

- environmental sensor data
- equipment maintenance status
- incident information
- maintenance dispatch status
- maintenance resource response
- maintenance status
- resource response
- roadway maintenance information
- work zone status

Malaysian Meteorological Services ==> Traffic Management Subsystem

- volume weather information

Mapping Service Provider ==> Traffic Management Subsystem

- map updates

Media ==> Traffic Management Subsystem

- external reports
- media information request

Meteorological Service Provider ==> Traffic Management Subsystem

- road weather prediction
- roadway micro prediction

Other Traffic Management ==> Traffic Management Subsystem

- traffic control coordination
- traffic information coordination

Parking Management Subsystem ==> Traffic Management Subsystem

- parking availability
- parking demand management response

Public Transport Management Subsystem ==> Traffic Management Subsystem

- traffic control priority request
- public transport demand management response
- public transport system data

Rail Operations ==> Traffic Management Subsystem

- railroad advisories
- railroad schedules

Road Transport Department ==> Traffic Management Subsystem

- registration

Roadway Subsystem ==> Traffic Management Subsystem

- AHS status
- environmental data
- environmental conditions
- fault reports

- freeway control status
- HOV data
- HRI status
- incident data
- intersection blockage notification
- request for right-of-way
- reversible lane status
- roadway information system status
- roadway warning status
- signal control status
- traffic flow
- traffic images
- vehicle probe data
- violation detection

Toll Administration Subsystem ==> Traffic Management Subsystem

- probe data
- toll demand management response

Traffic Management Subsystem ==> Archived Data Management Subsystem

- traffic archive data

Traffic Management Subsystem ==> Disaster Command Agency

- traffic information

Traffic Management Subsystem ==> Emergency Management Subsystem

- current network conditions
- emergency traffic control response
- incident information
- incident information request
- resource deployment status

Traffic Management Subsystem ==> Environment Management Subsystem

- environmental state data request

Traffic Management Subsystem ==> Enforcement Agency

- violation notification

Traffic Management Subsystem ==> Event Organisers

- event confirmation

Traffic Management Subsystem ==> Information Service Provider Subsystem

- request fare and price information
- traffic information

Traffic Management Subsystem ==> Maintenance Management Subsystem

- closure coordination
- environmental sensor data
- incident information
- maintenance resource request
- traffic equipment status
- traffic information

Traffic Management Subsystem ==> Mapping Service Provider

- map update request

Traffic Management Subsystem ==> Media

- traffic information for media

Traffic Management Subsystem ==> Meteorological Service Provider

- road and weather data

Traffic Management Subsystem ==> Other Traffic Management

- traffic control coordination
- traffic information coordination

Traffic Management Subsystem ==> Parking Management Subsystem

- parking demand management request
- parking instructions

Traffic Management Subsystem ==> Public Transport Management Subsystem

- public transport demand management request
- request public transport information
- traffic control priority status

- traffic information for public transport

Traffic Management Subsystem ==> Rail Operations
- HRI advisories

Traffic Management Subsystem ==> Road Transport Department
- licence request

Traffic Management Subsystem ==> Roadway Subsystem
- AHS control information
- freeway control data
- HRI control data
- HRI request
- roadway information system data
- roadway warning data
- sensor and surveillance control
- signal control data
- traffic control enforcement

Traffic Management Subsystem ==> Toll Administration Subsystem
- toll demand management request

Traffic Management Subsystem ==> Traffic Operations Personnel
- traffic operator data

Traffic Operations Personnel ==> Traffic Management Subsystem
- traffic operator inputs

## 2.2 Roadsides

This will be the second of the four general subsystem classes defined in the proposed ITS System Architecture. Intelligent infrastructure distributed along the transportation network which perform surveillance, information provision, and plan execution control functions and whose operation is governed by centre subsystems. Direct interface to vehicle subsystems exists.

The following subsystems are classified within this general subsystem class:

- Commercial Vehicle Check Subsystem
- Intermodal Terminal Subsystem
- Parking Management Subsystem
- Roadway Subsystem
- Toll Collection Subsystem

### 2.2.1 Commercial Vehicle Check Subsystem

This subsystem supports automated vehicle identification at mainline speeds for credential checking, international border clearance, 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. This 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 enrolment of vehicles and carriers in the electronic clearance program.

**Related Communications and Associated Architecture Flows are as follows:**

Commercial Vehicle ==> Commercial Vehicle Check Subsystem

- CVO weight and presence

Commercial Vehicle Administration Subsystem ==> Commercial Vehicle Check Subsystem

- credentials information
- CVO database update
- international border crossing data
- safety information

Commercial Vehicle Check Subsystem ==> Commercial Vehicle Administration Subsystem

- citation data
- credentials information request
- international border crossing data update
- roadside log update
- safety information request

Commercial Vehicle Check Subsystem ==> Commercial Vehicle Driver

- CVO Pull in Message

Commercial Vehicle Check Subsystem ==> Commercial Vehicle Subsystem

- border clearance event record
- clearance event record
- electronic clearance request
- lock tag data request
- on-board safety request
- pass/pull-in
- safety inspection record
- screening request

Commercial Vehicle Check Subsystem ==> CVO Inspector

- CVO inspector information

Commercial Vehicle Subsystem ==> Commercial Vehicle Check Subsystem

- electronic clearance data
- lock tag data
- on-board safety data
- screening data

CVO Inspector ==> Commercial Vehicle Check Subsystem

- Commercial Vehicle Check override mode
- CVO inspector input

### 2.2.2 Intermodal Terminal Subsystem

This subsystem represents the terminal areas corresponding to modal change points. This would include any interfaces between roadway freight transportation and air, rail, and/or marine modes. The basic unit of cargo handled by this subsystem is the container. Less-than-container load handling will typically be handled at a different facility (e.g. Freight Consolidation Station). This subsystem is responsible for efficiently handling the movement of freight containers between different transportation modes. This can include electronic gate control for entrance and exit from the facility, automated guidance of vehicles within the facility, alerting appropriate parties of container arrivals and departures, and inventory and location of temporarily stored containers. The subsystem also provides support for Royal Customs Malaysia to perform their functions, where international cargo may be handled. This subsystem may also implement weigh-in-motion and other commercial vehicle inspection capabilities to ensure that commercial vehicle–chassis–container assemblages that leave the facility are roadworthy. This subsystem can support security functionality both to secure containers and to prevent unauthorised personnel or vehicles from violating the facilities.

**Related Communications and Associated Architecture Flows are as follows:**

Archived Data Management Subsystem ==> Intermodal Terminal Subsystem

- archive requests
- archive status

Commercial Vehicle Subsystem ==> Intermodal Terminal Subsystem

- container transfer location request
- entry request
- exit request
- vehicle identification

Fleet and Freight Management Subsystem ==> Intermodal Terminal Subsystem

- container delivery request
- container pickup confirmation
- intermodal CVO co-ordination

Intermodal Container Subsystem ==> Intermodal Terminal Subsystem

container identification

- container location

Intermodal Terminal Operator ==> Intermodal Terminal Subsystem

- intermodal terminal operator inputs

Intermodal Terminal Subsystem ==> Archived Data Management Subsystem

- intermodal freight archive data

Intermodal Terminal Subsystem ==> Commercial Vehicle Subsystem

- container transfer location
- entry permission
- exit permission

Intermodal Terminal Subsystem ==> Fleet and Freight Management Subsystem

- container delivery confirmation
- container pickup request
- intermodal CVO co-ordination

Intermodal Terminal Subsystem ==> Intermodal Terminal Operator

- intermodal terminal operator data

Intermodal Terminal Subsystem ==> Logistics Solutions Provider

- container availability status

Intermodal Terminal Subsystem ==> Royal Customs Malaysia

- container arrival information

Logistics Solutions Provider ==> Intermodal Terminal Subsystem

- container availability request

Other Intermodal Fleet Management System ==> Intermodal Terminal Subsystem

- container release status

Royal Customs Malaysia ==> Intermodal Terminal Subsystem

- container release status

### 2.2.3 Parking Management Subsystem

This subsystem provides electronic monitoring and management of parking facilities. It supports a DSRC communications link to the Vehicle Subsystem that allows electronic collection of parking fees. It also includes the instrumentation, signs, and other infrastructure that monitors parking lot usage and provides local information about parking availability and other general parking information. This portion of the subsystem functionality must be located in the parking facility where it can monitor, classify, and share information with customers and their vehicles. The subsystem also interfaces with the financial infrastructure and broadly disseminates parking information to other operational centres in the region. Note that the latter functionality may be located in a back office, remote from the parking facility.

**Related Communications and Associated Architecture Flows are as follows:**

Archived Data Management Subsystem ==> Parking Management Subsystem

- archive requests
- archive status

Financial Institution ==> Parking Management Subsystem

- transaction status

Information Service Provider Subsystem ==> Parking Management Subsystem

- parking lot data request
- parking reservations request

Other Parking ==> Parking Management Subsystem

- parking coordination

Parking Management Subsystem ==> Archived Data Management Subsystem

- parking archive data

Parking Management Subsystem ==> Driver

- roadside transaction status

Parking Management Subsystem ==> Enforcement Agency

- violation notification

Parking Management Subsystem ==> Financial Institution

- payment request

Parking Management Subsystem ==> Information Service Provider Subsystem

- parking information
- parking lot reservation confirmation

Parking Management Subsystem ==> Other Parking

- parking coordination

Parking Management Subsystem ==> Parking Operator

- parking status

Parking Management Subsystem ==> Public Transport Management Subsystem

- public transport parking coordination

Parking Management Subsystem ==> Road Transport Department

- licence request

Parking Management Subsystem ==> Traffic Management Subsystem

- parking availability
- parking demand management response

Parking Management Subsystem ==> Vehicle Subsystem

- request tag data
- tag update

Parking Operator ==> Parking Management Subsystem

- parking operator inputs
- request for performance data

Public Transport Management Subsystem ==> Parking Management Subsystem

- public transport parking lot response

Road Transport Department ==> Parking Management Subsystem

- registration

Traffic Management Subsystem ==> Parking Management Subsystem

- parking demand management request
- parking instructions

Vehicle Characteristics ==> Parking Management Subsystem

- vehicle characteristics

Vehicle Subsystem ==> Parking Management Subsystem

- tag data

### 2.2.4 Roadway Subsystem

This subsystem includes the equipment distributed on and along the roadway which monitors and controls traffic. Equipment includes highway advisory radios, dynamic 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. The subsystem provides support for smart work zone deployments through support of portable monitoring and control devices, as well as the capability to have one roadside device (such as a sensor and local processor) control the outputs of another roadside device (such as a portable dynamic message sign). This subsystem also provides the capability for emissions and environmental condition monitoring including weather sensors, pavement sensors, haze, etc. In support of Traffic Management System and other Centre Subsystems, high occupancy vehicle (HOV) lane management, reversible lane management, transit priority, and emergency vehicle pre-emption

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 (AHS) 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. Advanced sensor systems are supported which provide automated protection for non vehicular road users, and users in such vehicles as bicycles and motorcycles.

**Related Communications and Associated Architecture Flows are as follows:**

Archived Data Management Subsystem ==> Roadway Subsystem
- sensor and surveillance control

Emergency Vehicle Subsystem ==> Roadway Subsystem
- local signal pre-emption request

Environment Management Subsystem ==> Roadway Subsystem
- environmental state criteria
- vehicle pollution criteria

Environment ==> Roadway Subsystem
- environmental hazards
- environmental levels

Maintenance Management Subsystem ==> Roadway Subsystem
- device control data
- roadway information system data
- sensor control

Multimodal Crossings ==> Roadway Subsystem
- multimodal crossing status

Other Roadside ==> Roadway Subsystem
- device control data

Pedestrians ==> Roadway Subsystem
- crossing call
- non-vehicular presence

Potential Obstacles ==> Roadway Subsystem
- physical presence

Public Transport Vehicle Subsystem ==> Roadway Subsystem
- local signal priority request

Railside Equipment ==> Roadway Subsystem
- arriving train information
- track status

Roadway ==> Roadway Subsystem
- roadway characteristics

Roadway Environment ==> Roadway Subsystem
- environmental hazards
- weather conditions

Roadway Subsystem ==> Archived Data Management Subsystem
- roadside archive data

Roadway Subsystem ==> Basic Vehicle
- broadcast advisories

Roadway Subsystem ==> Driver
- driver information
- driver roadway warning
- variable speed limit

Roadway Subsystem ==> Environment Management Subsystem
- device status
- environmental conditions
- environmental data
- fault reports
- roadway information system status
- surveillance data

Roadway Subsystem ==> Multimodal Crossings

- highway control status

Roadway Subsystem ==> Other Roadside
- roadside display data

Roadway Subsystem ==> Pedestrians
- crossing permission

Roadway Subsystem ==> Railside Equipment
- HRI operational status
- intersection blockage notification

Roadway Subsystem ==> Traffic Management Subsystem
- AHS status
- environmental conditions
- environmental data
- fault reports
- freeway control status
- HOV data
- HRI status
- incident data
- intersection blockage notification
- request for right-of-way
- reversible lane status
- roadway information system status
- roadway warning status
- signal control status
- traffic flow
- traffic images
- vehicle probe data
- violation detection

Roadway Subsystem ==> Vehicle Subsystem
- AHS control data

- intersection status
- request tag data
- vehicle roadway warning data
- vehicle signage data
- vehicle variable speed limit data

Traffic ==> Roadway Subsystem

- traffic characteristics

Traffic Management Subsystem ==> Roadway Subsystem

- AHS control information
- freeway control data
- HRI control data
- HRI request
- roadway information system data
- roadway warning data
- sensor and surveillance control
- signal control data
- traffic control enforcement

Vehicle Characteristics ==> Roadway Subsystem

- vehicle characteristics
- vehicle signal violation
- vehicle speed violation
- vehicular presence

Vehicle Subsystem ==> Roadway Subsystem

- AHS vehicle data
- vehicle probe data

### 2.2.5 Toll Collection Subsystem

This subsystem provides the capability for vehicle operators to pay tolls without stopping their vehicles using locally determined pricing structures and including the capability to implement various variable road-pricing policies. Electronic payment transactions, such as using smart cards, can be accompanied by feedback to the customer on the general status of the customer account. A record of the transactions is provided to the Toll Administration Subsystem for reconciliation and so that the customer can periodically receive a detailed record of the transactions.

**Related Communications and Associated Architecture Flows are as follows:**

Toll Administration Subsystem ==> Toll Collection Subsystem
- toll instructions

Toll Collection Subsystem ==> Driver
- roadside transaction status

Toll Collection Subsystem ==> Toll Administration Subsystem
- toll transactions

Toll Collection Subsystem ==> Toll Operator
- toll transaction reports

Toll Collection Subsystem ==> Vehicle Subsystem
- request tag data
- tag update

Toll Operator ==> Toll Collection Subsystem
- toll operator requests

Vehicle Characteristics ==> Toll Collection Subsystem
- vehicle characteristics

Vehicle Subsystem ==> Toll Collection Subsystem
- tag data

## 2.3 Traveller

This will be the third of the four general subsystem classes defined in the proposed ITS System Architecture. Traveller subsystem covers equipment used by travellers to access ITS services pre-trip and en-route. This includes elements that are owned and operated by the traveller as well as elements that are owned by transportation and information providers.

The following subsystems are classified within this general subsystem class:

- Personal Information Access Subsystem
- Remote Traveller Support Subsystem

### 2.3.1 Personal Information Access Subsystem

This subsystem provides the capability for travellers to access formatted traffic and weather 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 capabilities 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.

**Related Communications and Associated Architecture Flows are as follows:**

Emergency Management Subsystem ==> Personal Information Access Subsystem

- emergency acknowledge

Information Service Provider Subsystem ==> Personal Information Access Subsystem

- broadcast information
- traveller information
- trip plan
- yellow pages information

Location Data Source ==> Personal Information Access Subsystem

- position fix

Mapping Service Provider ==> Personal Information Access Subsystem

- map updates

Payment Instrument ==> Personal Information Access Subsystem

- payment

Personal Information Access Subsystem ==> Emergency Management Subsystem

- emergency notification

Personal Information Access Subsystem ==> Information Service Provider Subsystem

- traveller profile
- traveller request
- trip confirmation
- trip request
- yellow pages request

Personal Information Access Subsystem ==> Mapping Service Provider

- map update request

Personal Information Access Subsystem ==> Payment Instrument

- request for payment

Personal Information Access Subsystem ==> Public Transport Management Subsystem

- public transport information user request

- trip confirmation

Personal Information Access Subsystem ==> Traveller

- traveller interface updates

Public Transport Management Subsystem ==> Personal Information Access Subsystem

- personal public transport information
- trip plan

Traveller ==> Personal Information Access Subsystem

- traveller inputs

### 2.3.2 Remote Traveller Support Subsystem

This subsystem provides access to traveller information at public transport stations, stops, other fixed sites along travel routes, and at major trip generation locations such as special event centres, hotels, office and shopping complexes, amusement parks, and theatres. Traveller information access points include kiosks and informational displays supporting varied levels of interaction and information access. At public transport 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 and weather conditions and public transport schedules along with yellow pages information to support mode and route selection at major trip generation sites. Personalised route planning and route guidance information can also be provided based on criteria supplied by the traveller. In addition to traveller information provision, this subsystem also supports public safety monitoring using closed-circuit television (CCTV) cameras or other surveillance equipment and emergency notification within these public areas. Fare card maintenance, and other features which enhance traveller convenience may also be provided at the discretion of the deploying agency.

**Related Communications and Associated Architecture Flows are as follows:**

Commuter ==> Remote Traveller Support Subsystem

- commuter inputs

Emergency Management Subsystem ==> Remote Traveller Support Subsystem

- emergency acknowledge

Information Service Provider Subsystem ==> Remote Traveller Support Subsystem

- broadcast information
- traveller information
- trip plan
- yellow pages information

Mapping Service Provider ==> Remote Traveller Support Subsystem

- map updates

Payment Instrument ==> Remote Traveller Support Subsystem

- payment

Public Transport Management Subsystem ==> Remote Traveller Support Subsystem

- commuter information
- emergency acknowledge
- public transport fare payment responses
- secure area monitoring support
- trip plan

Remote Traveller Support Subsystem ==> Commuter

- commuter fare status
- commuter outputs

Remote Traveller Support Subsystem ==> Emergency Management Subsystem

- emergency notification

Remote Traveller Support Subsystem ==> Information Service Provider Subsystem

- traveller request

- trip confirmation
- trip request
- yellow pages request

Remote Traveller Support Subsystem ==> Mapping Service Provider

- map update request

Remote Traveller Support Subsystem ==> Payment Instrument

- request for payment

Remote Traveller Support Subsystem ==> Public Transport Management Subsystem

- emergency notification
- public transport fare payment requests
- public transport information user request
- secure area surveillance data
- trip confirmation

Remote Traveller Support Subsystem ==> Traveller

- traveller interface updates

Secure Area Environment ==> Remote Traveller Support Subsystem

- secure area characteristics

Traveller ==> Remote Traveller Support Subsystem

- traveller inputs

## 2.4 Vehicles

This will be the last of the four general subsystem classes defined in the proposed ITS System Architecture. It covers ITS related elements on vehicle platforms. Vehicle subsystems include general driver information and safety systems applicable to all vehicle types.

The following subsystems are classified within this general subsystem class:

- Commercial Vehicle Subsystem
- Emergency Vehicle Subsystem
- Intermodal Container Subsystem
- Maintenance Vehicle Subsystem
- Public Transport Vehicle Subsystem
- Vehicle Subsystem

### 2.4.1 Commercial Vehicle Subsystem

This subsystem resides in a commercial vehicle and provides the sensory, processing, storage, and communications functions necessary to support safe and efficient commercial vehicle operations. It 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. It interfaces with the Intermodal Container Subsystem to collect container or cargo status. It can also collect status and measures from the intermodal chassis itself. 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.

**Related Communications and Associated Architecture Flows are as follows:**

Commercial Vehicle ==> Commercial Vehicle Subsystem

- commercial vehicle measures

Commercial Vehicle Check Subsystem ==> Commercial Vehicle Subsystem

- border clearance event record
- clearance event record
- electronic clearance request
- lock tag data request
- on-board safety request
- pass/pull-in
- safety inspection record
- screening request

Commercial Vehicle Driver ==> Commercial Vehicle Subsystem

- CVO driver initialisation

Commercial Vehicle Subsystem ==> Commercial Vehicle

- lock tag data request

Commercial Vehicle Subsystem ==> Commercial Vehicle Check Subsystem

- electronic clearance data
- lock tag data
- on-board safety data
- screening data

Commercial Vehicle Subsystem ==> Commercial Vehicle Driver

- alerts, messages
- CVO Pull in Message
- intermodal dispatch
- log information

Commercial Vehicle Subsystem ==> Fleet and Freight Management Subsystem

- driver and vehicle information
- intermodal status

- on-board vehicle data
- vehicle location

Commercial Vehicle Subsystem ==> Freight Consolidation Station

- container transfer location request
- entry request
- exit request
- vehicle identification

Commercial Vehicle Subsystem ==> Intermodal Terminal Subsystem

- container transfer location request
- entry request
- exit request
- vehicle identification

Commercial Vehicle Subsystem ==> Vehicle Subsystem

- commercial vehicle data

Fleet and Freight Management Subsystem ==> Commercial Vehicle Subsystem

- container transport assignment
- fleet to driver update
- intermodal status request
- location request

Freight Consolidation Station ==> Commercial Vehicle Subsystem

- container transfer location
- entry permission
- exit permission

Intermodal Chassis ==> Commercial Vehicle Subsystem

- chassis data
- chassis status

Intermodal Container Subsystem ==> Commercial Vehicle Subsystem

- cargo data
- container status

Intermodal Terminal Subsystem ==> Commercial Vehicle Subsystem

- container transfer location
- entry permission
- exit permission

Vehicle Subsystem ==> Commercial Vehicle Subsystem

- commercial vehicle data request
- vehicle location

### 2.4.2 Emergency Vehicle Subsystem

This subsystem resides in an emergency vehicle and provides the sensory, processing, storage, and communications functions necessary to support safe and efficient emergency response. It includes two-way communications to support co-ordinated 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 the above-mentioned capabilities, the appropriate emergency vehicle to respond to each emergency is determined.

Route guidance capabilities within the vehicle enable safe and efficient routing to the emergency. In addition, the emergency vehicle may be equipped to support signal pre-emption through communications with the roadside subsystem.

**Related Communications and Associated Architecture Flows are as follows:**

Emergency Management Subsystem ==> Emergency Vehicle Subsystem

- emergency dispatch requests
- incident command information
- suggested route

Emergency Response Personnel ==> Emergency Vehicle Subsystem

- emergency response personnel inputs

Emergency Vehicle Subsystem ==> Emergency Management Subsystem

- emergency dispatch response
- emergency vehicle tracking data
- incident command request
- incident status

Emergency Vehicle Subsystem ==> Emergency Response Personnel

- dispatch information
- incident command information presentation

Emergency Vehicle Subsystem ==> Roadway Subsystem

- local signal pre-emption request

Vehicle Subsystem ==> Emergency Vehicle Subsystem

- vehicle location

### 2.4.3 Intermodal Container Subsystem

This subsystem includes the sensors and systems incorporated into an intermodal container. Containers are strengthened and stackable boxes that carry freight and allow horizontal and vertical transfers between modes (truck transport, rail, or marine vessel). They are built to standardised dimensions to allow efficient handling. The most basic capability of this subsystem is to provide a unique identification via wireless interrogation. It can also have the capability to sense cargo conditions, including temperature, controlled atmosphere integrity, status of control systems (like refrigeration), peak and total shock/vibration, and any other aspects peculiar to the specific cargo.

This subsystem can potentially support the determination of location and the communication of that location to appropriate infrastructure elements, either on demand or as part of a periodic status reporting activity. This subsystem also can support a number of security measures, including sensing and alarms for unauthorised breaches of

the container seals, electronic locking devices suitable for Royal Customs Malaysia preclearance, and basic security measures to prevent unauthorised interrogation of the container's systems and stored data.

This subsystem must also function as an integrated unit with Intermodal Chassis and the Commercial Vehicle Subsystem for roadway transport. This would require the ability to interface via either wireless or wire harness means to the Commercial Vehicle Subsystem to allow monitoring of the container's status as part of the composite vehicle.

**Related Communications and Associated Architecture Flows are as follows:**

Intermodal Container Subsystem ==> Commercial Vehicle Subsystem
- cargo data
- container status

Intermodal Container Subsystem ==> Intermodal Terminal Subsystem
- container identification
- container location

Intermodal Container Subsystem ==> Logistics Solutions Provider
- cargo data
- container location
- container status

Intermodal Container Subsystem ==> Royal Customs Malaysia
- container manifest
- container seal status

Logistics Solutions Provider ==> Intermodal Container Subsystem
- cargo data request
- container location request
- container status request

Royal Customs Malaysia ==> Intermodal Container Subsystem

- container seal interrogation
- manifest request

### 2.4.4 Maintenance Vehicle Subsystem

This subsystem resides in a maintenance vehicle and provides the sensory, processing, storage, and communications functions necessary to perform the operations and maintenance functions of the Maintenance Management Subsystem. It provides two-way communications between maintenance vehicle drivers and the operators (who may be dispatchers) of the Maintenance Management Subsystem.

This subsystem contains the capability to provide location and status. The status can include the automated recording of operational data, vehicle measures, or even security features (such as a silent alarm). This subsystem may also contain vehicle system, environmental or roadway sensors, whose outputs can be communicated to the Maintenance Management Subsystem either manually, or in an automated fashion.

**Related Communications and Associated Architecture Flows are as follows:**

Maintenance Management Subsystem ==> Maintenance Vehicle Subsystem

- maintenance vehicle dispatch

Maintenance Vehicle ==> Maintenance Vehicle Subsystem

- maintenance vehicle measures

Maintenance Vehicle Driver ==> Maintenance Vehicle Subsystem

- maintenance driver inputs

Maintenance Vehicle Subsystem ==> Maintenance Management Subsystem

- maintenance status data
- maintenance vehicle status data

Maintenance Vehicle Subsystem ==> Maintenance Vehicle

- maintenance vehicle controls

Maintenance Vehicle Subsystem ==> Maintenance Vehicle Driver

- maintenance driver data

Roadway ==> Maintenance Vehicle Subsystem

- roadway characteristics

Roadway Environment ==> Maintenance Vehicle Subsystem

- environmental hazards
- weather conditions

Vehicle Subsystem ==> Maintenance Vehicle Subsystem

- vehicle location

### 2.4.5 Public Transport Vehicle Subsystem

This subsystem resides in a public transport vehicle and provides the sensory, processing, storage, and communications functions necessary to support safe and efficient movement of passengers. It collects accurate ridership levels and supports electronic fare collection. An optional traffic signal prioritisation function communicates with the roadside subsystem to improve on-schedule performance. Automated vehicle location functions enhance the information available to the Public Transport Management Subsystem enabling more efficient operations. On-board sensors support public transport vehicle maintenance. It also furnishes travellers with real-time travel and weather information, continuously updated schedules, transfer options, routes, and fares.

**Related Communications and Associated Architecture Flows are as follows:**

Commuter ==> Public Transport Vehicle Subsystem

- commuter inputs
- emergency request

Payment Instrument ==> Public Transport Vehicle Subsystem

- payment

Public Transport Management Subsystem ==> Public Transport Vehicle Subsystem

- bad tag list
- driver instructions
- emergency acknowledge
- fare management information
- public transport schedule information
- public transport traveller information
- request for vehicle measures

Public Transport Vehicle ==> Public Transport Vehicle Subsystem

- public transport vehicle measures

Public Transport Vehicle Driver ==> Public Transport Vehicle Subsystem

- public transport vehicle driver inputs

Public Transport Vehicle Subsystem ==> Commuter

- commuter fare status
- commuter outputs

Public Transport Vehicle Subsystem ==> Payment Instrument

- request for payment

Public Transport Vehicle Subsystem ==> Public Transport Management Subsystem

- commuter information
- emergency notification
- fare and payment status
- public transport vehicle conditions
- public transport vehicle location data

- public transport vehicle passenger and use data
- public transport vehicle schedule performance
- request for bad tag list
- traveller request

Public Transport Vehicle Subsystem ==> Public Transport Vehicle Driver

- public transport vehicle driver display

Public Transport Vehicle Subsystem ==> Roadway Subsystem

- local signal priority request

Public Transport Vehicle Subsystem ==> Vehicle Subsystem

- traveller advisory request

Vehicle Subsystem ==> Public Transport Vehicle Subsystem

- vehicle location

### 2.4.6 Vehicle Subsystem

This subsystem resides in a vehicle (usually in an automobile, but any vehicle not covered by another subsystem) and provides the sensory, processing, storage, and communications functions necessary to support efficient, safe, and convenient travel by personal vehicle. Information services provide the driver with current travel and weather 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 personalised 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 co-ordination with supporting infrastructure subsystems. Pre-collision safety systems are deployed and emergency notification messages are issued when unavoidable collisions do occur. While the majority of the systems described above apply to automobiles, some of the systems can apply to other forms of vehicles such as motorcycles and even bicycles.

**Related Communications and Associated Architecture Flows are as follows:**

Basic Vehicle ==> Vehicle Subsystem
- basic vehicle measures

Commercial Vehicle Subsystem ==> Vehicle Subsystem
- commercial vehicle data

Driver ==> Vehicle Subsystem
- driver inputs

Emergency Management Subsystem ==> Vehicle Subsystem
- emergency acknowledge
- emergency data request

Information Service Provider Subsystem ==> Vehicle Subsystem
- broadcast information
- traveller information
- trip plan
- yellow pages information

Location Data Source ==> Vehicle Subsystem
- position fix

Mapping Service Provider ==> Vehicle Subsystem
- map updates

Other Vehicle ==> Vehicle Subsystem
- vehicle to vehicle coordination

Parking Management Subsystem ==> Vehicle Subsystem

- request tag data
- tag update

Payment Instrument ==> Vehicle Subsystem

- payment

Potential Obstacles ==> Vehicle Subsystem

- physical presence

Public Transport Vehicle Subsystem ==> Vehicle Subsystem

- traveller advisory request

Roadway ==> Vehicle Subsystem

- roadway characteristics

Roadway Environment ==> Vehicle Subsystem

- AHS control data
- intersection status
- request tag data
- vehicle roadway warning data
- vehicle signage data
- vehicle variable speed limit data
- weather conditions

Toll Collection Subsystem ==> Vehicle Subsystem

- request tag data
- tag update

Vehicle Subsystem ==> Basic Vehicle

- vehicle control

Vehicle Subsystem ==> Commercial Vehicle Subsystem

- commercial vehicle data request
- vehicle location

Vehicle Subsystem ==> Driver

- driver updates
- in-vehicle transaction status

Vehicle Subsystem ==> Emergency Management Subsystem

- emergency notification

Vehicle Subsystem ==> Emergency Vehicle Subsystem

- vehicle location

Vehicle Subsystem ==> Information Service Provider Subsystem

- traveller profile
- traveller request
- trip confirmation
- trip request
- vehicle probe data
- yellow pages request

Vehicle Subsystem ==> Maintenance Vehicle Subsystem

- vehicle location

Vehicle Subsystem ==> Mapping Service Provider

- map update request
- vehicle to vehicle coordination

Vehicle Subsystem ==> Parking Management Subsystem

- tag data

Vehicle Subsystem ==> Payment Instrument

- request for payment

Vehicle Subsystem ==> Public Transport Vehicle Subsystem

- vehicle location

Vehicle Subsystem ==> Roadway Subsystem

- AHS vehicle data
- vehicle probe data

Vehicle Subsystem ==> Toll Collection Subsystem

- tag data

# Section 3

# TERMINATORS

## 3.1 Environment Terminators

This will be the first of the four groups of terminators, which define the boundary of the proposed ITS System Architecture. The following terminators are classified as Environment Terminators:

- Environment
- Potential Obstacles
- Roadway
- Roadway Environment
- Secure Area Environment
- Traffic

### 3.1.1 Environment

This terminator is the operational setting in which the ITS interfaces and operates. This setting consists of weather effects such as strong winds, rain, haze, pollution, dust, temperature, humidity, solar radiation, and man-made electromagnetic effects. The setting also includes environmental hazards such as flooding, poor visibility, landslides and mudslides. Environmental conditions must be monitored by the ITS Architecture so that Travellers may be informed and control strategies can reflect adverse environmental conditions in a timely fashion.

**Related Communications and Associated Architecture Flows are as follows:**

Environment ==> Environment Management Subsystem
- environmental levels

Environment ==> Roadway Subsystem
- environmental hazards
- environmental levels

### 3.1.2 Potential Obstacles

Any object that possesses the potential of being sensed and struck and thus also possesses physical attributes. Potential Obstacles include roadside obstructions, other vehicles, pedestrians, fallen trees, fallen utility lines, infrastructure elements or any other element which is in a potential path of the vehicle. This external represents the physical obstacles which possess properties which enable detection using sensory functions included as part of the ITS Architecture. These physical attributes are represented as a data input to the system.

**Related Communications and Associated Architecture Flows are as follows:**

Potential Obstacles ==> Roadway Subsystem

- physical presence

Potential Obstacles ==> Vehicle Subsystem

- physical presence

### 3.1.3 Roadway

This terminator represents the physical conditions and geometry of the surface on which vehicles travel from an origin to a destination. Roadways can vary in type, such as municipal streets, arteries, state roads, federal roads, two-lane rural roads, expressways, or any other vehicle travel surface.

The condition of the roadway must be monitored by the Architecture to enable corrective action and information dissemination regarding roadway conditions, which may adversely affect travel. Roadways can also depict travel networks, such as municipal street networks, arterial networks, or expressway networks. The roadway interface to the system carries the physical condition and geometry attributes

which must be sensed, interpreted, and processed by functions internal to the system to achieve ITS user-service functionality.

**Related Communications and Associated Architecture Flows are as follows:**

Roadway ==> Maintenance Vehicle Subsystem
- roadway characteristics

Roadway ==> Roadway Subsystem
- roadway characteristics

Roadway ==> Vehicle Subsystem
- roadway characteristics

### 3.1.4 Roadway Environment

This terminator represents the physical conditions surrounding the roadway itself. These may include emissions, haze, poor visibility, strong winds, rain, standing water, etc., which will influence the way in which a vehicle can be safely operated on the roadway.

**Related Communications and Associated Architecture Flows are as follows:**

Roadway Environment ==> Maintenance Vehicle Subsystem
- environmental hazards
- weather conditions

Roadway Environment ==> Roadway Subsystem
- environmental hazards
- weather conditions

Roadway Environment ==> Vehicle Subsystem
- weather conditions

### 3.1.5 Secure Area Environment

This terminator comprises public access areas that commuters users frequent during trips. Areas include bus stops, park-and-ride facilities, rest-and-service areas, kiosks, public transport transfer walkways and multimodal transfer locations. These environments are monitored as part of the proposed ITS System Architecture functions to promote public transport safety.

**Related Communications and Associated Architecture Flows are as follows:**

Secure Area Environment ==> Remote Traveller Support Subsystem

- secure area characteristics

### 3.1.6 Traffic

This terminator represents the collective body of vehicles that travel on municipal streets, arteries, state roads, federal roads, expressways, or any other vehicle travel surface. Traffic depicts the vehicle population from which traffic flow surveillance information is collected (average occupancy, average speed, total volume, average delay, etc.), and to which traffic control indicators are applied (intersection signals, stop signs, ramp meters, lane control barriers, variable speed limit indicators, etc.). All sensory and control elements that interface to this vehicle population are internal to ITS.

**Related Communications and Associated Architecture Flows are as follows:**

Traffic ==> Roadway Subsystem

- traffic characteristics

### 3.1.7 Vehicle Characteristics

This terminator represents the external view of an individual vehicle. It includes vehicle characteristics such as height, width, length, weight, and other properties (e.g., magnetic properties, number of axles) that allow an individual vehicle to be detected and measured or classified. This external view of an individual vehicle is also used as a source of visible data that supports individual vehicle imaging requirements in the Architecture. The vehicles represented by this terminator include automobiles, trucks, buses, motorcycles, bicycles, and any other form of motorised vehicle (e.g., trencher, golf carts, etc).

ITS subsystems at the roadside sense these characteristics and generate ITS data flows. These individual vehicle characteristics are important for toll collection, parking management, and other applications that identify and measure individual vehicles.

**Related Communications and Associated Architecture Flows are as follows:**

Vehicle Characteristics ==> Parking Management Subsystem

- vehicle characteristics

Vehicle Characteristics ==> Roadway Subsystem

- vehicle characteristics
- vehicle signal violation
- vehicle speed violation
- vehicular presence

Vehicle Characteristics ==> Toll Collection Subsystem

- vehicle characteristics

## 3.2 Human Terminators

This will be the second of the four groups of terminators, which define the boundary of the proposed ITS System Architecture. There are twenty-two terminators classified under the human terminators.

### 3.2.1 Archived Data Administrator

This terminator represents the human operator who provides overall data management, administration, and monitoring duties for the ITS data archive. Unlike the manager of the operational databases, this terminator's role is focused on the archive and covers areas such as establishing user authentication controls, monitoring data quality, and initiating data import requests.

**Related Communications and Associated Architecture Flows are as follows:**

Archived Data Administrator ==> Archived Data Management Subsystem

- archive management requests

Archived Data Management Subsystem ==> Archived Data Administrator

- archive management data

### 3.2.2 Commercial Vehicle Driver

This terminator represents the human entity that operates vehicles transporting goods including long-haul trucks, local pickup and delivery vans. This terminator is complementary to the Driver terminator in that it represents those interactions, which are unique to Commercial Vehicle Operations (CVO). In general, a "real world" commercial vehicle driver will interact as both a Driver and a CVO Driver.

Data flowing from this terminator will include those system inputs specific to Commercial Vehicle Operations, such as information back to the Commercial Vehicle Manager. Data flowing to this terminator may include system outputs such as commands to pull into a roadside safety inspection facility. Showing the Driver terminator as the external interface includes the user interface devices within the ITS Architecture boundary. The CVO Driver will be expected to interact with the ITS with interface devices designed to provide support for their usage.

**Related Communications and Associated Architecture Flows are as follows:**

Commercial Vehicle Check Subsystem ==> Commercial Vehicle Driver

- CVO Pull in Message

Commercial Vehicle Driver ==> Commercial Vehicle Subsystem

- CVO driver initialisation

Commercial Vehicle Subsystem ==> Commercial Vehicle Driver

- alerts, messages
- CVO Pull in Message
- intermodal dispatch
- log information

### 3.2.3 Commercial Vehicle Manager

This terminator represents the human entities that are responsible for the dispatching and management of Commercial Vehicle fleets (e.g. traditional Fleet Managers). It may be many people in a large tracking organisation but it can also be a single person (owner driver) in the case of single vehicle fleets. This terminator provides instructions and co-ordination for Commercial Vehicles, including electronic clearance and tax filing, and receives the status of the Vehicles in the fleet that they manage. This terminator is expected to

interface with ITS on a regular basis to enhance productivity. Many interfaces with the system are also provided through normal user interfaces. This interface is specific to CVO and is intended to complement these other interfaces.

**Related Communications and Associated Architecture Flows are as follows:**

Commercial Vehicle Manager ==> Fleet and Freight Management Subsystem

- fleet manager inquiry

Fleet and Freight Management Subsystem ==> Commercial Vehicle Manager

- fleet status

### 3.2.4 Commuter

This terminator represents the human entities using Public Transport Vehicles. They may be in the act of embarking or debarking the vehicles and are thus sensed for the purpose of determining passenger loading and fares, or on the vehicles and able to request and receive information.

**Related Communications and Associated Architecture Flows are as follows:**

Commuter ==> Public Transport Vehicle Subsystem

- emergency request

commuter inputs

Commuter ==> Remote Traveller Support Subsystem

- commuter inputs

Public Transport Vehicle Subsystem ==> Commuter

- commuter fare status
- commuter outputs

Remote Traveller Support Subsystem ==> Commuter

- commuter fare status
- commuter outputs

### 3.2.5 CVO Inspector

This terminator represents the human entities who perform regulatory inspection of Commercial Vehicles in the field. CVO Inspectors support the roadside inspection, weighing, and checking of credentials either through automated preclearance or manual methods. This terminator is an inspection and enforcement arm of the regulatory agencies, such as Commercial Vehicle Licensing Board (CVLB-LPKP), Royal Malaysian Police, Royal Customs Malaysia, or Road Transport Department (RTD-JPJ) with frequent direct interface with the Commercial Vehicles and their Drivers.

**Related Communications and Associated Architecture Flows are as follows:**

CVO Inspector ==> Commercial Vehicle Check Subsystem

- Commercial Vehicle Check override mode
- CVO inspector input

Commercial Vehicle Check Subsystem ==> CVO Inspector

- CVO inspector information

### 3.2.6 Driver

This terminator represents the human entity that operates a vehicle on the roadway. Included are operators of public transport vehicles, commercial vehicles, maintenance vehicles, emergency vehicles, intermodal container and other vehicles, where the data being sent or received is not particular to the type of vehicle. This general description of the person who operates a vehicle could apply even to riders of motorcycles or bicycles. Thus this terminator originates driver requests and receives driver information that reflects the

interactions that might be useful to all drivers, regardless of vehicle classification.

The Driver terminator is the operator of the Basic Vehicle terminator. Information and interactions which are unique to drivers of a specific vehicle type (e.g., fleet interactions with public transport, commercial, maintenance, or emergency vehicle drivers) are covered separately.

**Related Communications and Associated Architecture Flows are as follows:**

Driver ==> Vehicle Subsystem
- driver inputs
- request for service

Parking Management Subsystem ==> Driver
- roadside transaction status

Roadway Subsystem ==> Driver
- driver information
- driver roadway warning
- variable speed limit

Toll Collection Subsystem ==> Driver
- roadside transaction status

Vehicle Subsystem ==> Driver
- driver updates
- in-vehicle transaction status

### 3.2.7 Emergency Response Personnel

This terminator represents personnel that are responsible for police, fire and rescue services, emergency medical services, towing, and other special response team (e.g., hazardous material clean-up) activities at an incident site. These personnel are associated with the Emergency Vehicle Subsystem during dispatch to the incident site,

but often work independently of the Emergency Vehicle Subsystem, while providing their incident response services. Emergency response personnel may include an Officer-in-Charge (OIC) and a crew. When managing an incident following standard Incident Command System practices, the on-site emergency response personnel form an organisational structure under the auspices of an Incident Commander. For a typical privatised highway, these emergency response personnel form part of its Traffic Control and Surveillance Team.

**Related Communications and Associated Architecture Flows are as follows:**

Emergency Response Personnel ==> Emergency Vehicle Subsystem

- emergency response personnel inputs

Emergency Vehicle Subsystem ==> Emergency Response Personnel

- dispatch information
- incident command information presentation

### 3.2.8 Emergency System Operator

This terminator represents the human entity that monitors all ITS emergency requests, and sets up pre-defined responses to be executed by an emergency management system. The operator may also override pre-defined responses where it is observed that they are not achieving the desired result. This terminator includes dispatchers, who manage an emergency fleet (police, fire, ambulance, HAZMAT, etc.) or higher order emergency managers who provide response coordination during emergencies.

**Related Communications and Associated Architecture Flows are as follows:**

Emergency Management Subsystem ==> Emergency System Operator

- emergency operations status

Emergency System Operator ==> Emergency Management Subsystem

- emergency operations request
- emergency response personnel inputs

### 3.2.9 Information Service Provider Operator

This terminator is the human entity that may be physically present at the ISP to monitor the operational status of the facility and provide human interface capabilities to Travellers and other ISP subsystems.

**Related Communications and Associated Architecture Flows are as follows:**

Information Service Provider Operator ==> Information Service Provider Subsystem

- ISP operating parameter updates

Information Service Provider Subsystem ==> Information Service Provider Operator

- ISP operating parameters

### 3.2.10 Intermodal Terminal Operator

The personnel that operate the Intermodal Terminal subsystem.

**Related Communications and Associated Architecture Flows are as follows:**

Intermodal Terminal Operator ==> Intermodal Terminal Subsystem

- intermodal terminal operator inputs

Intermodal Terminal Subsystem ==> Intermodal Terminal Operator

- intermodal terminal operator data

### 3.2.11 Maintenance Management Operator

This terminator represents the human entity that directly interfaces with the systems in the Maintenance Management subsystem. These personnel interact with fleet dispatch and management systems, incident management systems, and work zone management systems. They provide operator data and command inputs to direct systems' operations to varying degrees depending on the type of system and the deployment scenario. All functionality associated with these services that might be automated in the course of ITS deployment is modelled as internal to the Architecture.

**Related Communications and Associated Architecture Flows are as follows:**

Maintenance Management Subsystem ==> Maintenance Management Operator

- maintenance management operator data

Maintenance Management Operator ==> Maintenance Management Subsystem

- maintenance management operator inputs

### 3.2.12 Maintenance Vehicle Driver

This terminator represents the human entity that operates any maintenance vehicle. This terminator is complementary to the Driver terminator in that it represents those interactions that are unique to Operations and Maintenance. In general, a "real world" this terminator will interact as both a Driver (for things like general route guidance and vehicle safety features) and a Maintenance Vehicle Driver. Data flowing from the Maintenance Vehicle Driver terminator will include those system inputs specific to Operations and Maintenance, such as information regarding work zone status, or the status of maintenance actions. Data flowing to this terminator may

include system outputs such as dispatching commands and maintenance actions to be performed.

**Related Communications and Associated Architecture Flows are as follows:**

Maintenance Vehicle Driver ==> Maintenance Vehicle Subsystem
- maintenance vehicle driver inputs

Maintenance Vehicle Subsystem ==> Maintenance Vehicle Driver
- maintenance vehicle driver data

### 3.2.13 Parking Operator

This terminator is the human entity that may be physically present at the parking lot facility to monitor the operational status of the facility.

**Related Communications and Associated Architecture Flows are as follows:**

Parking Management Subsystem ==> Parking Operator
- parking status

Parking Operator ==> Parking Management Subsystem
- parking operator inputs
- request for performance data

### 3.2.14 Pedestrians

This terminator provides input (e.g. a request for right of way at an intersection) from a specialised form of the Traveller, who is not using any type of vehicle (including bicycles) as a form of transport. Pedestrians may comprise those on foot and those in wheelchairs.

**Related Communications and Associated Architecture Flows are as follows:**

Pedestrians ==> Roadway Subsystem
- crossing call

- non-vehicular presence

Roadway Subsystem ==> Pedestrians
- crossing permission

### 3.2.15 Public Transport Vehicle Driver

This terminator represents the human entity that is a special form of the Driver terminator that receives and provides additional information that is specific to Public Transport (including demand responsive public transport) operations. This information will not be received by other types of Driver.

This terminator operates the Public Transport Vehicle terminator and represents random route drivers, flexible fixed route drivers and fixed route drivers. The fixed route drivers require minimal information such as run times and passenger loading. The flex fixed and random route drivers require additional information such as dynamically changing routes.

**Related Communications and Associated Architecture Flows are as follows:**

Public Transport Management Subsystem ==> Public Transport Vehicle Driver
- route assignment

Public Transport Vehicle Driver ==> Public Transport Management Subsystem
- public transport vehicle driver availability

Public Transport Vehicle Driver ==> Public Transport Vehicle Subsystem
- public transport vehicle driver inputs

Public Transport Vehicle Subsystem ==> Public Transport Vehicle Driver
- public transport vehicle driver display

### 3.2.16 Public Transport Fleet Manager

This terminator represents the human entity that is responsible for planning the operation of public transport fleets, including monitoring and controlling the public transport fleet route schedules and the public transport fleet maintenance schedules. This comprises planning routes and schedules for either daily use or for special occasions as distinct from making day to day variations to schedules and routes.

**Related Communications and Associated Architecture Flows are as follows:**

Public Transport Fleet Manager ==> Public Transport Management Subsystem

- public transport fleet manager inputs

Public Transport Management Subsystem ==> Public Transport Fleet Manager

- public transport operations planning data

### 3.2.17 Public Transport Maintenance Personnel

The terminator represents the human entity that is actively responsible for monitoring, controlling, and planning the schedules for the maintenance of public transport fleets.

**Related Communications and Associated Architecture Flows are as follows:**

Public Transport Maintenance Personnel ==> Public Transport Management Subsystem

- maintenance status

Public Transport Management Subsystem ==> Public Transport Maintenance Personnel

- public transport work schedule

### 3.2.18 Public Transport System Operators

This terminator represents the human entities that are responsible for all aspects of the Public Transport Management subsystem operation including planning and management. They actively monitor, control, and modify the public transport fleet routes and schedules on a day to day basis. The modifications will be to take account of abnormal situations such as vehicle breakdown, vehicle delay, etc. These personnel may also be responsible for demand responsive public transport operation and for managing emergency situations within the public transport network.

**Related Communications and Associated Architecture Flows are as follows:**

Public Transport Management Subsystem ==> Public Transport System Operators

- public transport operator display

Public Transport System Operators ==> Public Transport Management Subsystem

- public transport operator management data

### 3.2.19 Toll Administrator

The Toll Administrator is the human entity that manages the back office payment administration systems for a electronic toll system. This terminator monitors the systems that support the electronic transfer of authenticated funds from the customer to the system operator. The terminator monitors customer enrolment and supports the establishment of escrow accounts depending on the clearinghouse scheme and the type of payments involved. The terminator also establishes and administers the pricing structures and policies.

**Related Communications and Associated Architecture Flows are as follows:**

Toll Administration Subsystem ==> Toll Administrator
- toll revenues and summary reports

Toll Administrator ==> Toll Administration Subsystem
- toll administration requests

### 3.2.20 Toll Operator

This terminator is the human entity that may be physically present at the toll plaza to monitor the operational status of the plaza.

**Related Communications and Associated Architecture Flows are as follows:**

Toll Collection Subsystem ==> Toll Operator
- toll transaction reports

Toll Operator ==> Toll Collection Subsystem
- toll operator requests

### 3.2.21 Traffic Operations Personnel

This terminator represents the human entity that directly interfaces with vehicle traffic operations. This terminator interacts with traffic control and surveillance systems, incident management systems, work-zone management systems, and travel demand management systems to accomplish ITS services. They provide operator data and command inputs to direct systems' operations to varying degrees depending on the type of system and the deployment scenario. All functionality associated with these services that might be automated in the course of ITS deployment is modelled as internal to the Architecture.

**Related Communications and Associated Architecture Flows are as follows:**

Environment Management Subsystem ==> Traffic Operations Personnel

- environmental data display

Traffic Management Subsystem ==> Traffic Operations Personnel

- traffic operator data

Traffic Operations Personnel ==> Environment Management Subsystem

- environmental data parameters

Traffic Operations Personnel ==> Traffic Management Subsystem

- traffic operator inputs

### 3.2.22 Traveller

This terminator represents any individual (human) who uses transportation services. At the time that data is passed to or from the terminator, the individual is neither a driver, pedestrian, nor commuter. This means that the data provided is that for pre-trip planning or multi-modal personal guidance and includes their requests for assistance in an emergency. Subsequent to receipt of pre-trip information, a Traveller may become a vehicle driver, passenger, commuter, or pedestrian.

**Related Communications and Associated Architecture Flows are as follows:**

Personal Information Access Subsystem ==> Traveller

- traveller interface updates

Remote Traveller Support Subsystem ==> Traveller

- traveller interface updates

Traveller ==> Personal Information Access Subsystem

- traveller inputs

Traveller ==> Remote Traveller Support Subsystem

- traveller inputs

## 3.3 Other Systems Terminators

This will be the third of the four groups of terminators, which define the boundary of the proposed ITS System Architecture. The following terminators are classified as Other Systems Terminators:

- Other Archives
- Other Commercial Vehicle Administration Subsystem
- Other Emergency Management
- Other Information Service Provider
- Other Intermodal Fleet Management System
- Other Parking
- Other Public Transport Management
- Other Roadside
- Other Traffic Management
- Other Vehicle

### 3.3.1 Other Archives

This terminator represents distributed archived data systems or Centres whose data can be accessed and shared with a local archive. The interface between this terminator and the Archived Data Management Subsystem allows data from multiple archives to be accessed on demand or imported and consolidated into a single repository.

**Related Communications and Associated Architecture Flows are as follows:**

Archived Data Management Subsystem ==> Other Archives
- archive coordination

Other Archives ==> Archived Data Management Subsystem
- archive coordination

### 3.3.2 Other CV Commercial Vehicle Administration Subsystem

This terminator is intended to provide a source and destination for ITS data flows between peer (e.g. inter-regional/corridor) commercial vehicle administration functions. It enables commercial vehicle administration activities to be coordinated across different jurisdictional areas. In the physical architecture, this terminator is a reciprocal Commercial Vehicle Administration Subsystem.

**Related Communications and Associated Architecture Flows are as follows:**

Commercial Vehicle Administration Subsystem ==> Other Commercial Vehicle Administration Subsystem

- Commercial Vehicle Administration Subsystem information exchange
- credentials and safety information request

Other Commercial Vehicle Administration Subsystem ==> Commercial Vehicle Administration Subsystem

- Commercial Vehicle Administration Subsystem information exchange
- credentials and safety information response

### 3.3.3 Other Emergency Management

Representing other Emergency Management Centres, systems or subsystems, this terminator provides a source and destination for ITS data flows between various communications Centres operated by public safety agencies as well as Centres operated by other allied agencies and private companies that participate in coordinated management of highway-related incidents. The interface represented by this terminator enables emergency management activities to be coordinated across jurisdictional boundaries and between functional areas. In the physical architecture this terminator

is a reciprocal Emergency Management (EM) Subsystem implying the requirements for general networks connecting many allied agencies. The interface between this terminator and the EM supports coordination of incident management information between many different Centres providing Public Safety Answering Point (both public or private sector implementations), Public Safety Dispatch, Emergency Operations, and other functions that participate in the detection, verification, response, and clearance of highway incidents. This terminator also supports interface to other allied agencies like utility companies that also participate in the coordinated response to selected highway-related incidents.

**Related Communications and Associated Architecture Flows are as follows:**

Emergency Management Subsystem ==> Other Emergency Management

- incident report
- incident response coordination

Other Emergency Management ==> Emergency Management Subsystem

- incident report
- incident response coordination

### 3.3.4 Other Information Service Provider

Representing other distinct Information Service Providers, this terminator is intended to provide a source and destination for ITS data flows between peer information and service provider functions. It enables cooperative information sharing between providers as conditions warrant. In the physical architecture this terminator is a reciprocal Information Service Provider (ISP) Subsystem.

**Related Communications and Associated Architecture Flows are as follows:**

Information Service Provider Subsystem ==> Other Information Service Provider

- ISP coordination

Other Information Service Provider ==> Information Service Provider Subsystem

- ISP coordination

### 3.3.5 Other Intermodal Fleet Management System

This terminator represents the management systems for individual fleets of intermodal transport companies. These fleets may be trucks, rail, aeroplanes, helicopters, container vessels, barges, etc. However, the terminator is broader than this and is primarily intended to show the interface between intermodal roadway trucking operators (haulage companies) and other mode shipping companies.

**Related Communications and Associated Architecture Flows are as follows:**

Fleet and Freight Management Subsystem ==> Other Intermodal Fleet Management System

- intermodal CVO co-ordination

Other Intermodal Fleet Management System ==> Fleet and Freight Management Subsystem

- intermodal CVO co-ordination

Other Intermodal Fleet Management System ==> Intermodal Terminal Subsystem

- container release status

### 3.3.6 Other Parking

Representing another parking facility, system or subsystem, this terminator provides a source and destination for information that may be exchanged between peer parking systems. This terminator enables parking management activities to be coordinated between

different parking operators or systems in a region. In the physical architecture this terminator is a reciprocal Parking Management Subsystem.

**Related Communications and Associated Architecture Flows are as follows:**

Other Parking ==> Parking Management Subsystem

- parking coordination

Parking Management Subsystem ==> Other Parking

- parking coordination

### 3.3.7 Other Public Transport Management

Representing another Public Transport Management Centre, system or subsystem, this terminator is intended to provide a source and destination for ITS data flows between peer (e.g. inter-regional) public transport management functions. It enables traffic management activities to be coordinated across geographic boundaries or different jurisdictional areas. In the physical architecture this terminator represents a reciprocal Public Transport Management Subsystem (PTMS).

**Related Communications and Associated Architecture Flows are as follows:**

Other Public Transport Management ==> Public Transport Management Subsystem

- Public Transport Management System Co-ordination

Public Transport Management Subsystem ==> Other Public Transport Management

- Public Transport Management System Co-ordination

### 3.3.8 Other Roadside

Representing another Roadside element or system, this terminator provides a source and destination for information that may be exchanged between peer roadside elements. For example, a surveillance system (sensors and processor) may directly interface to a portable dynamic message sign to display real-time information to drivers approaching a work zone.

**Related Communications and Associated Architecture Flows are as follows:**

Other Roadside ==> Roadway Subsystem
- device control data

Roadway Subsystem ==> Other Roadside
- roadside display data

### 3.3.9 Other Traffic Management

Representing another Traffic Management Centre, system or subsystem, this terminator is intended to provide a source and destination for ITS data flows between peer (e.g. inter-regional) traffic management functions. It enables traffic management activities to be coordinated across different jurisdictional areas. In the physical architecture this terminator is a reciprocal Traffic Management Subsystem (TMS).

**Related Communications and Associated Architecture Flows are as follows:**

Other Traffic Management ==> Traffic Management Subsystem
- traffic control coordination
- traffic information coordination

Traffic Management Subsystem ==> Other Traffic Management
- traffic control coordination

- traffic information coordination

#### 3.3.10 Other Vehicle

This terminator represents a vehicle that is neighbouring the Basic Vehicle, where the Basic Vehicle is equipped to support vehicle-to-vehicle communication and coordination. These features are associated with advanced vehicle safety user-service implementations. These high-end vehicle control services may involve vehicles coordinating their activities.

**Related Communications and Associated Architecture Flows are as follows:**

Other Vehicle ==> Vehicle Subsystem
- vehicle to vehicle coordination

Vehicle Subsystem ==> Other Vehicle
- vehicle to vehicle coordination

## 3.4 Systems Terminators

This will be the last of the four groups of terminators, which define the boundary of the proposed ITS System Architecture. There are thirty-two terminators classified under the systems terminators.

### 3.4.1 Archived Data User Systems

This terminator represents the systems users employ to access archived data. The general interface provided from this terminator allows a broad range of users (e.g. planners, researchers, analysts, operators) and their systems (e.g. databases, models, analytical tools, user interface devices) to acquire data and analyses results from the archive.

**Related Communications and Associated Architecture Flows are as follows:**

Archived Data Management Subsystem ==> Archived Data User Systems

- archive analysis results
- archive request confirmation
- archived data products

Archived Data User Systems ==> Archived Data Management Subsystem

- archive analysis requests
- archived data product requests

### 3.4.2 Basic Vehicle

This terminator represents the basic vehicle platform that interfaces with and hosts ITS electronics. This terminator provides an interface to drive train, driver convenience and entertainment systems, and other non-ITS electronics on-board the vehicle. This interface allows general vehicle systems (e.g., the stereo speaker system) to be shared by ITS and non-ITS systems. It also allows monitoring and control of the vehicle platform for advanced vehicle control system applications.

**Related Communications and Associated Architecture Flows are as follows:**

Basic Vehicle ==> Vehicle Subsystem

- basic vehicle measures

Roadway Subsystem ==> Basic Vehicle

- broadcast advisories

Vehicle Subsystem ==> Basic Vehicle

- vehicle control

### 3.4.3 Commercial Vehicle

The actual commercial vehicle along with the special aspects of large commercial vehicles and vehicles designed to carry cargo that extend beyond the characteristics defined for the Basic Vehicle. This terminator thus represents a special type of Basic Vehicle that is used to transport goods or services which are operated by professional drivers, typically administered as part of a larger fleet, and regulated by a Commercial Vehicle Manager. This classification applies to all such vehicles ranging from small panel vans used in local pick-up and delivery services to large, multi-axle tractor trailer rigs operating on long haul routes.

**Related Communications and Associated Architecture Flows are as follows:**

Commercial Vehicle ==> Commercial Vehicle Check Subsystem

- CVO weight and presence

Commercial Vehicle ==> Commercial Vehicle Subsystem

- commercial vehicle measures

Commercial Vehicle Subsystem ==> Commercial Vehicle

- lock tag data request

### 3.4.4 CVO Information Requestor

This terminator represents any organisation requesting CVO information. It typically represents insurance companies requesting safety information on carriers, etc.

**Related Communications and Associated Architecture Flows are as follows:**

CVO Information Requestor ==> Commercial Vehicle Administration Subsystem

- credentials and safety information request

Commercial Vehicle Administration Subsystem ==> CVO Information Requestor

- credentials and safety information response

### 3.4.5 Disaster Command Agency

The Disaster Command Agency Terminator represents the systems used by authorities that provide command-and-control leadership for coordinated disaster response. Disasters may be natural or man-made, but are civil emergencies that require multi-agency response and coordination on a massive scale. Depending on the nature and scale of the emergency, the Disaster Command Agency may be the highway concessionaire, Royal Malaysian Police, Fire and Rescue Services Department, a municipality-level agency, a state-level agency, or a national-level organisation. In the case of a major disaster, the Crisis and Disaster Management Unit of the National Security Division under the Prime Minister's Department shall take charge of the operations, which will be handled by its Special Malaysian Disaster Assistance and Rescue Team (SMART).

This terminator provides information and status on facilities that provide shelter and protection for people during emergency and disaster situations. Key aspects of the shelter are its location, suitability for the current situation, and the available capacity.

**Related Communications and Associated Architecture Flows are as follows:**

Disaster Command Agency ==> Emergency Management Subsystem

- disaster response coordination
- disaster response status
- shelter availability
- shelter location

Disaster Command Agency ==> Information Service Provider Subsystem

- disaster advisories
- shelter availability
- shelter location

Disaster Command Agency ==> Maintenance Management Subsystem

- disaster advisories
- maintenance support request

Disaster Command Agency ==> Public Transport Management Subsystem

- disaster advisories
- evacuation support request
- shelter availability
- shelter location

Disaster Command Agency ==> Traffic Management Subsystem

- disaster advisories
- road network status request

Emergency Management Subsystem ==> Disaster Command Agency

- disaster response coordination
- incident information for disaster

Maintenance Management Subsystem ==> Disaster Command Agency

- maintenance response status

Public Transport Management Subsystem ==> Disaster Command Agency

- evacuation status
- shelter status request

Traffic Management Subsystem ==> Disaster Command Agency

- traffic information

### 3.4.6 Emergency Telecommunications System

This terminator represents the human entity that monitors all ITS emergency requests, and sets up pre-defined responses to be executed by an emergency management system. The operator may also override predefined responses where it is observed that they are not achieving the desired result. This terminator includes dispatchers who manage an emergency fleet (police, fire and rescue, ambulance, HAZMAT, etc.) or higher order emergency managers, who provide response co-ordination during emergencies.

This terminator represents the telecommunications systems that connect a caller with a Public Safety Answering Point (PSAP). A PSAP refers to a call centre for call-taking and dispatch for an individual emergency service provider. These systems transparently support priority wireline and wireless caller access to the PSAP through 9-1-1 and other access mechanisms, and motorist aid call boxes. The calls are routed to the appropriate PSAP, based on caller location when this information is available. When available, the caller's location and call-back number are also provided to the PSAP by this interface.

**Related Communications and Associated Architecture Flows are as follows:**

Emergency Management Subsystem ==> Emergency Telecommunications System

- incident notification response

Emergency Telecommunications System ==> Emergency Management Subsystem

- incident notification

### 3.4.7 Enforcement Agency

This terminator represents an external entity which receives reports of violations detected by various ITS facilities, e.g. individual vehicle emissions, toll violations, speed or red light running violation, CVO violations, etc.

**Related Communications and Associated Architecture Flows are as follows:**

Commercial Vehicle Administration Subsystem ==> Enforcement Agency

- request for information on violators
- violation notification

Enforcement Agency ==> Commercial Vehicle Administration Subsystem

- information on violators

Parking Management Subsystem ==> Enforcement Agency

- violation notification

Public Transport Management Subsystem ==> Enforcement Agency

- violation notification

Toll Administration Subsystem ==> Enforcement Agency

- violation notification

Traffic Management Subsystem ==> Enforcement Agency

- violation notification

### 3.4.8 Event Organisers

This terminator represents external Special Event Organisers that have knowledge of events that may impact travel on roadways or other modal means. Examples of special event organisers include sporting events, conventions, motorcades, parades, public or political events, religious celebrations and funeral processions.

These organisers interface to the ITS to provide event information such as date, time, estimated duration, location, and any other information pertinent to traffic movement in the surrounding area.

**Related Communications and Associated Architecture Flows are as follows:**

Emergency Management Subsystem ==> Event Organisers
- event confirmation

Event Organisers ==> Emergency Management Subsystem
- event plans

Event Organisers ==> Traffic Management Subsystem
- event plans

Traffic Management Subsystem ==> Event Organisers
- event confirmation

### 3.4.9 Financial Institution

This terminator represents the organisation that handles all electronic fund transfer requests to enable the transfer of funds from the user of the service to the provider of the service. The functions and activities of financial clearinghouses are subsumed by this entity.

**Related Communications and Associated Architecture Flows are as follows:**

Archived Data Management Subsystem ==> Financial Institution
- payment request

Commercial Vehicle Administration Subsystem ==> Financial Institution
- payment request

Financial Institution ==> Archived Data Management Subsystem
- transaction status

Financial Institution ==> Commercial Vehicle Administration Subsystem

- transaction status

Financial Institution ==> Information Service Provider Subsystem

- transaction status

Financial Institution ==> Parking Management Subsystem

- transaction status

Financial Institution ==> Public Transport Management Subsystem

- transaction status

Financial Institution ==> Toll Administration Subsystem

- transaction status

Information Service Provider Subsystem ==> Financial Institution

- payment request

Parking Management Subsystem ==> Financial Institution

- payment request

Public Transport Management Subsystem ==> Financial Institution

- payment request

Toll Administration Subsystem ==> Financial Institution

- payment request

### 3.4.10 Freight Consolidation Station

An intermediate point (usually an intermodal terminal located at a port) prior to (or after) container-based shipping, where less-than-container load or less-than-truckload cargoes are consolidated into full container loads (or full containers are disbursed), for cost-effective intermodal shipping.

**Related Communications and Associated Architecture Flows are as follows:**

Commercial Vehicle Subsystem ==> Freight Consolidation Station

- container transfer location request

- entry request
- exit request
- vehicle identification

Fleet and Freight Management Subsystem ==> Freight Consolidation Station

- container delivery request
- container pickup confirmation

Freight Consolidation Station ==> Commercial Vehicle Subsystem

- container transfer location
- entry permission
- exit permission

Freight Consolidation Station ==> Fleet and Freight Management Subsystem

- container delivery confirmation
- container pickup request

### 3.4.11 Government Administrators

This terminator represents those Government agencies responsible for regulating commercial vehicle operations, e.g., Road Transport Department (RTD-JPJ), Royal Customs Malaysia, Commercial Vehicle Licensing Board (CVLB-LPKP), Royal Malaysian Police and the land offices. Regulatory Agencies are envisioned to be an integral part of the ITS Commercial Vehicle Operations (CVO) as they will be directly involved with issuance of licences, permits and other credentials for preclearance, provide database information to support most CVO services, and will receive, distribute, and audit CVO related taxes.

**Related Communications and Associated Architecture Flows are as follows:**

Commercial Vehicle Administration Subsystem ==> Government Administrators

- tax-credentials-fees request

Government Administrators ==> Commercial Vehicle Administration Subsystem

- regulations

### 3.4.12 Government Reporting Systems

This terminator represents the system and associated personnel that prepare the inputs to support the various municipal, district, state, and federal government transportation data reporting requirements using data collected by ITS systems. This terminator represents a system interface that would provide access to the archived data that is relevant to these reports. This terminator would combine data collected from the ITS archives with data from non-ITS sources to assemble and submit the required information.

**Related Communications and Associated Architecture Flows are as follows:**

Archived Data Management Subsystem ==> Government Reporting Systems

- government reporting system data

Government Reporting Systems ==> Archived Data Management Subsystem

- government reporting data receipt

### 3.4.13 Intermodal Chassis

A chassis is the frame on wheels that an intermodal container is secured to for roadway transport by a truck. This terminator includes the capabilities to provide chassis safety data for the brakes, container fasteners, and other systems.

**Related Communications and Associated Architecture Flows are as follows:**

Intermodal Chassis ==> Commercial Vehicle Subsystem

- chassis data

- chassis status

### 3.4.14 Intermodal Customer

The originator of an order to move cargo (the consignor or shipper) or the final recipient of a cargo shipment (the consignee, technically the cargo owner).

**Related Communications and Associated Architecture Flows are as follows:**

Fleet and Freight Management Subsystem ==> Intermodal Customer

- consignment contract
- shipment status

Intermodal Customer ==> Fleet and Freight Management Subsystem

- container delivery confirmation
- freight consignment request
- shipment status request

### 3.4.15 Location Data Source

This terminator represents an external entity, which provides accurate position information. External systems, which use GPS, terrestrial trilateration, or driver inputs, are potential examples. This terminator contains sensors such as radio position receivers (e.g. GPS) and/or dead reckoning sensors (e.g. odometer, differential odometer, magnetic compass, gyro, etc.). This external implies that some additional functionality associated with developing an absolute position is outside the system and will not be directly modelled by the logical or physical architecture representations of the system.

**Related Communications and Associated Architecture Flows are as follows:**

Location Data Source ==> Personal Information Access Subsystem
- position fix

Location Data Source ==> Vehicle Subsystem
- position fix

### 3.4.16 Logistics Solutions Provider

A system that provides intermodal logistics support and support for the efficient distribution of freight across transport systems and modes. This can include cargo consolidation arrangements, warehousing, and consignor-to-consignee intermodal shipping arrangements. These capabilities may be provided as part of intermodal fleet management activities, or can be provided by an independent logistics specialist.

**Related Communications and Associated Architecture Flows are as follows:**

Fleet and Freight Management Subsystem ==> Logistics Solutions Provider
- container delivery confirmation
- container location
- container pickup confirmation
- container status

Intermodal Container Subsystem ==> Logistics Solutions Provider
- cargo data
- container location
- container status

Intermodal Terminal Subsystem ==> Logistics Solutions Provider
- container availability status

Logistics Solutions Provider ==> Fleet and Freight Management Subsystem
- container location request
- container pickup request

- container status request

Logistics Solutions Provider ==> Intermodal Container Subsystem
- cargo data request
- container location request
- container status request

Logistics Solutions Provider ==> Intermodal Terminal Subsystem
- container availability request

### 3.4.17 Maintenance Vehicle

This terminator represents a specialised form of the Basic Vehicle used by maintenance fleets. It supports the on-board equipment that control the non-ITS systems such as the actual operation of the power brooms, as well as any non-ITS sensor equipment that monitors the amount of sand or salt on-board. The monitoring of the Maintenance Vehicle mechanical condition and mileage provides the major inputs for maintenance vehicle activity scheduling.

**Related Communications and Associated Architecture Flows are as follows:**

Maintenance Vehicle ==> Maintenance Vehicle Subsystem
- maintenance vehicle measures

Maintenance Vehicle Subsystem ==> Maintenance Vehicle
- maintenance vehicle controls

### 3.4.18 Malaysian Meteorological Services

This terminator provides weather, hydrologic, and climate information and warnings of hazardous weather including thunderstorms, flooding, monsoon, and hazy weather. It provides current and forecast weather data that is collected and derived by its network of meteorological stations, private sector providers, and various research organisations. The interface provides formatted

weather data and forecasts products suitable for on-line processing and integration with other ITS data products as well as Doppler radar images, satellite images, severe storm warnings, and other products that are formatted for presentation to various ITS users.

**Related Communications and Associated Architecture Flows are as follows:**

Archived Data Management Subsystem ==> Malaysian Meteorological Services

- archive requests
- archive status

Maintenance Management Subsystem ==> Malaysian Meteorological Services

- road and weather data

Malaysian Meteorological Services ==> Archived Data Management Subsystem

- volume weather information

Malaysian Meteorological Services ==> Emergency Management Subsystem

- volume weather information

Malaysian Meteorological Services ==> Information Service Provider Subsystem

- volume weather information

Malaysian Meteorological Services ==> Maintenance Management Subsystem

- volume weather information

Malaysian Meteorological Services ==> Public Transport Management Subsystem

- volume weather information

Malaysian Meteorological Services ==> Traffic Management Subsystem

- volume weather information

### 3.4.19 Mapping Service Provider

This terminator represents a service developer and provider of digitised map databases used to support ITS services. It supports the provision of the databases that are required exclusively for route guidance as well as those that are used exclusively for display by operators and at traveller information points, e.g. kiosks.

**Related Communications and Associated Architecture Flows are as follows:**

Archived Data Management Subsystem ==> Mapping Service Provider

- map update request

Emergency Management Subsystem ==> Mapping Service Provider

- map update request

Environment Management Subsystem ==> Mapping Service Provider

- map update request

Information Service Provider Subsystem ==> Mapping Service Provider

- map update request

Mapping Service Provider ==> Archived Data Management Subsystem

- map updates

Mapping Service Provider ==> Emergency Management Subsystem

- map updates

Mapping Service Provider ==> Environment Management Subsystem

- map updates

Mapping Service Provider ==> Information Service Provider Subsystem

- map updates

Mapping Service Provider ==> Personal Information Access Subsystem

- map updates

Mapping Service Provider ==> Public Transport Management Subsystem

- map updates

Mapping Service Provider ==> Remote Traveller Support Subsystem

- map updates

Mapping Service Provider ==> Traffic Management Subsystem

- map updates

Mapping Service Provider ==> Vehicle Subsystem

- map updates

Personal Information Access Subsystem ==> Mapping Service Provider

- map update request

Public Transport Management Subsystem ==> Mapping Service Provider

- map update request

Remote Traveller Support Subsystem ==> Mapping Service Provider

- map update request

Traffic Management Subsystem ==> Mapping Service Provider

- map update request

Vehicle Subsystem ==> Mapping Service Provider

- map update request

### 3.4.20 Media

This terminator represents the information systems that provide traffic reports, travel and weather conditions, and other transportation-related news services to the travelling public through radio, TV, and other media. Traffic and travel advisory information that are collected by ITS are provided to this terminator. It is also a source for traffic flow information, incident and special event

information, and other events which may have implications for the transportation system.

**Related Communications and Associated Architecture Flows are as follows:**

Emergency Management Subsystem ==> Media
- incident information for media

Environment Management Subsystem ==> Media
- environmental information

Information Service Provider Subsystem ==> Media
- traveller information for media

Media ==> Emergency Management Subsystem
- media information request

Media ==> Information Service Provider Subsystem
- external reports
- media information request

Media ==> Public Transport Management Subsystem
- media information request

Media ==> Traffic Management Subsystem
- external reports
- media information request

Public Transport Management Subsystem ==> Media
- public transport incidents for media
- public transport information for media

Traffic Management Subsystem ==> Media
- traffic information for media

### 3.4.21 Medical Facility

The Medical Facility terminator represents hospitals, trauma centres, field emergency treatment facilities and any other location capable of receiving injured persons and providing emergency care.

**Related Communications and Associated Architecture Flows are as follows:**

Emergency Management Subsystem ==> Medical Facility

- medical facility request

Medical Facility ==> Emergency Management Subsystem

- medical facility availability

### 3.4.22 Meteorological Service Provider

This terminator represents the providers of value-added sector specific meteorological services. These privatised service providers utilise Malaysian Meteorological Services data and predictions, road condition information and local environmental data provided by the traffic management or maintenance management organisations, and their own models to provide specialised detailed forecasts of local weather conditions.

**Related Communications and Associated Architecture Flows are as follows:**

Maintenance Management Subsystem ==> Meteorological Service Provider

- road and weather data

Meteorological Service Provider ==> Emergency Management Subsystem

- road weather prediction

Meteorological Service Provider ==> Information Service Provider Subsystem

- road weather prediction

Meteorological Service Provider ==> Maintenance Management Subsystem

- road weather prediction
- roadway micro prediction

Meteorological Service Provider ==> Public Transport Management Subsystem

- road weather prediction

Meteorological Service Provider ==> Traffic Management Subsystem

- road weather prediction
- roadway micro prediction

Traffic Management Subsystem ==> Meteorological Service Provider

- road and weather data

### 3.4.23 Multimodal Crossings

This terminator represents the control equipment that interfaces to a non-road based transportation system at an interference crossing with the roadway. The majority of these crossings are railroad grade crossings that are more specifically addressed by the "Railside Equipment" terminator. This terminator addresses similar interface requirements, but for other specialised intersections like draw bridges at rivers and waterways. Like highway-rail intersections, these other multimodal crossings carry traffic that may take priority over the road traffic at the intersection. The data provided will in its basic form be a simple "stop road traffic" indication. However more complex data flows may be provided that give the time at which right-of-way will be required and the duration of that right-of-way requirement.

**Related Communications and Associated Architecture Flows are as follows:**

Multimodal Crossings ==> Roadway Subsystem

- multimodal crossing status

Roadway Subsystem ==> Multimodal Crossings

- highway control status

### 3.4.24 Multimodal Transportation Service Provider

This terminator provides the interface through which transportation service providers can exchange data with ITS. They are the operators of non-roadway transportation systems (e.g. airlines, ferry services, passenger carrying heavy rail). This two-way interface enables coordination for efficient movement of people across multiple transportation modes. It also enables the traveller to efficiently plan itineraries which include segments using modes not directly included in the ITS user-services.

**Related Communications and Associated Architecture Flows are as follows:**

Archived Data Management Subsystem ==> Multimodal Transportation Service Provider

- archive requests
- archive status

Information Service Provider Subsystem ==> Multimodal Transportation Service Provider

- multimodal information request
- service request

Multimodal Transportation Service Provider ==> Archived Data Management Subsystem

- multimodal archive data

Multimodal Transportation Service Provider ==> Information Service Provider Subsystem

- multimodal information
- service response

Multimodal Transportation Service Provider ==> Public Transport Management Subsystem

- multimodal information
- public transport multimodal information
- service response

Public Transport Management Subsystem ==> Multimodal Transportation Service Provider

- service request
- public transport information
- public transport multimodal information

### 3.4.25 Other Data Sources

This terminator represents the myriad systems and databases containing data not generated from subsystems and terminators represented in the proposed Malaysian ITS System Architecture that can provide predefined data sets to the ITS archive. The terminator can provide economic, cost, demographic, land use, law enforcement, and other data that is not collected by ITS systems and would otherwise be unavailable within an ITS data archive.

**Related Communications and Associated Architecture Flows are as follows:**

Archived Data Management Subsystem ==> Other Data Sources

- archive requests
- archive status

Other Data Sources ==> Archived Data Management Subsystem

- other data source archive data

### 3.4.26 Payment Instrument

This terminator represents the entity that enables the actual transfer of funds from the user of a service to the provider of the service. This terminator can be as abstract as an account number in the logical architecture, or as real as the electronic tag in the physical architecture.

**Related Communications and Associated Architecture Flows are as follows:**

Fleet and Freight Management Subsystem ==> Payment Instrument
- request for payment

Payment Instrument ==> Fleet and Freight Management Subsystem
- payment

Payment Instrument ==> Personal Information Access Subsystem
- payment

Payment Instrument ==> Public Transport Vehicle Subsystem
- payment

Payment Instrument ==> Remote Traveller Support Subsystem
- payment

Payment Instrument ==> Vehicle Subsystem
- payment

Personal Information Access Subsystem ==> Payment Instrument
- request for payment

Public Transport Vehicle Subsystem ==> Payment Instrument
- request for payment

Remote Traveller Support Subsystem ==> Payment Instrument
- request for payment

Vehicle Subsystem ==> Payment Instrument
- request for payment

### 3.4.27 Public Transport Vehicle

This terminator represents a specialised form of the Basic Vehicle used by public transport service providers. It supports equipment to collect fares, monitor activities, request priority at signals, and provide information to Travellers. It may be a bus, LRT vehicle, or other vehicle specially designed for the carriage of passengers, such as those used by demand responsive public transport operators. The monitoring of the Public Transport Vehicle mechanical condition and

mileage provides the major inputs for transit vehicle maintenance scheduling.

**Related Communications and Associated Architecture Flows are as follows:**

Public Transport Vehicle ==> Public Transport Vehicle Subsystem

- public transport vehicle measures

### 3.4.28 Rail Operations

This is roughly the railroad equivalent to a highway, Traffic Management Centre. It is (usually) a centralised control point for a substantial segment of a railroad's operations. It is the source and destination of information that can be used to coordinate rail and highway traffic management. This terminator would also represent a railroad's management information system, if that system is the source or destination for this information. The use of a single terminator for multiple sources and destination for information exchange with the railroad entity is meant to imply the need for a single, consistent interface between a given railroad's operations and ITS traffic management. In any given implementation of ITS there may be multiple instantiations of this interface.

**Related Communications and Associated Architecture Flows are as follows:**

Rail Operations ==> Traffic Management Subsystem

- railroad advisories
- railroad schedules

Traffic Management Subsystem ==> Rail Operations

- HRI advisories

### 3.4.29 Railside Equipment

This terminator represents train interface equipment maintained and operated by the railroad and physically located at or near a grade crossing. This terminator is the source and destination for Highway-Rail Intersection (HRI) information for, or about, approaching trains and their crews (e.g. the time at which the train will arrive and the time it will take to clear a crossing, crossing status or warnings, etc.). Generally one railside equipment interface would be associated with one highway rail intersection. However, multiple crossings may be controlled.

**Related Communications and Associated Architecture Flows are as follows:**

Railside Equipment ==> Roadway Subsystem

- arriving train information
- track status

Roadway Subsystem ==> Railside Equipment

- HRI operational status
- intersection blockage notification

### 3.4.30 Road Transport Department

This terminator represents a specific public agency responsible for registering and licensing vehicles, e.g., Road Transport Department (RTD-JPJ). RTD-JPJ is a special case of the Government Administrators Terminator, but in some areas are identified separately to emphasise the specific nature of the data being exchanged, i.e. vehicle identification.

**Related Communications and Associated Architecture Flows are as follows:**

Commercial Vehicle Administration Subsystem ==> Road Transport Department

- licence request

Parking Management Subsystem ==> Road Transport Department
- licence request

Road Transport Department ==> Commercial Vehicle Administration Subsystem
- registration

Road Transport Department ==> Parking Management Subsystem
- registration

Road Transport Department ==> Traffic Management Subsystem
- registration

Road Transport Department ==> Toll Administration Subsystem
- registration

Traffic Management Subsystem ==> Road Transport Department
- licence request

Toll Administration Subsystem ==> Road Transport Department
- licence request

### 3.4.31 Royal Customs Malaysia

Royal Customs Malaysia, or Royal Customs and Excise Department is principally a revenue collecting agency under the Ministry of Finance entrusted to administrate and enforce matters relating to customs, sales tax, excise duty, and service tax. Royal Customs Malaysia performs the primary regulatory inspection function at an international point of entry, as well as at the points of exit for manufactured goods.

This border inspection agency is traditionally stationed at the Customs, Immigration and Quarantine (CIQ) Complexes at international points of entry. In Malaysia, this is generally the Royal Customs Malaysia, but can also include Immigration, Agriculture, and other inspection agencies.

**Related Communications and Associated Architecture Flows are as follows:**

Intermodal Container Subsystem ==> Royal Customs Malaysia
- container arrival information

Royal Customs Malaysia ==> Intermodal Container Subsystem
- container seal interrogation
- manifest request

Royal Customs Malaysia ==> Intermodal Terminal Subsystem
- container release status
- container manifest
- container seal status

### 3.4.32 Yellow Pages Service Providers

This terminator represents the individual organisations that provide any service oriented towards the Traveller. Example services that could be included are gas, food, lodging, vehicle repair, points of interest, and recreation areas. The Service Providers may pay a fee to have their services advertised to Travellers. The interface with the Service Provider is necessary so that accurate, up-to-date service information can be provided to the Traveller and to support electronic reservation capabilities included in the ITS User-Services.

**Related Communications and Associated Architecture Flows are as follows:**

Information Service Provider Subsystem ==> Yellow Pages Service Providers
- provider profile confirmation
- travel service request

Yellow Pages Service Providers ==> Information Service Provider Subsystem
- provider profile data
- travel service information

# APPENDICES

# APPENDIX A

# ARCHITECTURE FLOWS

**Activity reports**
Activity reports containing records of citations, accidents, inspections, etc.

**AHS control data**
Information required for vehicles to operate on AHS lanes.

**AHS control information**
Control data to AHS roadway equipment

**AHS status**
Status of AHS equipment, lane controls etc.

**AHS vehicle data**
AHS route and vehicle condition data

**alerts, messages**
Specific alerts and messages related to Commercial Vehicles (e.g. trucks not advised, trucks over 10 tons not allowed on bridge, route details)

**archive analysis requests**
A user request that initiates data mining, analytical processing, aggregation or summarisation, report formulation, or other advanced processing and analysis of archived data. The request also includes information that is used to identify and authenticate the user and support electronic payment requirements, if any.

**archive analysis results**
Processed information products, supporting meta data, and any associated transaction information resulting from data mining, analytical processing, aggregation or summarisation, report formulation, or other on-line processing and analysis of archived data.

**archive coordination**
Catalogue data, meta data, published data, and other information exchanged between archives to support data synchronisation and satisfy user data requests.

**archive management data**
Information used to support the management of an ITS archive including database reports on the condition and quality of the archived data, status of the import and collection process, reports that monitor archive usage, and any special requests that require direct action by the administrator (e.g., requests for access to new data sources).

**archive management requests**
Commands, requests, and queries that support the administration and management of an ITS data archive.

**archive request confirmation**
Confirmation that an archive request has been received and processed with information on the disposition of the request

**archive requests**
A request to a data source for information on available data (i.e. "catalogue") or a request that defines the data to be archived. The request can be a general subscription intended to initiate a continuous or regular data stream or a specific request intended to initiate a one-time response from the recipient.

**archive status**
Notification that data provided to an archive contains erroneous, missing, or suspicious data or verification that the data provided appears valid. If an error has been detected, the offending data and the nature of the potential problem are identified.

**archived data product requests**
A user-specified request for archived data products (i.e. data, meta data, or data catalogs). The request also includes information that is used to identify and authenticate the user and support electronic payment requirements, if any.

**archived data products**
Raw or processed data, meta data, data catalogs and other data products provided to a user system upon request. The response may also include any associated transaction information.

**arriving train information**
Information for a train approaching a highway-rail intersection that may include direction and allow calculation of approximate arrival time and closure duration.

**bad tag list**
List of invalid commuter tags which may have previously failed a fare payment transaction.

**basic vehicle measures**
Information provided to on-board ITS equipment from the vehicle platform indicating current vehicle status.

**border clearance event record**
Results of border clearance check.

**broadcast advisories**
General broadcast advisories that are provided over wide-area wireless communications direct to the vehicle radio. These analogue advisory messages may provide similar content to ITS broadcast information flows, but include no digital data component. Existing Highway-Advisory Radio (HAR) advisory messages are a prime example of this flow.

**broadcast information**
General broadcast information that contains link travel times, incidents, advisories, transit services and a myriad of other traveller information.

**cargo data**
Measures associated with the cargo inside a container, like temperature.

**cargo data request**
Request for measures associated with the cargo inside a container, like temperature; may require authentication.

**chassis data**
Measures from chassis systems like brakes, tyres, and fasteners.

**chassis status**
Indication of operational readiness of a chassis.

**citation data**
Safety problems related to the carrier, driver and vehicle that may lead to a citation.

**clearance event record**
Results of vehicle clearance activity.

**closure coordination**

Coordination between subsystems regarding construction and maintenance closure times and durations.

**Commercial Vehicle Administration Subsystem information exchange**
Tax and credential fee information exchanged between cooperating commercial vehicle administration offices.

**commercial vehicle archive data**
Information describing commercial vehicle travel and commodity flow characteristics. Content may include a catalogue of available information, the actual information to be archived, and associated meta data that describes the archived information.

**Commercial Vehicle Check override mode**
Manual override by the commercial vehicle roadside facility inspector of automated pass/pull-in signage information.

**commercial vehicle data**
Information about the commercial vehicles cargo, credentials, and payments.

**commercial vehicle data request**
Request for commercial vehicle information (cargo, driver's credit, vehicle location).

**commercial vehicle measures**
Commercial vehicle, driver, and cargo safety status measured by on-board ITS equipment.

**commuter fare status**
Status of fare transaction for commuter.

**commuter information**
Information about individual commuters boarding a public transport vehicle, used to track a user's progress on a scheduled public transport trip.

**commuter inputs**
Requests from commuter through either an on-board or fixed location traveller information station.

**commuter outputs**
Information for traveller from either an on-board or fixed location traveller information station.

**compliance review report**
Report containing data from facility activity logs from various roadside facilities.

**consignment contract**
Contract to pickup and deliver freight.

**construction and maintenance archive data**
Information describing road construction and maintenance activities identifying the type of activity, the location of the activity, and the activity status. Content may include a catalogue of available information, the actual information to be archived, and associated meta data that describes the archived information.

**container arrival information**
Information on the time, location, identification and point-of-origin of a container arriving at an intermodal facility, which is provided to Royal Customs Malaysia.

**container availability request**
Request for information on the availability of a container at an Intermodal Terminal

**container availability status**
Information regarding the availability of a container at an Intermodal Terminal

**container delivery confirmation**
Notice confirming the arrival and transfer of control of a container at a container handling facility, for example an intermodal terminal.

**container delivery request**
Request for permission to deliver a container to an intermodal facility.

**container identification**
A unique identification of a container that can be used to associate the container with a manifest and other important data.

**container location**
The location of a container, to sufficient accuracy to allow efficient container management.

**container location request**
Request to a container to provide its location; may require the requestor to authenticate their identity.

**container manifest**
Official statement of the cargo held in a container.

**container pickup confirmation**
Notice confirming that a container has been picked up at an intermodal facility and that control has been transferred to a shipping or drayage agency.

**container pickup request**
Request for permission to pickup a container at an intermodal transfer facility.

**container release status**
Information regarding whether a container has been released (by Royal Customs Malaysia, or by the Other Intermodal FFMS)

**container seal interrogation**
Royal Customs Malaysia inspection of the electronic seal on a container to verify the container has not been opened or tampered with; requires proper authentication.

**container seal status**
The status of an electronic seal on a container, indicating sealing time, location, and authority, and any openings or tampering.

**container status**
Measures from systems on-board the container, possibly including refrigeration, shock measurement, controlled atmosphere sensing and any other systems that support special needs of the cargo.

**container status request**
Request for data from the sensing systems on-board the container.

**container transfer location**
Location within an intermodal facility that a container is to be received at or delivered to; may include guidance as well as location.

**container transfer location request**
Request for the location within an intermodal facility for the transfer of a container.

**container transport assignment**
Instructions to a commercial vehicle for the transportation of a container.

**credential application**
Application for commercial vehicle credentials for a particular route/trip.

**credentials and safety information request**
Request for additional credentials and safety information.

**credentials and safety information response**
Instructions to commercial vehicle managing and/or information systems indicating which vehicles are to be allowed to pass and which are out of service or have not been credentialed.

**credentials information**
Response containing credentials information.

**credentials information request**
Request for credential information.

**crossing call**
Request for pedestrian crossing.

**crossing permission**
Signal to pedestrians indicating permission to cross roadway.

**current network conditions**
Current traffic information, road and weather conditions, and camera images that can be used to locate and verify reported incidents, and plan and implement an appropriate response.

**CVO database update**
Credential information and safety problem list updates.

**CVO driver initialisation**
Commercial vehicle driver and vehicle information and requests to the commercial vehicle managing system.

**CVO inspector information**
Credential, safety, and preclearance information and instructions to the commercial vehicle inspector.

**CVO inspector input**
Requests from the commercial vehicle inspector to operate the commercial vehicle inspection station.

**CVO Pull in Message**
Message sent to commercial vehicle driver requesting pull in to inspection/verification stop along with inspection results.

**CVO weight and presence**
Weigh-In-Motion message to indicate presence of commercial vehicle and its weight.

**demand responsive public transport plan**
Plan regarding overall demand responsive public transport schedules and deployment.

**demand responsive public transport request**
Request for paratransit support.

**device control data**
Control data for roadside devices that is exchanged between roadside devices or from a maintenance management system to the roadside.

**device status**
Roadside control system and device status provided to maintenance management, for purposes of system maintenance and control

**disaster advisories**
Broadcast information on disaster extent, response activities, and recommended traveller actions.

**disaster response coordination**
Information supporting the coordination of disaster and emergency response assets and activities.

**disaster response status**
Broadcast of disaster response status and activities specifically for emergency management and public safety.

**dispatch information**
Dispatch information and command to emergency personnel.

**driver and vehicle information**
Requests from the driver and vehicle for routing, payment, and enrolment information.

**driver information**
General advisory and traffic control information provided to the driver while en-route.

**driver inputs**
Driver commands to the vehicle.

**driver instructions**
Public transport service instructions for both public transport and paratransit drivers.

**driver roadway warning**
Warning information provided to the driver based on dynamic sensing of localised factors affecting safe roadway usage.

**driver updates**
Information displayed or otherwise conveyed by the vehicle to the driver.

**electronic clearance data**
Information required for electronic clearance (toll, safety, Royal Customs Malaysia, etc.).

**electronic clearance request**
Request for electronic clearance data (Toll, safety, Royal Customs Malaysia, etc.).

**electronic credentials**
Authenticated credentials including route enrolment and payment confirmation.

**emergency acknowledge**
Acknowledge request for emergency assistance and provide additional details regarding actions and verification requirements.

**emergency archive data**
Logged incident information that characterises the identified incidents and provides a record of the corresponding incident response. Content may include a catalogue of available information, the actual information to be archived, and associated meta data that describes the archived information.

**emergency data request**
A request for additional information or a control command issued by the emergency response agency in response to an emergency request for assistance from a traveller.

**emergency dispatch requests**
Emergency vehicle dispatch instructions including incident location and available information concerning the incident.

**emergency dispatch response**
Request for additional emergency dispatch information (e.g., a suggested route) and provision of en-route status.

**emergency notification**
An emergency request for assistance originated by a traveller using an in-vehicle, public access, or personal device. Sufficient information is provided so that the recipient can determine the location of the emergency as a minimum. Additional information identifying the requestor and requesting device and the nature and severity of the emergency may also be provided (and required) by some systems.

**emergency operations request**
Emergency operator inputs supporting call taking, dispatch, and other operations and communications centre operator functions.

**emergency operations status**
Emergency operations data supporting a range of emergency operating positions including call taker, dispatch, and various other operations and communications centre operator positions.

**emergency response personnel inputs**
Current incident status information and requests from emergency response personnel in the field for information and/or resources.

**emergency request**
An emergency assistance request originated by a commuter using an in-vehicle, public access, or personal device.

**emergency traffic control request**
Special request to pre-empt the current traffic control strategy in effect at one or more signalised intersections or highway segments. For example, this flow can request all signals to red-flash, request a progression of traffic control preemptions along an emergency vehicle route, or request another special traffic control plan.

**emergency traffic control response**
Status of the special traffic signal control strategy implemented in response to the emergency traffic control request.

**emergency vehicle tracking data**
The current location and operating status of the emergency vehicle.

**entry permission**
Permission for a commercial vehicle to enter an intermodal transfer facility.

**entry request**
Request by a commercial vehicle for permission to enter an intermodal transfer facility.

**environmental archive data**
Raw or aggregated environmental data for archiving.

**environmental conditions**
Current environmental and roadway conditions (e.g., air temperature, wind speed, road surface and sub-surface temperatures) as measured by environmental sensors and communicated by supporting field equipment.

**environmental data**
Measured environmental data and associated imagery collected by roadside equipment.

**environmental data display**
Both reference and current environmental status details for a given geographic area.

**environmental hazards**
Detection of specific localised hazards affecting the roadway, like strong winds, mudslides, landslides and flooding.

**environmental information**
Aggregated region-wide measured environmental data and possible environmental incident information.

**environmental levels**
Environmental levels as monitored by sensors.

**environmental sensor data**
Raw or processed data from sensors on vehicles and roadside equipment, that describes roadway environmental conditions; this data is exchanged between traffic and maintenance management.

**environmental state criteria**
Environmental state acceptance criteria.

**environmental state data parameters**
Nominal environmental state data compliance (reference) levels for each sector of an urban area.

**environmental state data request**
Aggregated environmental state data information request.

**equipment maintenance status**
Current status of field equipment maintenance actions.

**evacuation status**
Plans and progress for the use of public transport to support a mass evacuation effort.

**evacuation support request**
Request to public transport to support efforts to implement an evacuation strategy.

**event confirmation**
Confirmation that special event details have been received and processed.

**event plans**
Plans for major events possibly impacting traffic.

**exit permission**
Permission for a commercial vehicle to leave an intermodal transfer facility.

**exit request**
Request by a commercial vehicle for permission to leave an intermodal transfer facility.

**external reports**
Traffic and incident information that is collected by the media through a variety of mechanisms (e.g., radio station call-in programs, air surveillance).

**fare and payment status**
Current fare collection information including the operational status of the fare collection equipment and financial payment transaction data.

**fare and price information**
Current public transport, parking, and toll fee schedule information.

**fare management information**
Public transport fare information and transaction data used to manage public transport fare processing on the public transport vehicle.

**fault reports**
Reports from field equipment (sensors, signals, signs, controllers, etc.) which indicate current operational status.

**fleet manager inquiry**
Inquiry from fleet manager requesting data from commercial vehicle management system.

**fleet status**
Fleet status information including enrolment status, routing information, current vehicle information, and emergency information.

**fleet to driver update**
Updated instructions to the driver including dispatch, routing, and special instructions

**freeway control data**
Control commands and operating parameters for ramp meters, dynamic message signs, mainline metering/lane controls and other systems associated with freeway operations.

**freeway control status**
Current operational status and operating parameters for ramp meters, dynamic message signs, mainline metering/lane controls and other control equipment associated with freeway operations.

**freight consignment request**
Request from a shipper (consignor) for services to handle shipping of a container or freight load.

**government reporting data receipt**
The acknowledgement of satisfactory receipt of information used as input to government data systems or a report identifying problems or issues with the data submittal.

**government reporting system data**
Information provided by an ITS archive, formatted as appropriate, that can be used as input to government data reporting systems.

**HAZMAT information**
Information about a particular hazmat load including nature of the load and unloading instructions. May also include HAZMAT vehicle route and route update information

**HAZMAT information request**
Request for information about a particular hazmat load.

**highway control status**
Current traffic control equipment status that indicates operational status and right-of-way availability to the non-highway transportation mode at a multimodal crossing.

**HOV data**
Current HOV lane information including both standard traffic flow measures and information regarding vehicle occupancy in HOV lanes.

**HRI advisories**
Notification of Highway-Rail Intersection equipment failure, intersection blockage, or other condition requiring attention, and maintenance activities at or near highway rail intersections.

**HRI control data**
Data required for HRI information transmitted at railroad grade crossings and within railroad operations.

**HRI operational status**
Status of the highway-rail grade crossing equipment including both the current state or mode of operation and the current equipment condition.

**HRI request**
A request for highway-rail intersection status or a specific control request intended to modify HRI operation.

**HRI status**
Status of the highway-rail intersection equipment including both the current state or mode of operation and the current equipment condition.

**in-vehicle transaction status**
The status of an electronic payment transaction presented to the driver by in-vehicle equipment.

**incident command information**
Information that supports local management of an incident. It includes resource deployment status, hazardous material information, traffic, road, and weather conditions, evacuation advice, and other information that enables emergency personnel in the field to implement an effective, safe incident response.

**incident command information presentation**
Presentation of information to emergency personnel in the field that supports local tactical decision-making within an incident command system structure.

**incident command request**
Request for resources, commands for relay to other allied response agencies, and other requests that reflect local command of an evolving incident response.

**incident data**
Data and imagery from the roadside supporting incident detection and verification.

**incident information**
Notification of existence of incident and expected severity, location, time and nature of incident.

**incident information for disaster**
Report of current disaster incident information prepared for the Disaster Command Authority.

**incident information for media**
Report of current desensitised incident information prepared for public dissemination through the media.

**incident information request**
Request for incident information, clearing time, severity. The request can be a subscription that initiates as-needed information updates as well as a one-time request for information.

**incident notification**
An incident request for assistance originated by a traveller using an in-vehicle, public access, or personal device. Sufficient information is provided so that the recipient can determine the location of the incident as a minimum. Additional information identifying the requestor and requesting device and the nature and severity of the incident may also be provided (and required) by some systems.

**incident notification response**
Interactive acknowledgement and verification of the incident information received, requests for additional information, and general information on incident response status.

**incident report**
Report of an identified incident including incident location, type, severity and other information necessary to initiate an appropriate incident response.

**incident response coordination**
Incident response procedures, resource coordination, and current incident response status that are shared between allied response agencies to support a coordinated response to incidents. This flow also coordinates a positive hand off of responsibility for all or part of an incident response between agencies.

**incident response status**
Status of the current incident response including traffic management strategies implemented at the site (e.g., closures, diversions, traffic signal control overrides).

**incident status**
Information gathered at the incident site that more completely characterises the incident and provides current incident response status.

**information on violators**
Response from law enforcement agency to violations notification request

**information request**
General purpose information request for data stored within the commercial vehicle operations information exchange network.

**intermodal CVO co-ordination**
Exchange of information between different Intermodal Freight Management centres regarding cargo or intermodal container movement. The information may involve unit ID, location, and status.

**intermodal dispatch**
Directions for dispatch for pickup or delivery of an intermodal load.

**intermodal freight archive data**
Information describing demand at intermodal freight terminals including loading/unloading activities of trailers and containers. Content may include a catalogue of available information, the actual information to be archived, and associated meta data that describes the archived information.

**intermodal status**
Information from a commercial vehicle on the status of container and chassis systems that the vehicle is transporting.

**intermodal status request**
Request from a fleet manager for the status of an intermodal load.

**intermodal terminal operator data**
Information provided to the operator of an intermodal terminal.

**intermodal terminal operator inputs**
Inputs and control actions by an intermodal terminal operator.

**international border crossing data**
Cleared commercial vehicle data to allow pass-through international border crossings.

**international border crossing data update**
Update from commercial vehicle check stations of international border crossing events.

**intersection blockage notification**
Notification that a highway-rail intersection is obstructed and supporting information.

**intersection status**
Status of intersection congestion, approaching vehicles, etc.

**ISP coordination**
Coordination and exchange of transportation information between centres. This flow allows a broad range of transportation information collected by one ISP to be redistributed to many other ISPs and their clients.

**ISP operating parameter updates**
Tuning and performance enhancement parameters to ISP algorithms

**ISP operating parameters**
Parameters provided to the ISP Operator by the ISP including broadcast information settings, route selection controls, and travel optimisation algorithms.

**licence request**
Request supporting registration data based on licence plate read during violation.

**local signal pre-emption request**
Direct control signal or message to a signalised intersection that results in pre-emption of the current control plan and grants right-of-way to the requesting vehicle.

**local signal priority request**
Request from a vehicle to a signalised intersection for priority at that intersection.

**location request**
Request for the location of a commercial vehicle.

**lock tag data**
Tag information on cargo lock.

**lock tag data request**
Request to supply lock information on cargo lock for retransmission to international border crossing station.

**log information**
Request information to be entered into the driver log.

**logged special vehicle route**
Anticipated route information for special vehicles (e.g., oversize vehicles) or groups of vehicles (e.g., Sultan's motorcade) that may require changes in traffic control strategy.

**maintenance archive data**
Raw or aggregated maintenance data for archiving.

**maintenance dispatch status**
Status of maintenance vehicle dispatching and deployment for traffic management.

**maintenance vehicle driver data**
Information and instructions provided to the driver of a maintenance vehicle.

**maintenance vehicle driver inputs**
Information and control actions provided by the driver of a maintenance vehicle.

**maintenance management operator data**
Information provided to the operator of maintenance management.

**maintenance management operator inputs**
Information, control, and dispatching inputs from the maintenance operator.

**maintenance resource request**
Request for road maintenance resources that can be used in the diversion of traffic (cones, portable signs), clearance of an incident, and repair of ancillary damage.

**maintenance resource response**
Current status of maintenance resources included availability and deployment status.

**maintenance response status**
Maintenance management response to a request for coordinated assistance in a disaster situation.

**maintenance status**
Current maintenance status of vehicle.

**maintenance status data**
Information and measures from specialised maintenance equipment on-board of a maintenance vehicle.

**maintenance support request**
Request for maintenance fleet support during a disaster situation.

**maintenance vehicle controls**
Control data sent from on-board ITS systems to control maintenance vehicle equipment.

**maintenance vehicle dispatch**
Maintenance activity instructions for a maintenance vehicle.

**maintenance vehicle measures**
Maintenance vehicle status to be measured by on-board ITS equipment.

**maintenance vehicle status data**
Operational status, location, and other measures associated with the operation of a maintenance vehicle.

**manifest request**
Royal Customs Malaysia request for the electronic manifest associated with a container; requires proper authentication.

**map update request**
Request for a map update which could include a new underlying map or map layer updates.

**map updates**
Map update which could include a new underlying static or real-time map or map layer(s) update.

**media information request**
Request from the media for current transportation information.

**medical facility availability**
Specific care capabilities and available space in a medical facility.

**medical facility request**
Request for specific emergency care or for the capabilities and capacity of a facility in a disaster situation.

**multimodal archive data**
Operational information from alternate passenger transportation modes including air, rail transit, taxis, and ferries. Content may include a catalogue of available information, the actual information to be archived, and associated meta data that describes the archived information.

**multimodal crossing status**
Indication of operational status and pending requests for right-of-way from equipment supporting the non-highway mode at multimodal crossings.

**multimodal information**
Schedule information (static and real-time) for non-vehicular transportation providers. (in areas such as train, ferry, and air).

**multimodal information request**
Information request for alternate mode transportation providers such as train, ferry, air and bus.

**non-vehicular presence**
Sensed presence of pedestrians and other non-motor vehicle travellers at roadway crossing or control points.

**on-board safety data**
Vehicle safety data measured by vehicle sensors and sent to inspection stations

**on-board safety request**
Request for on-board vehicle safety data.

**on-board vehicle data**
Condition of the commercial vehicle sent to commercial vehicle manager primarily for maintenance purposes.

**other data source archive data**
Data extracted from other data sources. A wide range of ITS and non-ITS data and associated meta data may be provided.

**parking archive data**
Data used to analyse and monitor trends in parking demand, pricing, and operational actions. Content may include a catalogue of available information, the actual information to be archived, and associated meta data that describes the archived information.

**parking availability**
Current parking lot occupancy, parking availability, and cost information.

**parking coordination**
Information that enables parking management activities to be coordinated between different parking operators or systems in a region.

**parking demand management request**
Request to change the demand for parking facility use through pricing or other mechanisms.

**parking demand management response**
Response to parking demand management change requests indicating level of compliance with request.

**parking information**
General parking information and current parking availability.

**parking instructions**
Information that allows local parking facilities to be managed to support regional traffic management objectives.

**parking lot data request**
Request for parking lot occupancy, fares, and availability. The request can be a subscription that initiates as-needed information updates as well as a one-time request for information.

**parking lot reservation confirmation**
Confirmation for parking lot reservation.

**parking operator inputs**
Local parking operator inputs that query current status and control the operation of the parking management system.

**parking reservations request**
Reservation request for parking lot.

**parking status**
Parking lot operational status.

**pass/pull-in**
Command to commercial vehicle to pull into inspection station.

**payment**
Information passing from a payment instrument (e.g., smart card) to a payment device to provide electronic payment of some kind (e.g., toll, parking, fare) by traveller. In most cases the payment can be related to a credit account.

**payment request**
Request for payment from financial institution.

**personal public transport information**
General and personalised public transport information for a particular fixed route, flexible route, or paratransit system.

**physical presence**
Detection of an obstacle by a vehicle or roadside equipment. Obstacle could include fallen trees, fallen utility lines, animals, other vehicles, pedestrians, rocks in roadway etc.

**position fix**
Information which provides a traveller or vehicles geographical position.

**probe data**
Aggregate data from probe vehicles including location, speed for a given link or collection of links.

**provider profile confirmation**
Confirmation of profile information received by a service provider (e.g. for a hotel or restaurant).

**provider profile data**
Information supplied by a service provider (e.g., a hotel or restaurant) that identifies the service provider and provides details of the service offering. This flow covers initial registration of a service provider and subsequent submittal of new information and status updates so that data currency is maintained.

**public transport archive data**
Data used to describe and monitor public transport demand, fares, operations, and system performance. Content may include a catalogue of available information, the actual information to be archived, and associated meta data that describes the archived information.

**public transport and fare schedules**
Specific public transport and fare schedule information including schedule adherence.

**public transport demand management request**
Request to change the demand for public transport facility use through pricing or other mechanisms.

**public transport demand management response**
Response to public transport demand management change requests indicating level of compliance with request.

**public transport emergency coordination data**
Data exchanged between centres dealing with a public transport-related incident.

**public transport emergency data**
Initial notification of public transport emergency at a public transport stop or on public transport vehicles and further coordination as additional details become available and the response is coordinated.

**public transport fare payment requests**
Information provided from the commuter location that supports fare payments and associated record-keeping.

**public transport fare payment responses**
Information provided by public transport management that supports a fare payment transaction

**public transport fleet manager inputs**
Instructions governing service availability, schedules, emergency response plans, public transport personnel assignments, public transport maintenance requirements, and other inputs that establish general system operating requirements and procedures.

**public transport incident information**
Information on public transport incidents that impact public transport services for public dissemination.

**public transport incidents for media**
Report of an incident impacting public transport operations for public dissemination through the media.

**public transport information**
Information on public transport services, schedules, and availability that is exchanged between different public transport mode providers.

**public transport information for media**
Report of public transport schedule deviations for public dissemination through the media.

**public transport information request**
Request for public transport operations information including schedule and fare information. The request can be a subscription that initiates as-needed information updates as well as a one-time request for information.

**public transport information user request**
Request for special public transport routing, real-time schedule information, and availability information.

**Public Transport Management System coordination**
Co-ordination information between local/regional public transport organisations including schedule, on-time information, connection co-ordination, and ridership.

**public transport multimodal information**
Public transport schedule information for coordination at modal interchange points.

**public transport operations planning data**
Accumulated schedule and fare information, emergency response plans, public transport personnel information, maintenance records, and other information intended to support overall planning and management of a public transport property.

**public transport operator display**
Display for public transport operations personnel regarding performance of the public transport fleet, current ridership and on-time performance.

**public transport operator management data**
Information and control provided by public transport system operators involving many aspects of managing public transport operations.

**public transport parking coordination**
Request for coordinated fare payment and parking lot price data.

**public transport parking lot response**
Response to public transport occupancy inquiries and coordination with parking lots.

**public transport request confirmation**
Confirmation of a request for public transport information or service.

**public transport schedule information**
Current and projected public transport schedule adherence.

**public transport system data**
Current public transport system operations information indicating current public transport routes, the level of service on each route, and the progress of individual vehicles along their routes for use in forecasting demand and estimating current transportation network performance.

**public transport traveller information**
Public transport information prepared to support commuter and other travellers. It contains public transport schedules, real-time arrival information, fare schedules, and general public transport service information.

**public transport trip plan**
An origin-destination public transport trip that may involve multiple modes and connections.

**public transport trip request**
Request for a public transport trip plan that is responsive to traveller requirements such as schedule, cost, or duration.

**public transport vehicle conditions**
Operating conditions of public transport vehicle (e.g., mileage).

**public transport vehicle driver availability**
Public transport vehicle driver availability data that can be used to develop driver assignments and detailed operations schedules.

**public transport vehicle driver display**
Display (either video or audio) to public transport vehicle driver containing status of various ITS services.

**public transport vehicle driver inputs**
Public transport vehicle driver emergency request as well as fare transaction data.

**public transport vehicle location data**
Current public transport vehicle location and related operational conditions data provided by a public transport vehicle.

**public transport vehicle measures**
Public transport vehicle status measured by on-board ITS equipment.

**public transport vehicle passenger and use data**
Data collected on board the public transport vehicle pertaining to availability and/or passenger count.

**public transport vehicle schedule performance**
Estimated times of arrival and anticipated schedule deviations reported by a public transport vehicle.

**public transport work schedule**
Orders for maintenance of public transport vehicle or other public transport system equipment.

**railroad advisories**
Real-time notification of railway-related incident or advisory.

**railroad schedules**
Train schedules, maintenance schedules, and other information from the railroad that supports forecast of HRI closures.

**registration**
Registered owner of vehicle and associated vehicle information.

**regulations**
Regulations imposed on Commercial Vehicle Administration agencies including safety ratings, facility locations and credential fee structure.

**remote surveillance control**
The control commands used to remotely operate another centre's sensors or surveillance equipment so that roadside surveillance assets can be shared by more than one agency.

**request fare and price information**

Requests for current fare and price information from a service

**request for bad tag list**
Request for list of bad vehicle tag IDs.

**request for information on violators**
Request for law enforcement information on vehicles and drivers suspected of violations.

**request for payment**
Request to deduct cost of service from user's payment account.

**request for performance data**
Request issued by a service provider for current parking service performance data.

**request for right-of-way**
Forwarded request from signal prioritisation, signal pre-emption, pedestrian call, multi-modal crossing activation, or other source for right-of-way.

**request for service**
A traveller service request initiated by a driver or traveller. The request may result in a financial transaction, summon an emergency response, or initiate another service at the behest of the driver.

**request for traffic information**
Request for traffic information that specifies the region/route of interest, the desired effective time period, and other parameters that allow preparation of a tailored response. The request can be a subscription that initiates as-needed information updates as well as a one-time request for information.

**request for vehicle measures**
Request for vehicle performance and maintenance data collected by onboard sensors.

**request tag data**
Request for tag information including credit identity, stored value card cash, etc.

**request public transport information**
Request for public transport service information and current public transport status.

**resource deployment status**
Status of traffic management centre resource deployment identifying the resources available and their current deployment status.

**resource request**
A request for traffic management resources to implement special traffic control measures, assist in clean up, verify an incident, etc.

**resource response**
Plan for deploying maintenance resources to address a specific maintenance request from traffic management.

**reversible lane status**
Current reversible lane status including traffic sensor and surveillance data and the operational status and mode of the reversible lane control equipment.

**road and weather data**
Roadway weather and environmental data and road maintenance information gathered by traffic management from roadside sensor systems.

**road network status request**
Request from an authority coordinating a disaster response for information on the usability and congestion of the road network.

**road network use**
Aggregated route usage and associated travel data from clients for planning and analysis.

**road weather prediction**
Prediction of weather information, customised to a particular users needs and region.

**roadside archive data**
A broad set of data derived from roadside sensors that includes current traffic conditions, environmental conditions, and any other data that can be directly collected by roadside sensors. This data also indicates the status of the sensors and reports of any identified sensor faults.

**roadside display data**
Information conveyed between roadside devices for display to travellers (e.g. temperature for a DMS).

**roadside log update**
Update of activities at commercial vehicle check stations including clearance events and

**roadside transaction status**
The status of an electronic payment transaction provided directly to the driver via sign or other roadside infrastructure.

**roadway characteristics**
Detectable or measurable road characteristics such as friction coefficient and general surface and sub-surface conditions, road geometry and markings, etc. These characteristics are monitored or measured by vehicle ITS components or roadside sensors and used to support advanced vehicle safety and control capabilities.

**roadway information system data**
Information used to initialise, configure, and control roadside systems that provide driver information (e.g., dynamic message signs, highway advisory radio, beacon systems). This flow can provide message content and delivery attributes, local message store maintenance requests,

control mode commands, status queries, and all other commands and associated parameters that support remote management of these systems.

**roadway information system status**
Current operating status of dynamic message signs, highway advisory radios, beacon systems, or other configurable field equipment that provides dynamic information to the driver.

**roadway maintenance information**
Summary of maintenance activities affecting the road network.

**roadway micro prediction**
Prediction of weather and roadway conditions at a fine level of resolution (e.g. for individual links in the road network).

**roadway warning data**
Information provided to roadway systems that support the dissemination of roadway warnings to vehicles and drivers, based on local road hazard conditions.

**roadway warning status**
Status of devices providing roadway hazard warnings.

**route assignment**
Route assignment information for public transport driver.

**route plan**
Tailored route provided by ISP in response to a specific request.

**route request**

Request for a tailored route based on given constraints.

**safety information**
Response containing commercial vehicle safety information.

**safety information request**
Request for commercial vehicle safety information.

**safety inspection record**
Record containing results of commercial vehicle safety inspection.

**screening data**
Data stored in vehicle's tag allowing electronic clearance at border crossings, debits at toll plazas, and clearance at safety inspections.

**screening request**
Request for screening data based on vehicle and possibly cargo's tags.

**secure area characteristics**
Characteristics (visual, audible, other) that are monitored by surveillance security systems via sensors.

**secure area monitoring support**
Commands that control surveillance equipment and security sensors that monitor secure public transportation areas. Also includes information for general advisories and alerts intended for general dissemination in these same public areas.

**secure area surveillance data**
Data collected from surveillance systems used to monitor secure areas. Includes video, audio, and other security sensor outputs.

**selected routes**
Routes selected based on route request criteria.

**sensor and surveillance control**
Control of roadway elements that provide control and monitoring of roadway and mixed use roadway and right-of-way interfaces, supporting mixed vehicular and pedestrian usage.

**sensor control**
Control of roadside sensors used by maintenance management to monitor traffic flow in and around work zones.

**service request**
Request to multimodal (possibly non-roadway) transport provider for general services information and specific trip information or reservations.

**service response**
Multimodal (possibly non-roadway) transport provider services information and trip reservation confirmations.

**shelter availability**
Available (unused) capacity of an emergency shelter.

**shelter location**
The location of an emergency shelter.

**shelter status request**
Request for information about and current occupancy status of an emergency shelter.

**shipment status**
Current location and transit status of a freight shipment, for the consignor or consignee.

**shipment status request**
Request from consignor or consignee for the current location and transit status of a freight shipment.

**signal control data**
Information used to configure and control traffic signal systems.

**signal control status**
Status of surface street signal controls.

**suggested route**
Suggested route for a dispatched emergency vehicle that may reflect current network conditions and the additional routing options available to en-route emergency vehicles that are not available to the general public.

**surveillance data**

Data acquired by work zone sensing systems for management of work zones.

**tag data**
Unique tag ID and related vehicle information for payment for services and access control purposes.

**tag update**
Update data held in tag which can be read at another screening.

**tax filing, audit data**
Commercial vehicle tax filing and audit data.

**tax-credentials-fees request**
Request to government agency for tax, credential and/or fee data.

**toll administration requests**
Instructions indicating toll fees which should be charged.

**toll archive data**
Data indicating toll facility usage and pricing schedules. Content may include a catalogue of available information, the actual information to be archived, and associated meta data that describes the archived information.

**toll data**
Current toll schedules for different types of vehicles as well as advanced toll payment information.

**toll data request**
Request made to obtain toll schedule information or pay a toll in advance. The request can be a subscription that initiates as-needed information updates as well as a one-time request for information.

**toll demand management request**
Request to change the demand for toll road facility use through pricing or other mechanisms.

**toll demand management response**
Response to toll demand management change requests indicating level of compliance with request.

**toll instructions**
Demand management toll pricing information based on current congestion.

**toll operator requests**
Request for information from toll operator at toll collection site.

**toll revenues and summary reports**
Summary of toll revenues and toll-related reports to toll service provider.

**toll transaction reports**

Summary report sent to toll collection point operator containing

**toll transactions**
Detailed list of transactions from a toll station.

**track status**
Current status of the wayside equipment and notification of an arriving train.

**traffic archive data**
Information describing the use and vehicle composition on transportation facilities and the traffic control strategies employed. Content may include a catalogue of available information, the actual information to be archived, and associated meta data that describes the archived information.

**traffic characteristics**
Physical traffic characteristics which are monitored and translated into macroscopic measures like occupancy, volume, density, and average speed. Point measures support presence detection and individual vehicle measures like speed. This may also include detection of non-vehicular traffic in the roadway, such as bicycles and pedestrians.

**traffic control coordination**
Information transfers that enable remote monitoring and control of traffic management devices. This flow is intended to allow cooperative access to, and control of, field equipment during incidents and special events and during day-to-day operations. This flow also allows 24-hour centres to monitor and control assets of other centres during off-hours, allows system redundancies and fail-over capabilities to be established, and otherwise enables integrated traffic control strategies in a region.

**traffic control enforcement**
Settings for parameters that dictate what conditions constitute a violation of speed limits and traffic signals.

**traffic control priority request**
Request for signal priority at one or more intersections along a particular route.

**traffic control priority status**
Status of signal priority request functions at the roadside (e.g. enabled or disabled).

**traffic equipment status**
Identification of field equipment requiring repair and known information about the associated faults.

**traffic flow**
Raw and/or processed traffic detector information which allows derivation of traffic flow variables (e.g., speed, volume and density measures) for mixed use vehicles.

**traffic images**
High fidelity, real-time traffic images suitable for surveillance monitoring by the operator or for use in machine vision applications.

**traffic information**
Current and forecasted traffic information, road and weather conditions, and incident information. Either raw data, processed data, or some combination of both may be provided by this architecture flow.

**traffic information coordination**
Traffic information exchanged between TMC's. Normally would include incidents, congestion data, traffic data, signal timing plans, and real-time signal control information.

**traffic information for media**
Report of current traffic conditions, incidents, maintenance activities and other traffic-related information prepared for public dissemination through the media.

**traffic information for public transport**
Current and forecasted traffic information and incident information.

**traffic operator data**
Presentation of traffic operations data to the operator including traffic conditions, current operating status of traffic control equipment, maintenance activity status, incident status, and other information. This data keeps the operator appraised of current road network status, provides feedback to the operator as traffic control actions are implemented, and supports review of historical data and preparation for future traffic operations activities.

**traffic operator inputs**
Traffic operations requests for information, configuration changes, commands to adjust current traffic control strategies (e.g, adjust signal timing plans, change DMS messages), and other traffic operations data entry.

**transaction status**
Response to transaction request. Normally dealing with a request for payment.

**travel service information**
Reservation information or yellow pages data.

**travel service request**
Request for reservation or other service (e.g., yellow pages).

**traveller advisory request**
In vehicle communication between transit and vehicle systems includes advisories and advance payment deductions.

**traveller archive data**
Data associated with traveller information services including service requests, facility usage, rideshare, routing, and traveller payment transaction data. Content may include a catalogue of available information, the actual information to be archived, and associated meta data that describes the archived information.

**traveller information**
Traveller information comprised of traffic status, advisories, incidents, payment information and many other travel-related data updates and confirmations.

**traveller information for media**
General traveller information regarding incidents, unusual traffic conditions, road weather conditions and forecasts, public transport issues, or other advisory information that has been desensitised and provided to the media.

**traveller inputs**
Request by a traveller to summon assistance, request travel information, make a reservation, or request any other traveller service.

**traveller interface updates**
Visual or audio information (e.g., routes, messages, guidance) to the traveller.

**traveller profile**
Information about a traveller including equipment capabilities, personal preferences and recurring trip characteristics.

**traveller request**
Request by a traveller to summon assistance, request information, make a reservation, or initiate any other traveller service.

**trip confirmation**
Acknowledgement by the driver/traveller of acceptance of a route.

**trip plan**
A sequence of links and special instructions comprising of a trip plan indicating efficient routes for navigating the links. Normally coordinated with traffic conditions, weather, other incidents, preemption and prioritisation plans.

**trip request**
Request by a driver/traveller for special routing.

**variable speed limit**
Legally enforceable speed limit information presented to a driver that can be varied as appropriate for roadway and weather conditions.

**vehicle characteristics**
The physical or visible characteristics of an individual vehicle that can be measured to classify a vehicle and imaged to uniquely identify a vehicle.

**vehicle control**
Vehicular control commands

**vehicle identification**
Identification of a commercial vehicle to an intermodal terminal for the purpose of entrance and exit control, guidance, and safety monitoring.

**vehicle location**
Location of vehicle and other vehicle characteristics which are exchanged between vehicle subsystems.

**vehicle pollution criteria**
Vehicular pollution acceptance criteria.

**vehicle probe data**
Vehicle probe data indicating identity, route segment identity, link time and location.

**vehicle roadway warning data**
Warnings about local roadway hazards or operating limits, conveyed to in-vehicle equipment.

**vehicle signage data**
In-vehicle signage data generated by the roadway infrastructure indicating either road conditions, street names, or special information which will be useful for a vehicle passing a specific point on the roadway.

**vehicle signal violation**
Detection of a vehicle violating a control signal.

**vehicle speed violation**
Detection of a vehicle violating a speed limit.

**vehicle to vehicle coordination**
Any type of advanced vehicle to vehicle communication.

**vehicle variable speed limit data**
Current speed limit in effect, conveyed to in-vehicle equipment.

**vehicular presence**
Non-traditional road vehicle user (bicycles, golf carts, etc.) approach and presence at the roadway.

**violation detection**
Roadside detection of a vehicle violating a speed limit, traffic signal, or control signage.

**violation notification**
Notification to enforcement agency of violation of a traffic law, emission requirement, or commercial vehicle regulation.

**volume weather information**
Accumulated forecasted and current weather data (e.g., temperature, pressure, wind speed, wind direction, humidity, precipitation, visibility, light conditions, etc.).

**weather conditions**
Weather and roadway conditions that serve as the input environmental data for sensors at the roadside or in maintenance and other vehicles.

**wide-area statistical environmental information**
Aggregated region-wide measured environmental data and possible environmental incident information.

**work zone status**
Status of maintenance work zone.

**yellow pages information**
Travel service information covering tourist attractions, lodging, restaurants, service stations, emergency services, and other services and businesses of interest to the traveller.

**yellow pages request**
Request for information through a yellow pages type service.

# APPENDIX B

# LIST OF ABBREVATIONS

**AHS**
Automated Highway System

**CASE**
Computer Aided System Engineering

**CCTV**
Closed Circuit Television

**CIQ**
Customs, Immigration and Quarantine

**CVLB-LPKP**
Commercial Vehicle Licensing Board – Lembaga Pelesenan Kenderaan Perdagangan

**CV**
Commercial Vehicle

**CVO**
Commercial Vehicle Operations

**DSRC**
Dedicated Short Range Communications

**EM**
Emergency Management

**FFMS**
Fleet and Freight Management Subsystem

**GPS**
Global Positioning System

**HAR**
Highway-Advisory Radio

**HAZMAT**
Hazardous materials

**HOV**
High Occupancy Vehicle

**HRI**
Highway-Rail Intersection

**ID**
Identification

**ISP**
Information Service Provider

**ITS**
Intelligent Transport System

**LRT**
Light Rail Transit

**OIC**
Officer-in-Charge

**PSAP**
Public Safety Answering Point

**PTMS**
Public Transport Management System

**RTD-JPJ**
Road Transport Department – Jabatan Pengangkutan Jalan

**SMART**
Special Malaysian Disaster Assistance and Rescue Team

**TMS**
Traffic Management Subsystem