KAJIAN PELAN INDUK SISTEM PENGANGKUTAN PINTAR

Development of ITS System Architecture for Malaysia

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Physical Architecture Framework Volume II - Subsystems

1 SUBSYSTEMS

1.1 Introduction

Subsystems are the primary structural elements of the Physical Architecture. Subsystems perform transportation functions (e.g., collect data from the roadside, perform route planning, etc.), all of which are defined in the Logical Architecture as Process Specifications. Processes that are likely to be collected together under one physical agency, jurisdiction, and physical unit are grouped together into a Subsystem.

1.2 Subsystem Classifications

Subsystems may be grouped into four distinct subsystem classes that share basic functional, deployment, and institutional characteristics. These classes are used to frame top level descriptions for each of the subsystems, as described below:

- **Centres** - provide management, administration, and support functions for the transportation system. The Centre Subsystems each communicate with other centres to enable co-ordination between modes and across jurisdictions. The Centre Subsystems communicate with other subsystems to gather information and provide information and control that is co-ordinated by the Centre Subsystems.

- **Roadsides** - provide the direct interface to the roadway, railway, or other transportation network, vehicles and travellers that are travelling on the network. Each of the Roadside Subsystems includes functions that require distribution to the transportation network that to support direct surveillance, information provision,

and plan execution. The Roadside Subsystems also provide interface to the Centre and Vehicle Subsystems to support operations.

- **Vehicles** - are all ITS related elements on vehicle platforms that allow the sharing of general driver information, vehicle navigation and safety systems functions. The Vehicle Subsystems communicate with the Roadside and Centre Subsystems for prevision of information to the driver.

- **Travellers** - includes the equipment that is used by traveller to access traveller information. These Subsystems interface to the information provider (mostly Information Service Provider Subsystem) to access the traveller information. Specific equipment included in this Subsystem class include personal computers, telephones, personal digital assistants (PDAs), televisions, and any other communications-capable consumer products that can be used to supply information to the traveller.

Table 1 provides a summary of the Subsystem classifications.

CENTRES
1. Archived Data Management Subsystem (ADMS)
2. Commercial Vehicle Administration Subsystem (CVAS)
3. Emergency Management Subsystem (EMS)
4. Environment Management Subsystem (ENMS)
5. Fleet and Freight Management Subsystem (FMS)
6. Information Service Provider Subsystem (ISP)
7. Maintenance Management Subsystem (MMS)
8. Public Transport Management Subsystem (PTMS)
9. Toll Administration Subsystem (TAS)
10. Traffic Management Subsystem (TMS)

Table 1 - Subsystem Classification

ROADSIDES
1. Commercial Vehicle Check Subsystem (CVCS)
2. Intermodal Terminal Subsystem (ITSS)
3. Parking Management Subsystem (PMS)
4. Roadway Subsystem (RS)
5. Toll Collection Subsystem (TCS)
TRAVELLERS
1. Personal Information Access Subsystem (PIAS)
2. Remote Traveller Support Subsystem (RTS)
VEHICLES
1. Commercial Vehicle Subsystem (CVS)
2. Emergency Vehicle Subsystem (EVS)
3. Intermodal Container Subsystem (ICS)
4. Maintenance Vehicle Subsystem (MVS)
5. Public Transport Vehicle Subsystem (PTVS)
6. Vehicle Subsystem (VS)

Table 1 - Subsystem Classification (cont.)

2 SUBSYSTEM DESCRIPTIONS

2.1 Centres

2.1.1 Archived Data Management Subsystem

This 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 aid the emergency dispatcher in selecting the emergency vehicle(s) and routes that will provide the most timely response. Interface with the Traffic Management Subsystem allows strategic 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

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 Travellers

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

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