3 The FRAME Architecture – its contents

3.1 Introduction

This chapter provides a guide to the contents of the FRAME Architecture. It is intended as a guide to those that are looking for particular parts of the Architecture and should be used as an initial step before using the FRAME Browsing Tool.

3.2 FRAME Architecture Contents

3.2.1 Introduction

The FRAME Architecture contents are divided into two parts: User Needs and the Functional Viewpoint. In simple terms the User Needs describe what ITS can provide and the Functional Viewpoint shows how it can be done. Details of the User Needs are in deliverable D13, available from the FRAME website at: http://www.frame-online.net.

3.2.2 What is in the Functional Viewpoint

In its current incarnation (Version 4.1) the FRAME Architecture covers the areas of ITS shown in Table 1 on the following pages. As can be seen from this table, each area of ITS is assigned to its own part of the Functional Viewpoint, called a "Functional Area".

Within each Functional Area there is a set of functionality in the form of Functions that are linked to each other using Data Flows. The Data Flows also link the Functions to Data Stores that contain data that is used by two or more Functions. Within each Functional Area, its Functions are arranged in a hierarchy. The structure of the hierarchy in each Functional Area is different and depends on the number of Functions needed for each area of ITS and their complexity. Generally speaking the hierarchical structures are driven by the following two main factors:

- The need to identify the functionality required for different purposes, e.g. car parking, urban traffic management, creating schedules for regular Public Transport schedules and managing on-demand Public Transport.

- The need to enable the functionality to be assigned to different physical locations in each sub-set ITS architecture. So for example it should be possible for some functionality to be assigned to the roadside in a sub-set architecture, but to a central system, or the vehicle in another. This will enable different overall system configurations to be explored so that there is more chance of finding the optimal one.

Other factors that influence the hierarchical structures are the need make the functionality easy to understand and the need to minimise the flow of data between Functional Areas.

Table 1 - Functional Viewpoint contents

Part of ITS		Functional Area in FRAME Architecture Functional Viewpoint		
Name	**Extra Information**	**Number**	**Name**	**Description**
Electronic Fee Collection		1	Provide Electronic Payment Facilities	This Area shall provide functionality that enables the acceptance of payment for services provided by other Functional Areas within the Architecture. It shall have an interface with the Financial Clearinghouse terminator to enable actual payment transactions to be made. If payment violations are detected, any details that are available shall be passed to functionality in the Law Enforcement Area.
Emergency Notification and Response	Notification of emergencies from the roadside and in-vehicles, plus management of emergency vehicle response and stolen vehicles.	2	Provide Safety and Emergency Facilities	This Area shall provide functionality that enables the Emergency Services to respond to incidents. The Functions in this Area shall have links with the Manage Traffic Area to enable the reporting and detection of incidents, the management of their impacts and the granting of priority to Emergency Vehicles. It shall be possible for priority to be provided either locally at each controlled point on the road network, or as a "route" through the network. There shall be links to the Provide Traveller Journey Assistance Area to enable priority routes for Emergency Vehicles to be produced.

Part of ITS		Functional Area in FRAME Architecture Functional Viewpoint		
Name	**Extra Information**	**Number**	**Name**	**Description**
Traffic Management	Management of urban and inter-urban parts of the road network, plus modelling, parking, tunnel, bridge and road maintenance management	3	Manage Traffic	This Area shall provide functionality enabling the management of traffic in urban and inter-urban environments. Functionality shall be included to detect and manage the impact of incidents, produce and implement demand management strategies, monitor car park occupancies and provide road transport planning. Links shall be provided to the Provide Safety and Emergency Facilities and Manage Public Transport Areas so that their vehicles are given priority through the road network and to enable assistance to be provided in the implementation of incident and demand management strategies. The External Service Provider terminator shall be sent data about traffic conditions and strategies.
Public Transport Management	Preparation and management of schedules and fares for regular PT, plus management of on-demand services and car pooling.	4	Manage Public Transport Operations	This Area shall provide functionality to enable the management of Public Transport. It shall include the scheduling of services and the generation of information that can be made available to travellers. The Area shall have links with the Manage Traffic Area to provide priority for its vehicles, and to provide data on the use of services so that an assessment can be made of demand for different modes of transport. The Manage Traffic Area shall also provide requests for service changes to enable a move towards a better balance in the use of transport modes. There shall also be links to other Areas to provide information about fraud and incidents that have been detected in the Public Transport network.

Part of ITS		Functional Area in FRAME Architecture Functional Viewpoint		
Name	**Extra Information**	**Number**	**Name**	**Description**
In-Vehicle Systems	Collection of data about vehicle operation, plus some aspects of cooperative systems	5	Provide Support for Host Vehicle Systems	This Area shall provide functionality that enables data to be collected from the Vehicle and inputs provided for possible use by its management functionality. Functionality shall also be included in this Area to enable the output within the Vehicle of traffic and travel information provided by the Manage Traffic Area, plus warning messages to Drivers produced from a variety of sources, the exchange of data with other nearby Vehicles and the detection of objects in the vicinity of the Vehicle. This Functional Area shall provide Drivers with functionality that shall enable trip planning to be done from within the Vehicle. Data that has been collected from the Vehicle about its operation is distributed to functionality in other Functional Areas. Interfaces shall be provided to the Provide Safety and Emergency Facilities Area to provide a speedy response to e-Calls that have been received from Vehicles. Vehicle identities shall be provided by the functionality when requested by other Areas for payment collection and the identification of fraud.

Part of ITS		Functional Area in FRAME Architecture Functional Viewpoint		
Name	**Extra Information**	**Number**	**Name**	**Description**
Traveller Assistance	Pre- and on-trip multi-modal journey planning for private and commercial vehicle drivers, plus provision of travel information	6	Provide Traveller Journey Assistance	This Functional Area shall provide functionality that enables the provision of information to all types of Travellers about traffic conditions and about other modes of transport. The functionality shall also provide pre-trip journey planning, including special routes for Emergency Vehicles and Goods Vehicles. On-trip route guidance shall also be provided, together with the ability to change a trip itinerary due to Traveller input, or the occurrence of events that affect the flow of Vehicles through the road network. As part of the trip planning process, the functionality shall provide access to other services such as accommodation and to other transport modes.
Law Enforcement		7	Provide Support for Law Enforcement	This Area shall provide functionality to enable the provision of an interface to Law Enforcement agencies. This interface shall be used to provide information about frauds and violations that have been detected by functionality within other Areas. Examples of frauds and violations shall include but not be limited to invalid or missing payment, speeding, incorrect use of lanes in the road, incorrect observance of other commands sent to drivers. Over-weight vehicles shall be detected by functionality within the Area itself and the details passed to the Law Enforcement Agency.

| Part of ITS		Functional Area in FRAME Architecture Functional Viewpoint		
Name	**Extra Information**	**Number**	**Name**	**Description**
Freight and Fleet Management	Provides both fleet management organisations and "owner drivers" and includes multi-modal freight movements.	8	Manage Freight and Fleet Operations	This Area shall provide functionality that enables the management of Freight and Fleet Operations. This shall control the use of freight vehicles and their transportation of goods. The use of other modes of freight transport shall also be supported. An interface to the Provide Safety and Emergency Facilities Area shall also be included to enable the provision of information about hazardous goods. Route planning for this and other types of goods shall be provided through the interface to the Provide Traveller Journey Assistance Area.
Support for Cooperative Systems	Includes specific aspects such as bus lane use.	9	Provide Support for Cooperative Systems	This Functional Area shall provide the functionality that is needed to support the implementation of some cooperative systems services that cannot be wholly assigned to parts of other Functional Areas. The particular services that shall be supported by this Functional Area include the management of priority for Other Vehicles, the use by non-Public Transport Vehicles of any spare capacity in Bus Lanes, Vehicle access to sensitive geographic areas within the road network, special routes for Hazardous Goods Vehicles and Urban Loading Zones.

A distinctive feature of the FRAME Architecture is that it is designed to have sub-sets created from it, and is thus unlikely to be used in its entirety. In fact using the Architecture in its entirety will create some functional redundancies since in places it contains the functionality for performing a service in different ways. When creating a sub-set ITS architecture the user can select the most appropriate set of functionality to deliver the required services. Thus the FRAME Architecture is not so much a model of integrated ITS, as a framework from which specific models of integrated ITS can be created in a systematic and common manner.

3.2.3 Communication between Functional Areas

Some of the functionality in each of the Functional Areas needs to communicate with functionality in other Functional Areas. An example of this is the sharing of traffic data collected by functionality in the Manage Traffic Area, which is used by functionality in other Areas, e.g. to plan journeys. Similarly some of the data collected in vehicles is distributed to functionality in other Functional Areas. This is shown by the highest level of Data Flow Diagram (called DFD0), which is shown in Figure 1 below.

**Figure 1 - DFD0 the highest level of Dat Flow Diagram**
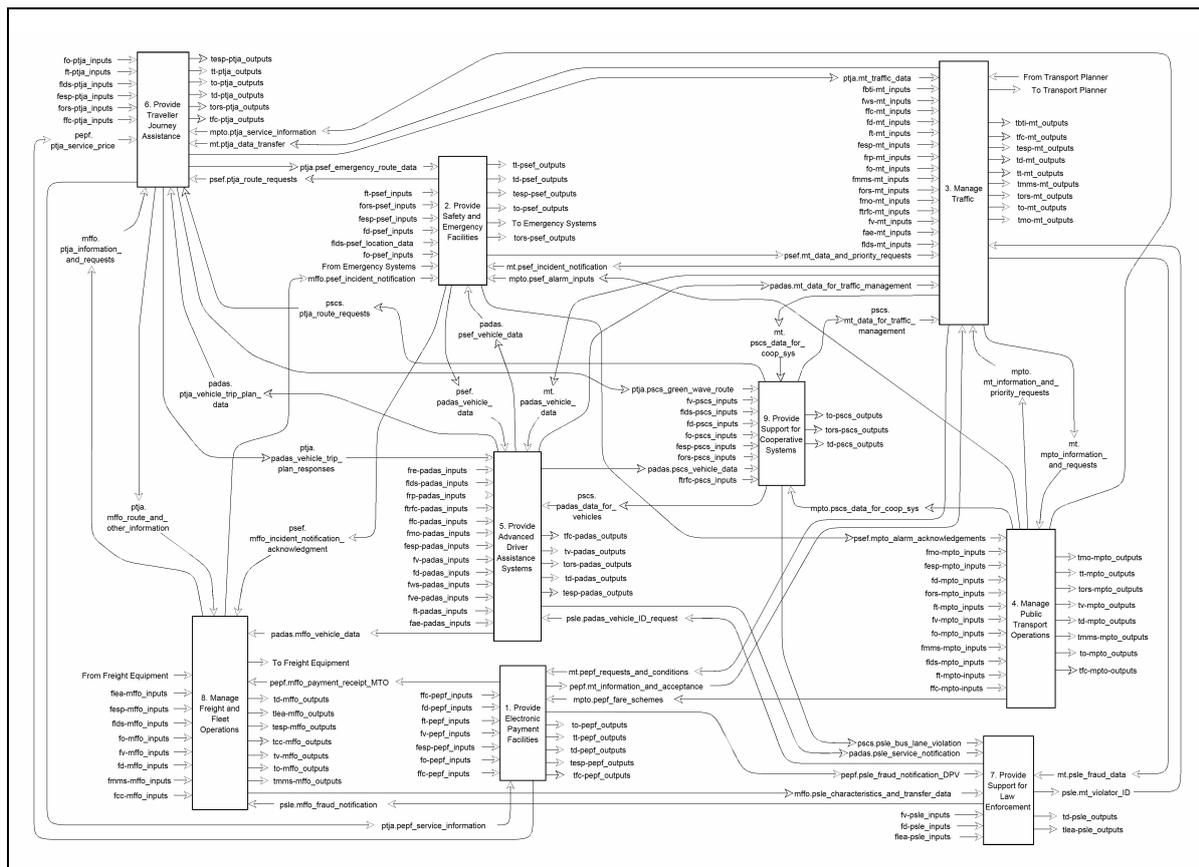
Each of the nine "boxes" in DFD0 represents the functional hierarchy in one of the Functional Areas. The lines that connect the "boxes" are showing the Data Flows that transfer data between the Areas, with each usually containing several items of data. Each

one has a unique name that gives some idea of what is in the Data Flow. All of the "boxes" have a number of Data Flows that enter and leave, and these provide the communication with the outside world that is discussed in the next section.

3.2.4 Communication with the outside world

In order for the functionality in each of the Functional Areas to work, it needs to be able to collect data from the outside world and to provide either that data, or a processed version of it back to the outside world. This is done by specific dedicated parts of the functionality in each Functional Area. The links with the outside world that this functionality needs are illustrated by what is called the "Context Diagram" which is shown in Figure 2 below.

Figure 2 – FRAME Architecture Context Diagram
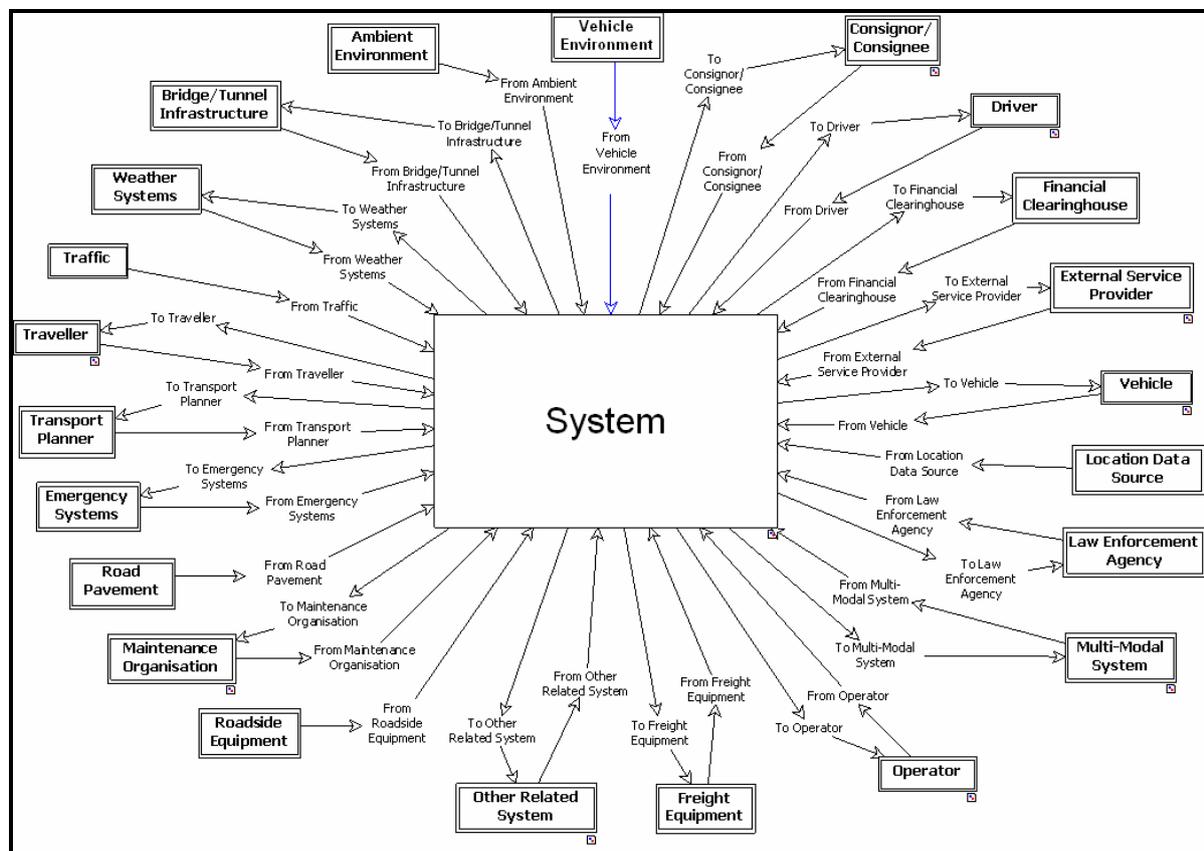
The System "box" in the middle of the diagram represents the functionality that is inside the Functional Areas (the system functionality) and their functional hierarchies. This is shown by DFD0 – see Figure 1. Each of the other "boxes" represents an aspect of the outside world and is called either a Terminator. A Terminator may consist of a number of Actors, each of which represents a specific sub-set, e.g. the Driver Terminator has an Actor to represent a driver of each type of Vehicle such as Private Car, Public Transport, Emergency, Goods, etc. Each Terminator and Actor has its own descriptions, which defines what the system functionality expects each of them to do.

3.3   Other Possible Viewpoints

Because the FRAME Architecture is intended for use within the European Union it conforms to the precepts of subsidiarity, and thus does not mandate any physical or organisational structure on a Member State. Hence it does not include any Physical, Communications or Organisational Viewpoints.   However the FRAME Selection Tool does enable users to create their own Physical Viewpoints, based on a sub-set of the FRAME Architecture created from the User Needs and Functional Viewpoint. These Physical Viewpoints can take into account the organisational setting of the ITS system and the stakeholders involved.

3.4   Studying the FRAME Architecture

As might be expected from Table 1 the FRAME Architecture is quite large. When originally produced by the KAREN project it was documented in paper form, resulting in several large documents that were not easy to navigate. As part of the work of the FRAME projects the Functional Viewpoint is now available in HTML format.   This is known as the FRAME Browsing Tool and can be viewed using Internet Explorer. A copy can be downloaded from the FRAME website at: http://www.frame-online.net/.

The FRAME Browsing Tool provides an interactive interface through which it is possible to move from one part of the FRAME Architecture to another and to follow through the relationships between all of the functional elements. It includes the diagrams shown in Figure 1 and Figure 2, plus Data Flow Diagrams for all the hierarchies in each of the Functional Areas. It also includes the descriptions of all of the elements in the functionality, i.e. Functions, Data Stores and Data Flows, the Terminator and Actor descriptions, plus the identity and description of each User Need that is defined in E-FRAME deliverable document D13.