KAJIAN PELAN INDUK SISTEM PENGANGKUTAN PINTAR

Development of ITS System Architecture for Malaysia

Technical Note No. 4

Volume I – Description

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TABLE OF CONTENTS

Physical Architecture Framework Volume I - Description

1 PHYSICAL ARCHITECTURE PROCESS MODEL

1.1 Introduction

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 inputs (sources) and system terminator outputs (destinations) for architecture flows into and out of the system.

1.2 System Overview

Functions (process specifications in the Logical Architecture) are assigned to subsystems such that the interfaces between subsystems represent candidate interfaces in the physical world. Subsystems were selected based on a limited set of criteria in order to:

- represent the functions of each major stakeholder group at a high level on in the physical architecture (e.g. Public Transport Agencies, Emergency Services, Commercial Vehicle Operators all see both infrastructure and vehicle components)

- explicitly specify those functions that are performed in centers and those functions performed in vehicles (e.g. Route Planning could be performed either in the vehicle or by a service provider, route selection and turn-by-turn guidance is always done in the vehicle)

- collect functions currently performed by a single agency together (e.g. public transport center functions are all performed in the Public Transport Management Subsystem, traffic management is performed in the Traffic Management Subsystem)

- separate functions that may in the future be split out to third party providers (e.g. provision of information in the Information Service Provider Subsystem, and data brokering in the Commercial Vehicle Administration Subsystem)

1.3 Architecture Definitions

The following definitions define the framework for the whole Physical Architecture:

- **Subsystems** - Subsystems are the primary structural components of the Physical Architecture. Focus group concerns, institutional issues, and technology constraints and capabilities are used to determine subsystems which can most likely be supported by single institution, which perform functions which "belong" together, and whose interfaces may require standards to promote interoperability and compatibility.

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

- **Physical Architecture Flows** - Processes from the logical architecture are assigned to each of the subsystems according to stakeholder inputs. Architecture flows between subsystems are determined based on the data exchange implied by the process specification assignments and the data flows in the logical architecture.

- **Physical Architecture Interconnections** - Each type of data flowing between subsystems requires a specific type of interconnect. The collection of interconnects which support all data flows are defined in the communications layer of the architecture.

1.4 Document Organizations

This document is comprised of four volumes. This document, volume I, introduces the components of the Physical Architecture and it is intended to provide an overview of the Architecture. Volume II, III, and IV define the Subsystems, Terminators and Architecture Flows of the Physical Architecture.

2 PHYSICAL ARCHITECTURE

This chapter describes the context of the Physical Architecture, that is, what functions are defined within the architecture and what is considered outside the scope of the architecture. The functions defined in the architecture are contained within subsystems. The functions outside the scope of the architecture are represented by terminators. These two types of architectural elements (subsystems and terminators) are called entities. Classes bundle entities together into different categories such as humans, computers, and the physical world. Interfaces between these entities are sometimes very clearly data flows which can be carried by communication media. Some interfaces are fuzzier representing physical observation, contact, or human interaction.

2.1 Physical Architecture Decomposition

The architecture can be viewed at several levels of detail. The Architecture defines collections of subsystems at a sufficient level to express interfaces and processes that are essential to the development of interface standards that are necessary for nationwide interoperability. This section provides a top level representation of the architecture in terms of the entity class. It indicates the different types of entities and the kinds of relations that the architecture includes.

2.1.1 Top Level Physical Architecture

Figure 1 shows the Physical Architecture at only the top level. The box in the center of Figure 1 represents the architecture subsystems while the outside boxes represent collections of terminators with which the subsystems interact. The lines between boxes represent at a high level the interfaces to the ITS system. Five classes of physical entities are defined:

- **Subsystems** - These perform transportation functions (e.g., collect data from the roadside, perform route planning, etc.). All of the functions are defined in the logical architecture as process specifications. Processes that are likely to be collected together under one physical agency or, jurisdiction, are grouped together into a subsystem. This grouping is done to optimize the overall expected performance of the resulting ITS deployments taking into consideration anticipated communication technologies, performance etc.

- **Human** - These are people who interact with the architecture. The people could either be travellers who use ITS to achieve travel goals, or operators of ITS who use features to streamline their operations, improve service, or make money. Each interface to a user involves human interaction with the system.

- **Systems outside ITS** - These are organizations or agencies that will likely interact with ITS through computer interfaces. These interfaces are similar to internal architecture interfaces.

- **Environment** - This is the physical world of pavement, air, obstacles and so on.

- **Other Subsystems within the Architecture** - There may be a multiplicity of instantiations of each of the Architecture subsystems. To adequately model the interaction between these multiple implementations, one representative of each subsystem is explicitly included in the diagrams while those which it communicates with are represented as Other Subsystems.

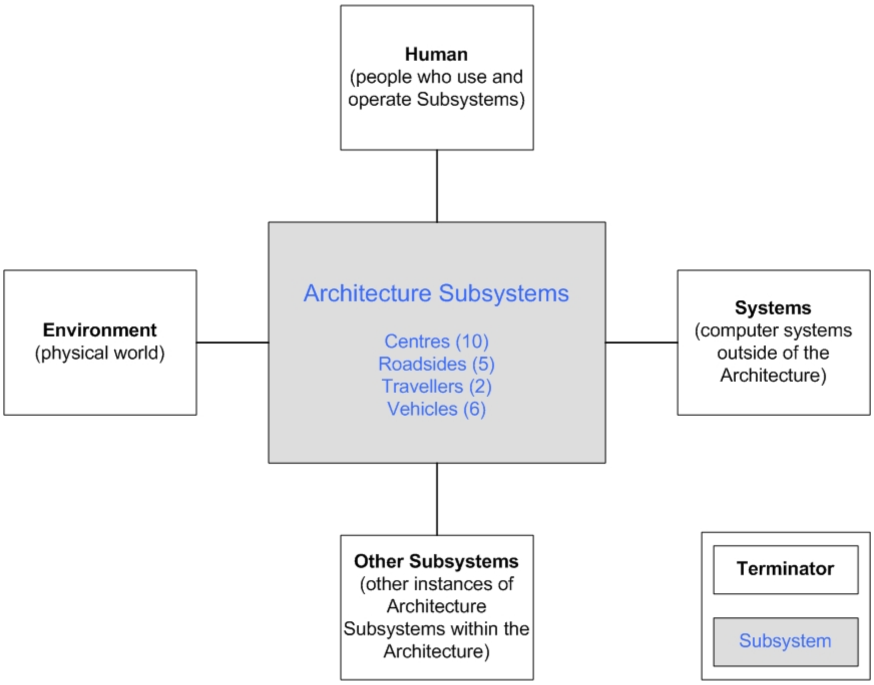

Figure 1 – Simple View of ITS Physical Architecture Structure

There are four subclasses for the subsystems:

- **Centers** which collect and store information within the infrastructure

- **Roadsides** represent the devices or equipment that are deployed along the side of the road at many locations.

- **Travellers** represent ITS users with transportation needs.

- **Vehicles** refer to all vehicles that communicate with the ITS, that is either feeding or receiving information from the ITS.

Figure 2 presents the top level Architecture Flow Diagram. The diagram represents the type of information that is exchanged between the four classes of subsystems and the associated terminators.

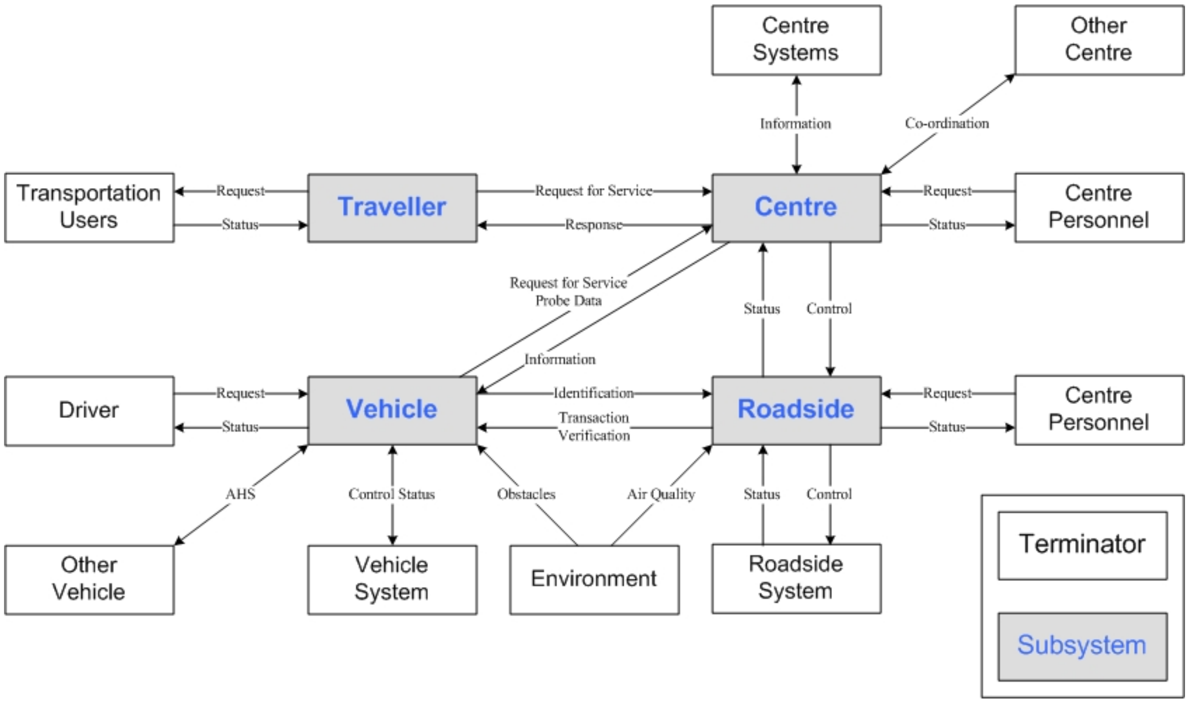

Figure 2 – Top Level Architecture Flow Diagram

The information types indicated in Figure 2 are the exchanged between entity classes using different types of communication media.

2.1.2 Physical Architecture Interconnects

Architecture Interconnects are communications paths that carry information between subsystems and terminators in the Physical Architecture. Figure 3 presents a very simplified view of this communications interface is provided in the Top Level Architecture Interconnect Diagram. Several different types of interconnects are defined in the architecture to reflect the range of interface requirements in ITS. The majority of the interconnects can be defined as one of the following types of communications links:

- **Wireline** - addresses the information transfer between two fixed entities. Typically, this interface is manifested using one of the many alternative existing public or private networks that may physically include wireless (e.g. microwave) as well as wireline infrastructure.

- **Wide Area Wireless** - defines cell-based wireless infrastructures and digital audio broadcasts supporting wide-area information transfer (most data flows). The cell-based airlink, from a mobile terminal to one of a set of base stations, provides connections between mobile users or between mobile and fixed network-connected users (e.g. those connected to the telephone network). It is typified by the current cellular telephone network, the larger cells of Specialized Mobile Radio, and PCS. This interface type also includes one-way broadcast wireless communications systems used to provide basic traveler information across a wide area. Both voice and data communications are included. FM Sub-carrier is a prime example of a data capable, broadcast communications technology that is included.

- **Dedicated Short Range Communications (DSRC)**- defines the short-range airlink used for close-proximity (less than 100 metres) transmissions between a mobile user and a base station, typified by transfers of vehicle identification numbers at toll booths.

- **Vehicle to Vehicle Communications** - addresses the dedicated wireless system handling high data rate, low probability of error, line of sight, AHS-related data flows, such as vehicle to vehicle transceiver radio systems.

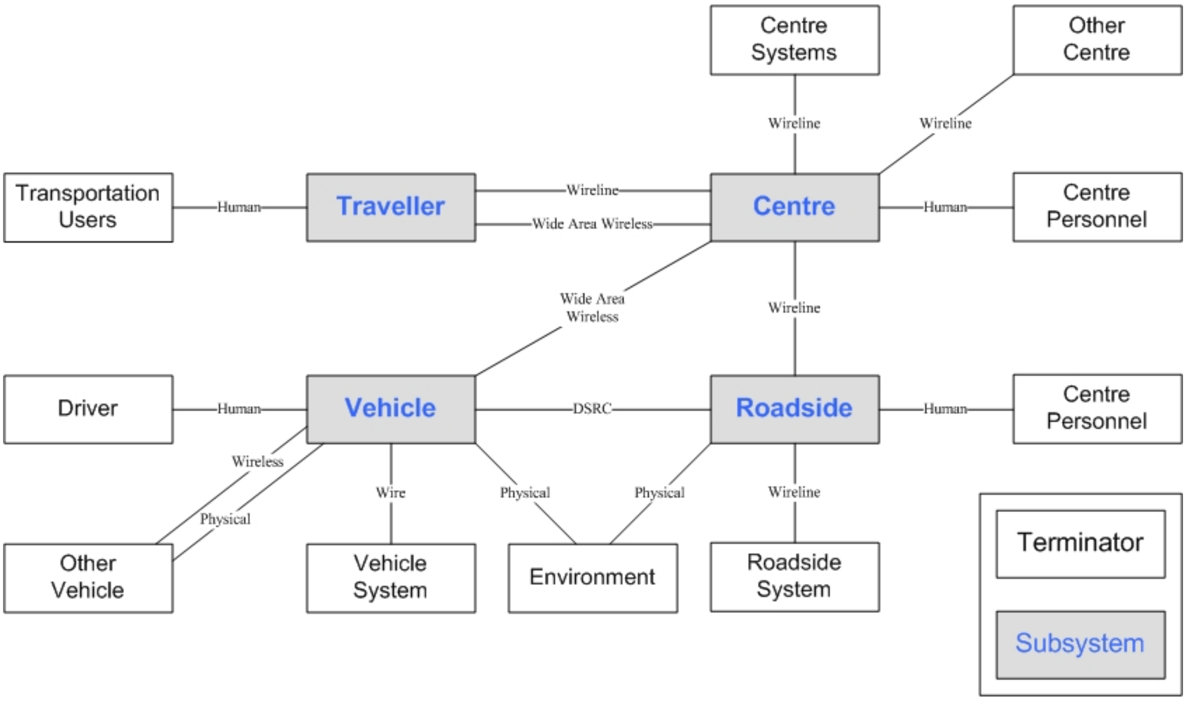

Figure 3 – Top Level Architecture Interconnect Diagram

In addition to these types of communication, there are several specialized interconnects, including human interface (i.e. what the systems user sees and hears) and physical/environmental (i.e. what the ITS sensors sense).

2.1.3 Physical Architecture Sausage Diagram

A sausage diagram is a top level architecture interconnect diagram that depicts the Physical Subsystems for full representation of ITS and the basic communication channels between these Subsystems. Figure 4 shows the Sausage Diagram for the Malaysian ITS Architecture.

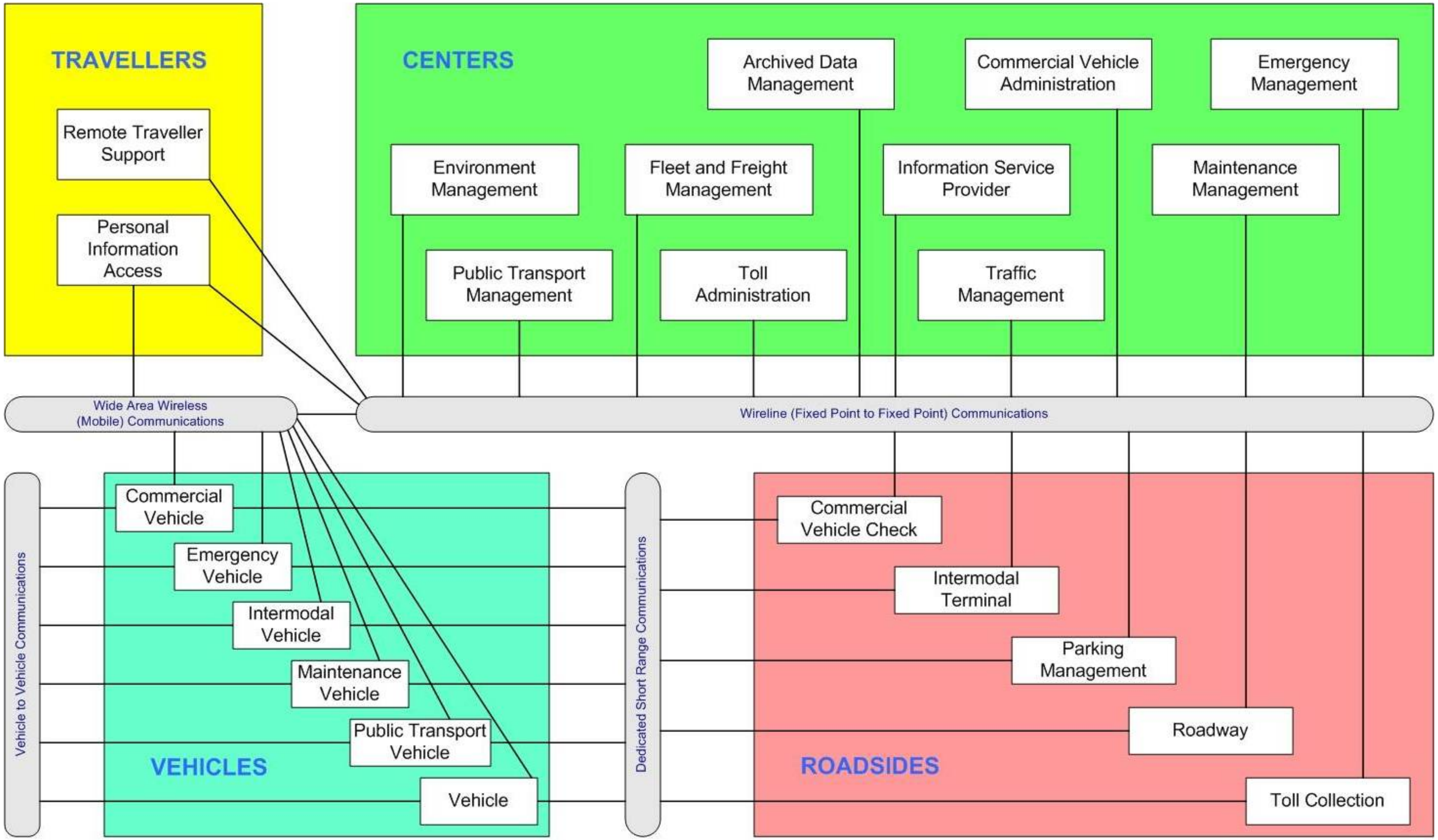

Figure 4 – Malaysian ITS Architecture Sausage Diagram