

# **Common Highways Agency Rijkswaterstaat Model (CHARM)**

## **Functional Specification**

**Version: 1\_0**

---

# Contents

---

1.	Introduction	3
1.1	Background .....	3
1.2	Purpose.....	4
1.3	Approach.....	4
2.	Functional Scope	7
2.1	Internal actors.....	8
2.2	External systems .....	9
3.	CHARM Functional model	12
3.1	Summary.....	12
3.2	Functional areas .....	13
3.3	External interfaces .....	16
4.	Annex A: CHARM Functional Areas	17
4.1	External Interaction .....	17
4.2	Data Storage and Retrieval .....	23
4.3	Event Detection and Handling .....	37
4.4	Prediction .....	41
4.5	Scenarios .....	43
4.6	Demand.....	45
4.7	Performance.....	47
5.	Annex B: External Interfaces	49
5.1	Functional Part of interface definition .....	50
5.2	Interface data.....	54
6.	Annex C: Function <->Activity relation	55
7.	Annex D: CHARM User Needs	60
8.	Annex E: Approach	73
8.1	User Needs Selection.....	73
8.2	Scoping of user needs.....	74
8.3	Selection of functions, datastores and dataflows .....	75
9.	Annex F: Notations and concepts	76
9.1	Notation.....	76
9.2	Concepts and definitions .....	76
10.	Annex G: References	80
11.	Annex H: Glossary	81

# 1. Introduction

## 1.1 Background

The Functional Specification (FS) is an activity of Tranche 1: Requirements & Architecture.

The FS is based on results of the Business Specification (modelling of CHARM business processes) and it will be the basis for the Application Specification (a definition of CHARM application components).

This FS is of importance to other Tranches of the CHARM Programme, namely Tranche 2 Market Research, and Tranche 3 Procurement Strategy.

Once the CHARM functions (subject of the FS) are defined, the market and internal stakeholders within Rijkswaterstaat (RWS) and the Highways Agency (HA) can be informed about the CHARM functional needs. This will in turn allow feedback from the market relating to the availability of application components and services and from internal stakeholders enabling the CHARM programme to align further with RWS and HA also.

The Tranche 3 Procurement Strategy can also use the stated functional needs for a better and specific decision concerning options to procure the application components.

The relation between Functional Specification and other activities is visualized in the Figure below:

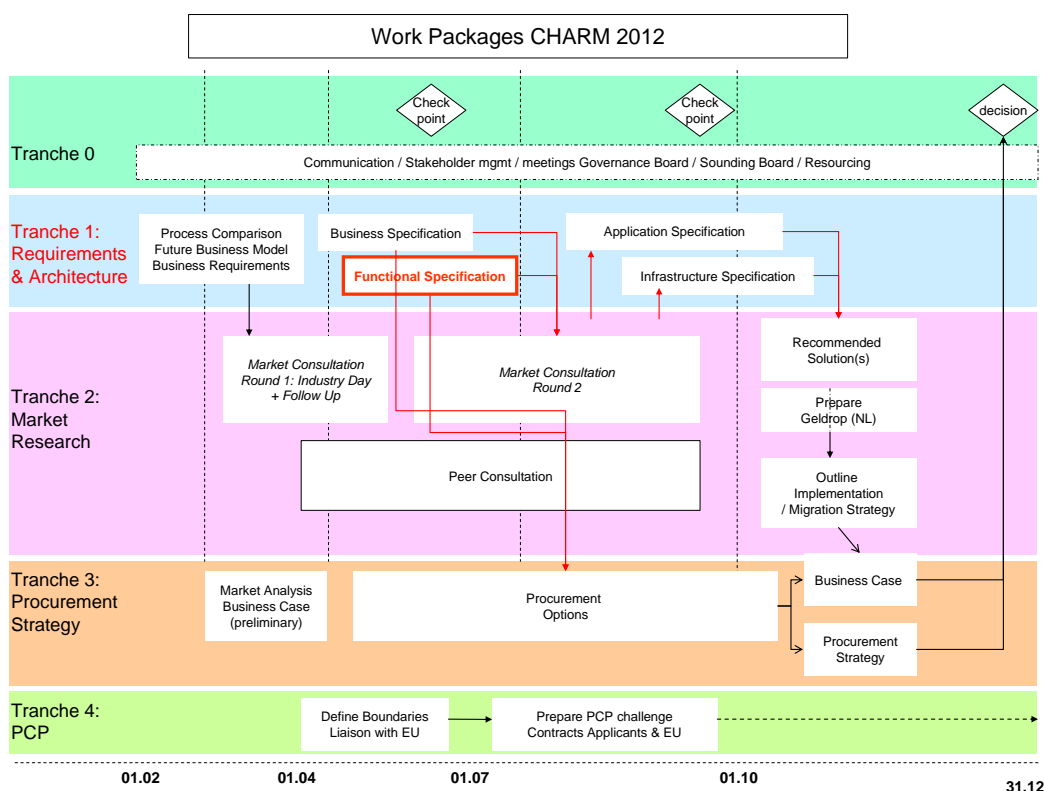


Figure 1: Functional Specification in relation to other CHARM activities

---

## 1.2 Purpose

The purpose of the Functional Specification is to define functions, datastores and dataflows required to support the CHARM business processes described in the CHARM Business Specification.

- A *function* represents an entity that transforms data in some way, i.e., it takes inputs (dataflow) and creates an output (dataflow).
- A *dataflow* represents the data that the processes require as an input and/or the data it generates as output.
- A *datastore* represents collections of data that the system must remember for a period of time. When the systems designers and programmers finish building the system, the stores will typically exist as files or databases.

The Functional Specification will be a basis for defining the Application Specification – the application components to implement functions, datastores and dataflows.

## 1.3 Approach

The method and steps to define the CHARM functions and datastores has been inspired, if not based, on the [ITS FRAME Architecture] methodology, in particular the methodology of defining the Functional View.

To derive the CHARM functions, datastores and dataflows the following steps have been taken:

- User Needs have been defined (in ITS FRAME Architecture parlance “selected”);
- Scoping of Selected User Needs has been performed; and
- Functions, datastores and dataflows have been derived (selected).

These steps are explained below and in more detail in Annex E along with definitions of the notation and key terminology used in this document.

### 1.3.1 User Needs Selection

First the CHARM user needs<sup>1</sup> were selected from the ITS FRAME Architecture and associated with the activities described in the common business model described in the Business Specification. Annex D describes this association.

The selection of the relevant user needs, and their association with the activities was performed in conjunction with the development of the business specification, by business architects and with input from Business Representatives from RWS and the HA.

Where the ITS FRAME Architecture failed to satisfy the scope of CHARM, as defined in the Business Specification new user needs in a similar style to that of FRAME user needs were defined. For instance with respect Resource Management or Incident Management. Similarly some FRAME user needs required redefining in order to align with the activities

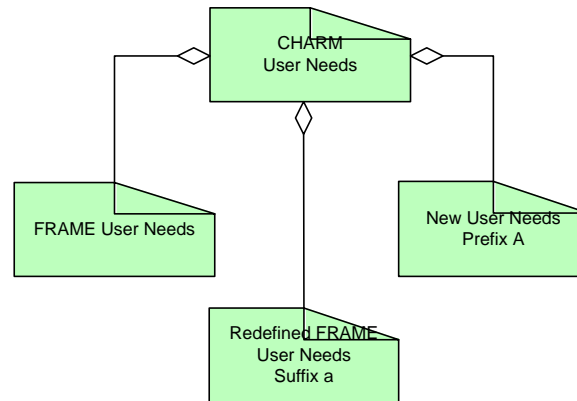
---

<sup>1</sup> The term User Needs is a FRAME Architecture concept, defined as a “technical” way of stating the Stakeholders’ Aspirations.

---

described in the CHARM common model.

This relationship is described below:

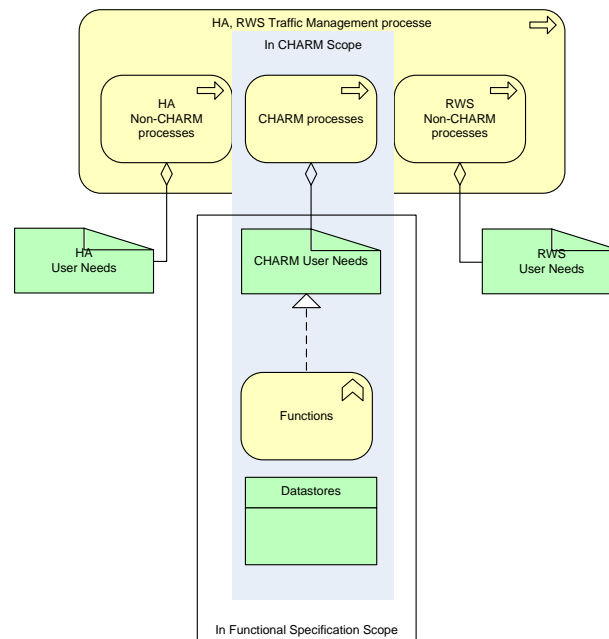


**Figure 1: CHARM user needs composition**

### 1.3.2 Scoping of user needs

The Business Specification defines the scope of CHARM in business terms, including the business activities that CHARM will support. These activities will be supported by functions, dataflows and datastores.

The scope of the functions defined by this document has been constrained to only those activities that are described as in-scope in the Business Specification. This relationship is described in the diagram below. These user needs are described in full in Annex D: CHARM User Needs.



**Figure 2: In-scope user needs, functions, datastores**

---

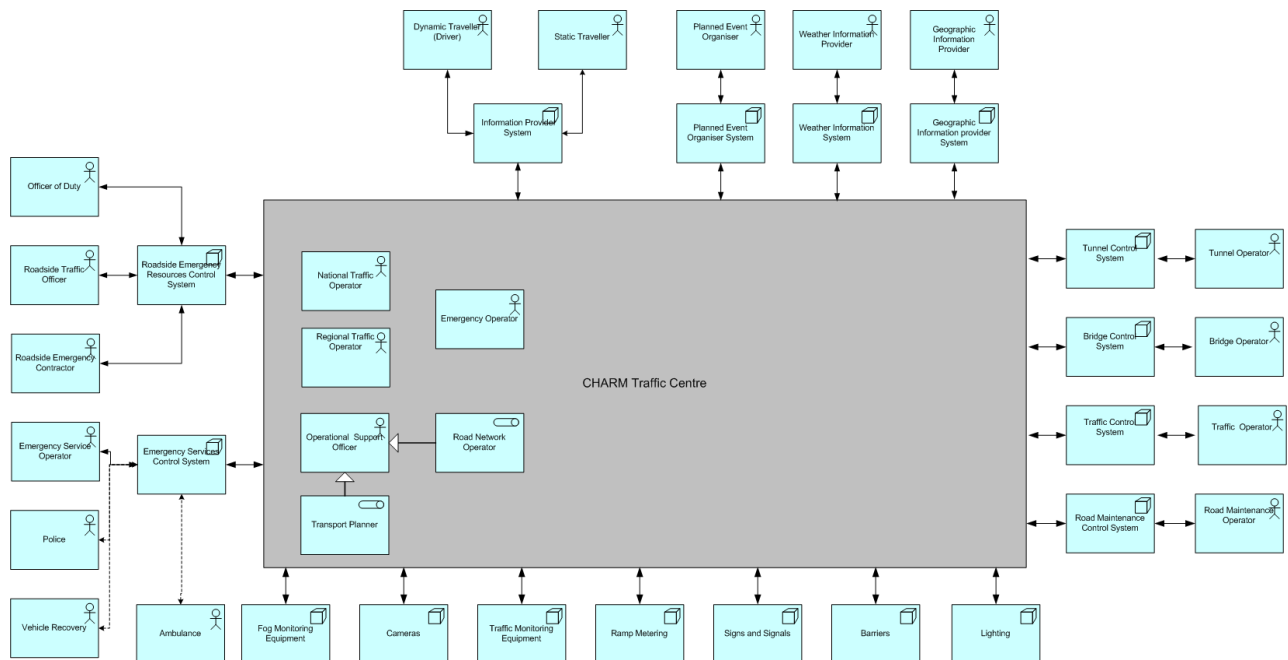
### **1.3.3 Selection of functions, datastores and dataflows**

The ITS FRAME Architecture links its user needs to the required functions and their relevant datastores and dataflows. Using the FRAME Architecture the required functions, datastores and dataflows aligned to these use needs were identified.

Where new or redefined user needs were required new functions have been defined and are proposed in this Functional Specification.

## 2. Functional Scope

Figure 3 below describes from a functional point of view which CHARM actors and external systems (terminators) are considered CHARM internal, and CHARM external. It also identifies the functional external interfaces.



**Figure 3: FS Actors and external systems**

The actors and external systems in Figure 3 align to those stakeholders referred to in Section 2 of the CHARM Business Specification (BS), the table below shows how the stakeholders in the BS are broken down further into actors and external systems described in this document:

Stakeholders in BS	Actors and external systems in FS
Operational Support Officer	Two roles of the Operational Support Officer : Road Network Operator, and Transport Planner
Roadside Emergency Contractor	Roadside Emergency Resources Control System with actors Roadside Emergency Contractor, Roadside Traffic Officer, and Officer of Duty.
Maintenance Organisation	Road Maintenance Operator together with Road Maintenance System.
Forecast Event Information providers	Planned Event Operator together with Planned Event System
Weather Information Providers	Weather Information provider together with Weather Information System
Traffic and Road Data Provider	Geographic Information Provider System and Geographic Information Provider actor
Other Control Systems	Inter-urban Traffic Control System and Inter-urban

Stakeholders in BS	Actors and external systems in FS
	Operator actor
Weather Monitoring Equipment	Fog Monitoring equipment, as this is the only weather aspect that has to be monitored.
Closed Circuit Television Cameras	Cameras
Signals, Variable Message Signs and Signals	Signs and Signals

**Table 1: BS Stakeholders versus FS Actors and external systems**

In the remainder of this chapter the internal Actors and External systems are briefly described. The External actors are not described as their interaction with the CHARM system (System for short) is performed via the External system.

## 2.1 Internal actors

Name	Ability
National Traffic Operator	Responsible for: <ul style="list-style-type: none"> <li>- Ensuring that traffic flow through the network is optimal during conditions of normality and that the impact of events on the road network impact road users not directly involved in an event as little as possible through dynamic management of traffic; and</li> <li>- Maintaining an overview of current events on the road network and co-ordinating the management of any that require a strategic response.</li> </ul>
Regional Traffic Operator	Responsible for: <ul style="list-style-type: none"> <li>- Managing the tactical deployment and operation of on-road resources, and undertake tactical traffic management activity, in response to events on the road network that disrupt the free flow of traffic on the live carriageway or jeopardise the safety of road users; and</li> <li>- When required, supporting the police in co-ordinating the restoration of the carriageway.</li> </ul>
Operational Support Officer	Responsible for: <ul style="list-style-type: none"> <li>- Evaluating the effect of a Scenario making recommendations for areas of improvements (role of Transport Planner)</li> <li>- Evaluating the performance of the road network and identifying the cause of identified problem; and</li> <li>- Reporting recommendations and lessons learnt both “upwards” to strategic level and “downwards” to support operations. (the role of Road Network Operator)</li> </ul>
Road Network Operator	Responsible for <ul style="list-style-type: none"> <li>- evaluating the performance of the road network in relation to agreed performance criteria (provided by Actor Business Unit)</li> <li>- Reporting the performance, providing strategic advice etc.</li> </ul>
Transport Planner	Responsible for planning changes to the structure of the road transportation network managed by the System. It shall be



Name	Ability
	possible for them to use information gathered by the System and to provide input and guidance to enable the System to produce scenarios that can be implemented to optimise transport network use. This optimisation may be required for event handling.
Emergency Operator	Responsible for receiving reports of emergency event, gathering and verifying and completing event data, identifying and event mitigating scenarios. For the HA, this role would be typically filled in by the RTO.

**Table 2: Internal actors**

## 2.2 External systems

This group describes the external systems that will exchange data with CHARM:

System Name	Description
Information Provider System	This system represents a provider of traffic and travel information to travellers. It shall be possible to broadcast travellers through “live” radio (interrupting other programmes) or through other means, such as the Internet and wireless technologies. This system also enables a traveller to query the System on issues as broad as travel situation, road works, planned or forecasted events etc. This system represents a number of different technologies such as a call centre reachable over fixed/wireless networks, dedicated fixed telephony networks, Radio/TV broadcasters, internet services, etc. The information shall be freely available either as a public service or through sponsorship. This system is provided with information that is tailored to a specific use/ groups of users/ device etc.
Planned Event Organiser System	This system represents all systems that are able to provide information on crowd generating forecast events that may have an impact on the road network.
Geographic Information Provider System	This system provides digitised map data that shall be for use in the System. Data concerning traffic, weather and other aspects of traffic management will be shown against the background of a digitized map.
Weather Information System	These organisations are able to predict future weather conditions that may have an impact on the road network and inform CHARM of these Extreme weather forecast events
Tunnel Control System	This system represents technology required to detect and manage the safety related aspects of a tunnel, e.g. <ul style="list-style-type: none"> <li>- the atmospheric pollution levels</li> <li>- water levels in the tunnel substructure</li> <li>- Access to escape doors, etc.</li> </ul> The control of traffic through the tunnel is controlled by the System. The Tunnel Control System may request the System to execute traffic measures on the part of the road through or around a tunnel. The Tunnel Control Systems informs the

System Name	Description
	System on status of the Tunnel so it can optimise the traffic situation.
Bridge Control System	<p>This system represents technology required to detect and manage the safety related aspects of a movable bridge, e.g. opening and closing of a bridge.</p> <p>The control of <i>traffic</i> over the Bridge is controlled by the System. The Bridge Control System may request the System to execute traffic measures on the part of the road over or around the bridge. The Bridge Control Systems informs the System on status of the Tunnel so it can optimise the traffic situation.</p>
Traffic Control System	This system represents other Urban or Inter-urban Traffic Management System. It shall be possible for data to be exchanged with this system to represent requests for execution of traffic measures/scenarios in the geographic area controlled by this system. System and Traffic Control System can also inform each other about the traffic situation in its area of traffic control.
Road Maintenance Control System	<p>This system represents technology to request an allocation of time slot for performing road maintenance. On the basis of requested time, place, duration and type of works the System evaluate traffic consequences, propose and allocate a time slot. The Road Maintenance Control System</p> <p>Inform the System about the status, progress and completion of maintenance activities.</p>
Roadside Emergency Resources Control System	This system represents technology required to communicate with Traffic offers, Contractors and Officer on Duty in order to assign task such as verifying on-road conditions, managing on-road traffic measures, clearing up carriageways etc.
Emergency Service Control System	This system represents systems that are designed for and used by Emergency Services as part of their operations. In this context the term “Emergency Services” shall include organisations that are responsible for services such as fire, police, ambulance and vehicle recovery. The Emergency Systems shall be able to co-ordinate the activities of individual Services. They shall dispatch and control the activities of the vehicles and personnel belonging to a particular Service when they attend incidents. The Emergency Systems shall be given information by the System about emergencies that its functionality has detected. In return the Emergency Systems shall provide reports on progress in dealing with the emergency to enable traffic and travel management strategies to be updated. The Systems shall also provide details of emergency situations affecting road transportation that is reported directly to them, such as through an eCall from a vehicle.
Traffic Monitoring Equipment	This system represents various technologies used by Highway Agency and Rijkswaterstaat to gather the data concerning the traffic situation. Examples of these systems are induction loops and ANPR (automatic number plate

---

System Name	Description
	recognition), Radar & Magnetic anomaly.
Fog Monitoring Equipment	This system represents meteorological systems that provide real-time fog information.
Cameras	This system represents technologies to create and gather video streams. The individual cameras can be controlled (Pan, Tilt & Zoom) or are fixed.
Signs and Signals	This system represents various technologies to mandate or advise speeds, lane diverge or closures (Signals) or to relay a message to the travelling public about road conditions ahead or strategically on other parts of the network.
Ramp Metering	A Traffic signal based system used to platoon traffic as it enters the motorway during peak periods.
Lighting	A system for that represent technologies to control) on/off dim) light sources along the road network.
Barriers	A system to control (open/close) a road barrier.

**Table 3: External systems**

## 3. CHARM Functional model

### 3.1 Summary

The CHARM functions required to support the CHARM Business activities described in the CHARM Business Specification are visualized in figure 3 below.

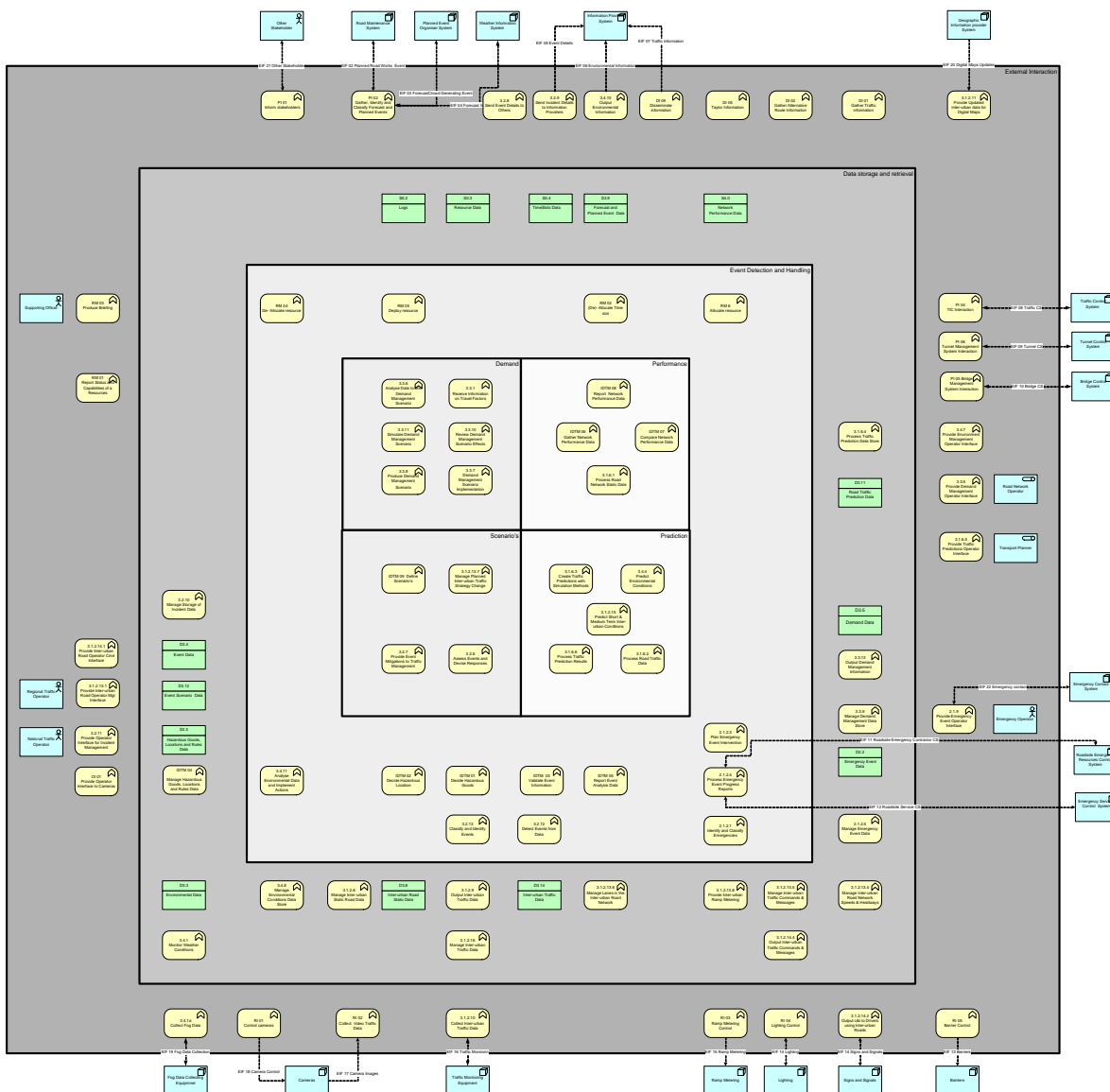


Figure 4: CHARM Functional Model

Figure 4: CHARM Functional Model

---

This figure only shows functions, data stores, actors, external systems and external interfaces. For reasons of readability, the data flows are not shown.

The separate document *CHARM All Functions (in Scope)* provides Microsoft Visio version of figure 4. The detailed description of the functions and datastores is contained in separate Word document *Functional Viewpoint CHARM - Selected Functions*. The identifying symbols in the Visio document are hyperlinked to their definitions in Functional Viewpoint.

The remainder of this section gives a brief description of CHARM's functional areas and external interfaces.

## 3.2 Functional areas

The CHARM functions are grouped into functional areas.

The functions in a functional area have in common the *type* of functionality they provide. E.g. functions in the functional area *External Interaction* provide either an adaptor functionality to external systems, or data gathering functionality (aggregating data from different external systems) or gateway functionality to other traffic/object management systems.

The grouping of the functions differs from the grouping of the activities stated within the CHARM Business Specification and the functions in the same functional area support different business activities.

The relation between functions and activities is stated in Annex C along with the descriptions of each function required to support the business activities within the scope of CHARM. A summary of which can be found in the sections below:

### 3.2.1 External Interaction

Required for the management of (all) contacts with HA-RWS. For the HA this includes contacts about forecast and current events. For RWS this includes only the forecast events. Contact about current events is in addition handled by the National police.

This functional area contains a number of functions that are grouped together as follows:

- Internal user interaction
- Dissemination of information
- Traffic System and Objects interaction
- Sensors and actuators interaction
- Internal resources interaction

### 3.2.2 Data Storage and Retrieval

This functional area contains datastores and functions whose function is mainly to operate on data stores, either to store data or to extract a particular type of data.

This functional area contains a number of functions as follows:

- 
- Manage storage of incident data
  - Manage hazardous goods, locations and rules data
  - Monitor weather conditions
  - Manage environmental conditions data store
  - Manage inter-urban static road data
  - Manage inter-urban traffic data
  - Manage emergency event data
  - Manage lanes in the inter-urban road network
  - Provide inter-urban ramp metering
  - Manage inter-urban traffic commands and messages
  - Manage inter-urban road network speeds and headways
  - Manage demand management data store
  - Manage traffic prediction data store
  - Output inter-urban traffic data
  - Output inter-urban traffic commands and messages
  - Output demand management information

### **3.2.3 Event Detection and Handling**

Required for the management of demand and capacity on the road network through influencing or directing the behaviour of road users and to ensure that traffic flow across the road network is as close to optimal as possible at all times and to protect people on the network.

Where events occur on the road network that cause traffic flow to deviate from normality (Current or Forecast Events, including routine congestion), Dynamic Traffic Management is employed to ensure that road users both locally near the scene of the incident and across the wider road network are able to continue their journeys with as little disruption as possible.

This functional area contains a number of functions as follows:

- Analyse environmental data and implement actions
- Decide hazardous location
- Decide hazardous goods
- Classify and identify events
- Report event analysis data
- Validate event information
- Detect events from data
- Plan emergency event intervention
- Process emergency event progress reports
- Identify and classify emergencies
- Allocate resource
- Allocate time slot
- Deploy resource
- De-allocate resource

### **3.2.4 Prediction**

This functional area is required for the management of people and physical resources to

---

ensure sufficient coverage of the priority areas of the road network based on road network intelligence.

This functional area contains a number of functions as follows:

- Create traffic predictions with simulation methods
- Predict environmental conditions
- Predict short and medium term inter-urban conditions
- Process road traffic data
- Process traffic predictions results

### **3.2.5 Scenarios**

Required for the management of activities which are undertaken where an event occurs on a live carriageway that causes traffic flow to deviate from normality or occurs off-network with an impact on the network. Incident management requires an on-road response to restore the network to normality. Additionally, the setting of signs and signals warning road users of an incident is considered part of Incident Management activity.

This functional area contains a number of functions as follows:

- Define scenario
- Manage planned inter-urban traffic strategy change
- Assess events and devise responses
- Provide event mitigations to traffic management

### **3.2.6 Demand**

This functional area is required for the management of activities that provide information about the state of the road network. Information is provided to internal consumers such as operational colleagues and to external operational partners (such as the emergency services or service providers) to enable HA-RWS to fulfil their role as network operator.

HA also provides information to the general public, both pre-trip and on-road, as well as to third party organisations and the media.

RWS provides information, via the National Data Warehouse, to value-added service providers who provide traffic information to the general public.

This functional area contains a number of functions as follows:

- Analyse data to find demand management scenario
- Receive information on travel factors
- Simulate demand management scenario
- Review demand management scenario effects
- Produce demand management scenario
- Demand management scenario implementation

---

### **3.2.7 Performance**

This functional area contains the functions required to evaluate the performance of the road network and identify areas where improvements can be made.

This functional area contains a number of functions as follows:

- Report network performance data
- Gather network performance data
- Compare network performance data
- Process network performance data

## **3.3 External interfaces**

The figure above describing the functional model shows a number of required external interfaces with the external systems listed in section 2.2.

Annex B describes these interfaces in more detail from a functional viewpoint, i.e. describing the data and in what order this is exchanged.

In summary, the exchanges of data relating to the areas listed below are as required:

- Planned Road Works Event
- Forecast Crowd Generating Event
- Forecast Weather Event
- Event Details
- Environmental Information
- Traffic information
- Traffic Control System
- Tunnel Control System
- Bridge Control System
- Roadside Emergency Resources
- Emergency Service Control System
- Barriers
- Signs and Signals
- Lighting
- Ramp Metering
- Traffic Monitoring
- Camera Images
- Camera Control
- Fog Data Collection
- Digital Maps Updates
- Other Stakeholders
- Emergency Contact



---

## 4. Annex A: CHARM Functional Areas

### 4.1 External Interaction

A supporting capability required for the management of (all) contacts with HA-RWS. For the HA this includes contacts about forecast and current events. For RWS this includes only the forecast events. Contact about current events is in addition handled by the National police.

ID	Name	Definition
<b>Internal user interaction – human interfaces</b>		
2.1.9	Provide Emergency Event Operator Interface	<ul style="list-style-type: none"><li>(1) The provision of the HMI for the Emergency Operator so that emergencies and all related information can be received and managed.</li><li>(2) Enable the Emergency Operator to manage the processing, classification and response to incidents or emergencies through Data Flow interfaces to other functionality.</li><li>(3) Enable the Emergency Operator to request statistics about the occurrence of incidents and the responses to them.</li></ul>
3.1.2.10	Collect Inter-urban Traffic Data	<ul style="list-style-type: none"><li>(1) The ability to collect and collate traffic data from variety of the (internal) inter-urban road network equipment and external sources, such as: flow, speed, traffic volume, travel time, vehicle types</li><li>(2) The ability to store the data (in data store D3.14)</li></ul>
3.1.2.11	Provide Updated Inter-urban data for Digital Maps	<ul style="list-style-type: none"><li>(1) The ability to provide up-to-date information for digital maps and databases for segments of the inter-urban road network.</li><li>(2) The ability for the information provided by this Function to include structural alteration, static speed limits and default journey times.</li><li>(3) The ability to provide updated information to the digital map provider in order to be implemented in the next issue of digital maps as well as to in-vehicle devices for use in current and future planned journeys</li></ul>
3.1.2.13.1	Provide Inter-urban Road Operator Mgt Interface	<ul style="list-style-type: none"><li>(1) A HMI that enables the Traffic Operator to manage the control of traffic using the inter-urban road network.</li><li>(2) The HMI shall enable the Traffic Operator to get a graphical representation of all road network (including equipment, events, traffic conditions, etc)</li><li>(3) The HMI shall enable the Road Network Operator to provide commands that change the current inter-urban traffic control scenario</li></ul>

ID	Name	Definition
		<p>and to override the use of lanes in the road network, except when it is imposed as part of an incident or demand management strategy, or to provide selective Vehicle priority.</p> <p>(4) The HMI shall have to ability to enable the Traffic Operator to examine and update the sequence of inter-urban traffic control scenarios that are implemented automatically, and to see the "log" of previously implemented inter-urban traffic control strategy changes.</p> <p>(5) The HMI shall have to ability to output requests to the Traffic Operator for a check to be made of the availability of auxiliary lanes (hard shoulders), and for the Operator to provide an available/not available response so that traffic can be directed to use it, or not.</p>
3.1.2.14.1	Provide Inter-urban Road Operator Cmd Interface	<p>(1) A HMI that enables the Traffic Operator to manage the control of traffic using the inter-urban road network.</p> <p>(2) The HMI shall enable the Traffic Operator to provide commands that change the current inter-urban traffic control scenario and to override the use of lanes in the road network, except when it is imposed as part of an incident or demand management strategy, or to provide selective Vehicle priority.</p> <p>(3) The HMI shall have the ability to inform the Traffic Operator of the success or failure of the requested change.</p> <p>(4) The HMI shall have to ability to output requests to the</p> <p>(5) Traffic Operator for a check to be made of the availability of auxiliary lanes (hard shoulders), and for the Operator to provide an available/not available response so that traffic can be directed to use it, or not.</p>
3.1.2.14.2	Output c&i to Drivers using Inter-urban	<p>(1) The ability to output information, and/or warnings, and/or commands to Drivers using the inter-urban road network by Signs &amp; Signals equipment</p> <p>(2) The ability for the outputs to have a variety of uses ranging from providing journey time information to providing Drivers with commands for unexpected speed or lane use. The list of all messages that shall be displayed is tbd.</p> <p>(3) The ability to use several different technologies (products) to provide the outputs..</p> <p>(4) The ability to accommodate through non-</p>

ID	Name	Definition
		functional mechanisms the differentiation between the way that information and commands are provided to Drivers according to the demands of the particular implementation. (5) The ability to monitor all of the outputs and revisions to any already being output that are likely to give rise to inconsistent and incoherent messages being displayed to Drivers.
3.1.6.5	Provide Traffic Predictions Operator Interface	(1) An HMI through which the Transport Planner can perform various tasks. (2) The HMI shall enable these tasks to include the management of the operation of Traffic Simulation Engine functionality and the modification of the road network model through the functionality that manages the store of Traffic Simulation Data. (3) The HMI shall enable the Transport Planner to request access to view both the simulation results and the current road network data for all or any of the models plus in the case of traffic data for varying periods of time and parts of the road network.
3.2.11	Provide Operator Interface for Incident Management	(1) A HMI through which the Traffic Operator can control the management of incidents and the implementation of traffic scenarios for incident management. (2) The HMI is able to provide an operator with a view of all current events in an area specified through these interfaces (3) The HMI shall enable the Traffic Operator to confirm the implementation of incident management scenarios if needed, to input and update incident data in the store of Incident Data, and to manage the development of new incident management scenarios. (4) The HMI shall enable the Traffic Operator to request and receive statistical reports on the occurrence of incidents and the used scenarios.
3.3.5	Provide Demand Management Operator Interface	The HMI shall enable the Road Network Operator to develop and implement demand related scenario's both off-line and in real time and to be informed of the effects of their implementation.
3.4.7	Provide Environment Management Operator Interface	(1) A HMI through which the Road Network Operator shall be able to manage the collection of environmental data, plus its analysis and use by other functionality within the System.

ID	Name	Definition
		<p>(2) The HMI shall enable the Road Network Operator to request and be provided with output of the data currently being collected, prediction of environmental conditions and historical data.</p> <p>(3) The HMI shall enable the Road Network Operator to request an analysis of the environmental data, receive the resulting suggested actions and confirm these actions.</p> <p>(4) The HMI shall enable the Road Network Operator to update the static data used in the prediction of environmental conditions.</p>
OI 01	Provide Operator Interface to Cameras	This function shall enable the operator to access the R 01, and R 02 functions (Control Cameras and Collect Video Traffic Data) in order to control the P/Z/T of the cameras and selection and presentation of the traffic video streams
<b>Dissemination of information</b>		
3.2.8	Send Event Details to Others	<p>(1) The ability to manage the output of instructions contained in an scenario to other functionality in the System in response to events that have been detected by other functionality.</p> <p>(2) The ability to sent instructions (command to perform traffic measures and other actions to other functionality such as that for Emergency Support,.</p> <p>(3) The ability to output of incident management scenarios shall begin as soon as the strategy information is received.</p> <p>(4) (The ability to keep a local store of the scenarios currently being implemented and delete them when their expiry time has passed, or when a strategy modification or removal indication arrives from the incident management functionality.</p>
3.2.9	Send Event Details to Information Providers	<p>(1) The ability to manage the output of information to Information Provider Systems as part of an incident strategy in response to incidents that have been detected by other functionality, inclusive emergency, or urgent information, and alternative routes</p> <p>(2) The ability to manage the output of information to Information Provider System as a part of demand management strategy, inclusive information concerning current and forecasted/ planned events, route restrictions, etc.</p> <p>(3) The ability for the Providers to also request a repeat of the output of the information and of incident data, where this applies to current or</p>

ID	Name	Definition
		<p>future events, i.e. not incidents involving the Emergency Services.</p> <p>(4) The ability for the output of the information to begin as soon as the strategy information is received.</p> <p>(5) The ability to keep a local store of the incident management scenarios currently being implemented and delete them when their expiry time has passed, or when a strategy modification or removal indication arrives from the incident management functionality.</p>
3.4.10	Output Environmental Information	<p>(1) The ability to receive data about weather conditions (excluding fog which is done by a separate function) that are relevant to the operation of the road network managed by the System.</p> <p>(2) The ability for some or all of the data to come from Weather Information Systems and from function 3.4.1a Collect Fog Information</p> <p>(3) The ability to forward the received data to other functionality for storage.</p>
DI 01	Gather Traffic information	<p>(1) collect traffic information from a variety of internal and external sources for the purpose of dissemination to external users</p> <p>(2) collect following traffic flow:</p> <ol style="list-style-type: none"> <li>flow,</li> <li>speed</li> <li>traffic volume,</li> <li>travel time</li> <li>vehicle types</li> </ol> <p>(3) collect following event information:</p> <ol style="list-style-type: none"> <li>current events</li> <li>forecasted events</li> <li>clearance time current event</li> </ol> <p>(4) collect weather related information</p> <p>(5) collect all the above information on time scale: present, past and forecasted</p>
DI 02	Gather Alternative Route Information	<p>Capability to collect alternative route information on</p> <ol style="list-style-type: none"> <li>diversions national</li> <li>diversions regional</li> </ol>
DI 05	Taylor Information	<p>(1) transform information to a format best suited to a specific communication system used for information dissemination</p> <p>(2) support following communication systems: tbd</p> <p>(3) transform information to a format best suited to a specific geographical scale</p> <p>(4) support following geographical scales: tbd</p> <p>(5) transform information to a format best suited to a specific presentation device</p>

ID	Name	Definition
		(6) support following presentation devices: tbd
DI 09	Disseminate information	Capability to disseminate information to the appropriate (internal) actors, such as traffic operators, network managers, etc
PI 01	Inform stakeholders	Capability to inform any stakeholders on planned or predicted events
PI 02	Gather, Identify and Classify Forecast and Planned Events	<ol style="list-style-type: none"> <li>(1) gather all relevant data about a forecast or planned event</li> <li>(2) store data in Forecast and Planned Event Data store</li> <li>(3) Identify stakeholders of the event</li> <li>(4) provide an initial (first) acknowledgement of event notification to its source</li> <li>(5) Initiate Allocation of Resources and, for Planned Road Works, the <i>Time Slot</i> function for handling of the event.</li> </ol>
<b>Traffic System and Objects Interaction</b>		
PI 04	TIC Interaction	<ol style="list-style-type: none"> <li>(1) Request other TIC (regional, modal, urban, international to perform a traffic measure, or a scenario. The measures or scenarios that can be requested have been renegotiated. These negotiations are out of scope of the FS.</li> <li>(2) Receive a request to perform a traffic measure or a scenario and pass it to the function 3.1.2.13.7 Manage Planned Inter-urban Strategy Change. The measures and scenarios that may be requested have been a priori requested. They are not part of the CHARM functionality</li> <li>(3) Pass the reply of the 3.1.2.13.7 to the requestor</li> <li>(4) Receive and/or send traffic information with other TICs, typically information on the areas that they cover. The received data could be originated from various sources, e.g. (aggregated) floating car data</li> </ol>
PI 05	Bridge Management System Interaction	<ol style="list-style-type: none"> <li>(1) Receive a request to perform a traffic measure or a scenario and pass it to the function 3.1.2.13.7 Manage Planned Inter-urban Strategy Change. The measures and scenarios that may be requested have been a priori requested. They are not part of the CHARM functionality</li> <li>(2) Pass the reply of the 3.1.2.13.7 to the requestor</li> <li>(3) Receive information on status of the .bridge that can be relevant for management of the traffic over the bridge</li> </ol>
PI 06	Tunnel Management System Interaction	<ol style="list-style-type: none"> <li>(1) Receive a request to perform a traffic measure or a scenario and pass it to function</li> </ol>

ID	Name	Definition
		<p>3.1.2.13.7 Manage Planned Inter-urban Strategy Change. The measures and scenarios that may be requested have been a priori requested. They are not part of the CHARM functionality</p> <p>(2) Pass the reply of the 3.1.2.13.7 to the requestor</p> <p>(3) Receive information on status of the .tunnel that can be relevant for management of the traffic through the tunnel</p>
<b>Sensors and Actuators Interaction</b>		
3.4.1a	Collect Fog Data	<p>(1) The ability to collect data about fog conditions that are relevant to the operation of the road network managed by the System.</p> <p>(2) The ability for some or all of the data to come from Weather Information Systems or to be detected using sensors within the road network.</p> <p>(3) The ability to forward the collected data to other functionality for storage.</p>
RI 01	Control Camera's	<p>(1) Control different types of camera's by</p> <p>(2) Allowing a traffic operator to select a camera</p> <p>(3) Allowing to select a camera through a predefined trigger</p> <p>(4) Providing PTZ-functionality</p>
RI 02	Collect Video Traffic Data	<p>(1) Collect data from camera's, possibly filtered</p> <p>(2) Select video data for storage</p> <p>(3) Store video data in D3.14 Inter-urban Traffic Data</p>
RI 04	Lighting Control	Control different types of Lighting equipment by setting it to a given level of light emission (0-100%)
RI 05	Barrier Control	Control different types of barriers (up/down)
RI 03	Ramp Metering Control	<p>(1) Turning on/turning off Ramp metering equipment</p> <p>(2) Activating/deactivating a given algorithm for determining the red/green cycle</p>
<b>Internal Resources Interaction</b>		
RM 1	Report Status and Capabilities of a Resources	
RM 3	Produce Briefing	

**Table 4: External Interaction**

## 4.2 Data Storage and Retrieval

This functional area contains datastores and functions whose function is mainly to operate on data stores, either to store data or to extract a particular type of data.

#### 4.2.1 Datastores

ID	Name	Definition
S0.2	Logs	This data store shall be used in to support all functions. It shall contain details of any decision that has been taken, all actions that have been taken, incident management details, etc
S0.3	Resource Data	This Data Store shall be used within the Resource Management (RM) area. It shall contain data describing status and capability of each resource. The capability data (what can the resource do) i shall be produced/changed by the owner of the resource. The status data shall be produced by the resource owner and by functions within the RM area. The status and capabilities will be produced/changed as their value change.
S0.4	Time Slots Data	<p>This data store shall be used to record time slots that are available (and free) for carrying out road works</p> <p>The data in the Store shall be structured in the following way:</p> <ul style="list-style-type: none"> <li>• road segment</li> <li>• time/and date</li> <li>• available yes/no (if not: link to planed road work for that date/time</li> <li>• Allowable time slots (e.g. no road works during rush hours, etc.)</li> </ul>
S3.9	Forecast and Planned Event Data	<p>This Data Store shall I contain details of all reported forecast and planned events. It consists of two parts related to forecast and planned events.</p> <p>The data for Extreme weather forecast events held in the Store shall be structured in the following way:</p> <ul style="list-style-type: none"> <li>• forecast start time and date</li> <li>• forecast end time and date</li> <li>• affected area</li> <li>• type of extreme weather</li> <li>• definition of originator of the event notification</li> </ul> <p>The data for Crowd generating events held in the Store shall be structured in the following way:</p> <p>The data for Planned Road Works held in the Store</p>



ID	Name	Definition
		<p>shall be structured in the following way</p> <ul style="list-style-type: none"> <li>planned start time and date</li> <li>planned end time and date</li> <li>location</li> <li>type of Road Works</li> <li>stakeholders</li> <li>definition of originator of the event notification</li> <li>allocated time slot</li> </ul>
S4.0	Network Performance Data	<p>This Data Store shall contain data about</p> <ul style="list-style-type: none"> <li>Target performance data, describing the required performance (on parts of) the traffic network</li> <li>Historic performance data of the network,</li> <li>Actual performance-related data. Such as average speed and intensity of traffic per road segment and for predefined intervals in time. This data is derived from the D3.14 Inter-urban Traffic Data. This data shall be used to evaluate the performance of the data</li> </ul>
S3.3	Hazardous Goods, Locations and Rules Data	<p>This Data Store shall contain data defining</p> <ul style="list-style-type: none"> <li>the hazard level of goods that can be transported</li> <li>the hazard level of locations along the road network</li> <li>The rules for determining the hazard level of goods involved in an emergency and hazard level of the location of the emergency.</li> </ul>
D2.2	Emergency Event Data	<p>This Data Store shall contain details of all incident/alarm notifications (including mayday calls) that have been received by the functionality in this Area. It is in two parts; un-processed and processed emergencies.</p> <p>The data for un-processed emergencies held in the Store shall be structured in the following way:</p> <ul style="list-style-type: none"> <li>time</li> <li>date</li> <li>incident location</li> <li>type of vehicle involved in the incident</li> <li>known status of each vehicle</li> <li>description of cargo (if any) carried by each vehicle</li> <li>the number of people involved in the incident</li> <li>health status of each person involved in the incident</li> <li>any additional information relevant for emergency process</li> <li>definition of originator of the incident</li> </ul>

ID	Name	Definition
		<p>notification</p> <ul style="list-style-type: none"> <li>• system that was the source of the incident notification</li> </ul> <p>The data for processed emergencies held in the Store shall be structured in the following way:</p> <ul style="list-style-type: none"> <li>• a consolidated problem description comprising: <ul style="list-style-type: none"> <li>- time</li> <li>- location</li> <li>- type of vehicle involved in the incident</li> <li>- known status of each vehicle</li> <li>- description of cargo (if any) carried by each vehicle</li> <li>- the number of people involved in the incident</li> <li>- health status of each person involved in the incident</li> <li>- any additional information relevant for emergency process</li> <li>- a list of all associated incidents</li> <li>- a description of planned actions comprising: <ul style="list-style-type: none"> <li>▪ the emergency services that will be involved in the action,</li> <li>▪ time when action will start ,</li> <li>▪ the number of vehicles involved</li> <li>▪ a description of the result of each action</li> <li>▪ a list of progress reports for each action</li> </ul> </li> </ul> </li> </ul>
D3.11	Road Traffic Prediction Data	<p>This Data Store shall contain various data that is to be used in modelling and simulating the traffic conditions in the road network managed by the System.</p> <p>The data in the Store shall be structured in the following way:</p> <ul style="list-style-type: none"> <li>• road network data (data for a digital roadmap using a standard format, e.g. GDF)</li> <li>• historic traffic data collected by other functionality in the System (numbers with dates)</li> <li>• recent traffic data collected by other functionality in the System (numbers with dates)</li> <li>• traffic management scenarios in use when the traffic data was collected (characters and numbers)</li> <li>• processed traffic data that shows the origin and destination of traffic flows (number and digital roadmap data)</li> <li>• results from the simulation of traffic conditions</li> </ul>

ID	Name	Definition
		<p>in the road network managed by the System (numbers and digital roadmap data)</p> <p>It shall be possible for the results data identified above to show the forecast traffic conditions produced by traffic management scenarios that were provided by the Transport Planner, or to be based on those used previously. These scenarios shall be stored in such a way that they can be associated with the results to which they are relevant. It shall also be possible for car park space requirements to be included in the results</p>
D3.12	Event Strategy Data	<p>This Data Store shall contain information about events scenarios that have been created and used previously.</p> <p>The data in the Store shall be structured in the following way:</p> <ul style="list-style-type: none"> <li>• scenario identity</li> <li>• reason for implementing the scenario</li> <li>• how the scenario was implemented, e.g. Operator, Automatically - (scenario);</li> <li>• implementation date <ul style="list-style-type: none"> <li>- implementation time (numbers defining hours, minutes and seconds)</li> </ul> </li> <li>• removal date <ul style="list-style-type: none"> <li>- removal time (numbers defining hours, minutes and seconds)</li> </ul> </li> <li>• part(s) of the road network covered by the strategy (data for a digital roadmap using a standard format, e.g. GDF)</li> <li>• set of traffic measures/scenario's requested from other TIC's</li> <li>• set of traffic measures for the inter-urban road network traffic management functionality - optional ; <ul style="list-style-type: none"> <li>- set of other traffic measures - optional ;</li> </ul> </li> <li>• Set of text messages to be displayed to Travellers and/or Drivers, with the identities of the equipment through which the displays shall be shown.</li> </ul>
D3.14	Inter-urban Traffic Data	<p>This Data Store shall contain traffic flow data and other traffic related data for the inter-urban road network. The data in the Store shall be divided into up to three parts comprising, current, historic and predicted data.</p> <p>The data in the Store for current and historic data shall be structured in the following way:</p>

ID	Name	Definition
		<ul style="list-style-type: none"> <li>• date</li> <li>• time location</li> <li>• vehicle flow</li> <li>• vehicle speed</li> <li>• vehicle headway</li> <li>• road occupancy</li> <li>• queue presence</li> <li>• vehicle count</li> </ul> <p>There shall be one set of the above data for each location in the inter-urban road network where some or all of the data shall have been obtained. Within each set there shall be both current and historic data.</p> <p>The data in the Store for predicted data shall be structured in the following way:</p> <ul style="list-style-type: none"> <li>• predicted date</li> <li>• predicted time</li> <li>• location</li> <li>• vehicle flow</li> <li>• vehicle speed</li> <li>• vehicle headway</li> <li>• road occupancy</li> <li>• prediction assumptions</li> </ul> <p>There shall be three sets of predicted data, comprising short, medium and long term predictions.</p>
D3.3	Environmental Data	<p>This Data Store shall contain data about the environmental conditions within the geographic area managed by the System. This data shall have been produced by Collect Fog Data within the Area from inputs received from the roadside equipment, and from external Weather Information Systems.</p> <p>The data in the Store shall be structured in the following way:</p> <ul style="list-style-type: none"> <li>• date</li> <li>• time</li> <li>• location</li> <li>• temperature</li> <li>• humidity</li> <li>• wind direction</li> <li>• wind speed</li> <li>• pollution level (fine particles, CO2) levels)</li> <li>• noise level</li> <li>• environmental action detection</li> </ul>

ID	Name	Definition
		<ul style="list-style-type: none"> <li>○ type of action (Fog, Heat, Rain, Wind, Ice , Snow, Excessive pollution, Excessive noise))</li> <li>○ recommended action</li> </ul> <p>The number of entries shall be fixed by the number of times that samples are taken. It shall be possible for the number and type of pollutants recorded to vary from one location to another and from one System to another.</p>
D3.4	Event Data	<p>This Data Store shall contain data collected about current and predicted events.</p> <p>The data in the Store shall be structured in the following way:</p> <ul style="list-style-type: none"> <li>• start date</li> <li>• start time</li> <li>• forecast duration</li> <li>• actual duration</li> <li>• event location</li> <li>• event type</li> <li>• event severity</li> <li>• scenario used</li> <li>• handling business unit</li> <li>• action by business unit</li> </ul> <p>The data in some of these entries shall be provided as the event state changes, whilst in others it shall be updated as the event impact progresses and remedial action is taken.</p> <p>The data concerning events that occur concurrently and at the same locations should be linked and interrelated.</p> <p>The data concerning the used scenario should provide a link to entry in D3.12 that describe the used scenario, details of execution, messages etc.</p>
D3.5	Demand Data	<p>This Data Store shall contain references on available/defined demand management scenarios.</p>
D3.8	Inter-urban Static Road Data	<p>This Data Store shall contain the static data for the inter-urban traffic road network managed by the System. The static data shall cover the actual layout and configuration of the inter-urban road network.</p> <p>The data in the Store shall be structured in the following way:</p> <ul style="list-style-type: none"> <li>• road type</li> <li>• type of data:</li> <li>• link: <ul style="list-style-type: none"> <li>- ID</li> </ul> </li> </ul>

ID	Name	Definition
		<ul style="list-style-type: none"> <li>- type</li> <li>- start location ,</li> <li>- end location</li> <li>- length: ,</li> <li>- number of lanes/carriageways ,</li> <li>- lane/carriageway width(s) ,</li> <li>- vehicle type usage restrictions ,</li> <li>- vehicle parking restrictions ,</li> <li>- vehicle speed limit(s) ,</li> <li>- bus lane present indicator</li> <li>- presence of other objects, e.g. tunnels/bridges</li> <li>- obstructions, e.g. narrow road/lanes, bridges/tunnels giving low clearance, bridges with weight restrictions</li> <li>• Date of last update.</li> </ul> <p>This data shall be used by a variety of Functions to enable traffic in the inter-urban network to be managed.</p>

**Table 5: Datastores**

#### 4.2.2 Datastore functions

ID	Name	Definition
3.2.10	Manage Storage of Incident Data	<ol style="list-style-type: none"> <li>(1) The ability to take responsibility for the management of data about incidents and the production of statistical reports.</li> <li>(2) The ability to receive data about reported incidents and updates to that data from other functionality and incident data from other entities outside the System.</li> <li>(3) The ability to load all the data that is received into the store of Incident Data.</li> <li>(4) The ability to retrieve data from the store of Incident Data for assessment, when requested by other functionality in the System.</li> <li>(5) The ability to provide upon request data to the functionality providing the HMI for the Road Network</li> </ol>
IDTM 04	Manage Hazardous Goods, Locations and Rules Data	<ol style="list-style-type: none"> <li>(1) The ability to take responsibility for the management of data Hazardous Goods, Locations and decision Rules.</li> <li>(2) The ability to receive data the changes in the above data from other BU entities</li> <li>(3) The ability to load all the data that is received into the store.</li> <li>(4) The ability to retrieve data from the store of for</li> </ol>

ID	Name	Definition
		assessment, when requested by other functionality in the System. (5) The ability to provide upon request data to the functionality providing the HMI for the Emergency, Traffic and Road Operators
3.4.1	Monitor Weather Conditions	(1) The ability to receive data about weather conditions (excluding fog which is done by a separate function) that are relevant to the operation of the road network managed by the System. (2) The ability for some or all of the data to come from Weather Information Systems and from function 3.4.1 Collect Fog Information (3) The ability to forward the received data to other functionality for storage
3.4.8	Manage Environmental Conditions Data Store	(1) The ability to manage the store of Environmental Conditions Data. (2) In performing this activity, the ability to collect and collate environmental data provided by other functionality and from other System(s) and load this data into the store of Environmental Conditions Data. (3) Periodically or when requested by the Road Network Operator, the ability to retrieve data from the store of Environmental Conditions Data and send it to other functionality in the System. (4) The ability to retrieve data from the store of Environmental Conditions Data and send it to other functionality in the System and when returned, load the results back into the store. (5) When confirmed by the Road Network Operator, the ability to add to the store of Environmental Conditions Data any confirmed actions to reduce the impact of environmental conditions. (6) The ability to provide the Road Network Operator with copies of the stored data when requested by the Traffic Operator
3.1.2.6	Manage Inter-urban Static Road Data	(1) The ability to take responsibility for managing the store of Inter-urban Road Static Data that is used by inter-urban traffic management functionality (2) Every time a new set of data is received from the Geographic Information Provider, the ability to make it available to the inter-urban traffic management functionality and to load it into the store. (3) The ability to receive changes to the data from the Road Network Operator HMI functionality. (4) The ability to load the data received from the

ID	Name	Definition
		<p>Road Network Operator HMI functionality into the store.</p> <p>(5) The ability to send changes in the data for the inter-urban road network provided through the Road Network Operator HMI functionality to functionality from which it will be returned to the Geographic Information Provider for use when digital map data is provided in the future.</p> <p>(6) The ability to archive a selection of historical traffic and environmental data</p>
3.1.2.16	Manage Inter-urban Traffic Data	<p>(1) The ability to manage the store of Inter-urban Traffic Data.</p> <p>(2) The ability to collect data about traffic conditions (i.e. traffic flows, road segment use, journey times, etc.) in the inter-urban road network.</p> <p>(3) The ability to use the inter-urban road network static data to enable the collected and received data to be validated, collated, fused and loaded in the store of Inter-urban Traffic Data in a coherent way that makes it easy to retrieve it for particular road segments, or larger parts of the inter-urban road network.</p> <p>(4) The ability to exchange data collected by the Function with similar functionality in another instance of the System, through the Other Related System, Inter-urban Traffic Management System.</p> <p>(5) The ability to provide the collated and fused data from the store of Inter-urban Traffic Data to other functionality, including that responsible for the output of the processed data to other parts of the System and entities outside the System.</p> <p>(6) The ability to provide current inter-urban traffic data for use in creating short and medium term predictions for that data and when received to load that data into the store of Inter-urban Traffic Data</p> <p>(7) The ability to use consistent historical data to complement real-time data, when necessary.</p>
2.1.2.5	Manage Emergency Event Data	<p>(1) The ability to manage the contents of the Store of Incident and Emergency Data.</p> <p>(2) The ability to receive data about incidents (e.g. eCalls) and the way that their responses are being processed (emergency plans) and update them in the Store of Incident and Emergency Data.</p> <p>(3) The ability to pass on incident descriptions when they are received to the functionality for planning emergency interventions.</p>
3.1.2.13.6	Manage Lanes in the	<p>(1) The management of the lanes on roads in the</p>



ID	Name	Definition
	Inter-urban Road Network	<p>inter-urban network (the coordination related to lane usage traffic measures)</p> <p>(2) The ability to enable the management of the lanes so that the most efficient use can be made of the available road space in the inter-urban road network.</p> <p>(3) The ability for the use of lanes to be changed in a way that is safe for vehicle operation and that causes the minimum disruption to all forms of inter-urban road traffic.</p> <p>(4) The ability to support the output of lane management commands that can ban the use of one or several lanes in some or the entire road network, for all or specific types of vehicles, provide keep-in-lane advice to stabilise traffic flow for all or specific types of vehicles and where available, make the auxiliary lane (sometimes called the hard shoulder) available for use.</p> <p>(5) The ability to support the output of lane management commands that can provide keep-in-lane advice to stabilise traffic flow for all or specific types of vehicles.</p> <p>(6) The ability to support the output of lane management commands that can, where available, make the auxiliary lane (sometimes called the "hard shoulder") available for use.</p> <p>(7) The ability to send commands to alter the use of lanes to the functionality that is responsible for the output of messages to Drivers, both at the roadside and in the Vehicle.</p>
3.1.2.13.8	Provide Inter-urban Ramp Metering	<p>(1) The ability to manage the traffic using an entrance to the inter-urban road network - sometimes call "entrance ramps" or "on ramps".</p> <p>(2) The ability to apply scenarios to manage the use of the "ramp" in support of other scenarios that are managing the inter-urban road network as a whole.</p> <p>(3) The ability to apply suitable and appropriate algorithms so that the flow of traffic down the "ramp" causes the least disruption possible to the traffic already using the inter-urban network.</p> <p>(4) The ability to use traffic data from the inter-urban road network to determine the traffic conditions on the inter-urban road network, both in the immediate vicinity of the "ramp" as well as upstream and downstream of the ramp.</p> <p>(5) The ability to supplement traffic data provided by other functionality with data collected by its</p>

ID	Name	Definition
		<p>own sensors about traffic conditions on the "ramp", on the approaches to the "ramp" and in the local part of the inter-urban road network surrounding the "ramp" and to use this data to determine local traffic conditions.</p> <p>(6) A suitable HMI through which commands can be sent to Drivers using the "ramp" and to those approaching the "ramp" from an upstream part of the inter-urban road network.</p> <p>(7) The ability for the commands to be displayed to Drivers either at the roadside</p> <p>(8) The ability to manage one or more "ramps" and to apply different scenarios and/or algorithms at each "ramp".</p>
3.1.2.13.5	Manage Inter-urban Traffic Commands & Messages	<p>(1) The ability to provide traffic control facilities that enable the traffic to be managed so that the most efficient use is made of the inter-urban road network.</p> <p>(2) The ability to manage the implementation of traffic management scenarios for the inter-urban road network in a planned sequence according to the time of day and day of week.</p> <p>(3) The ability for the traffic management scenarios to include control of access to the inter-urban network (ramp metering), plus commands to manage the use of lanes in the carriageway (including the hard shoulder) and the maximum speeds for vehicles in each lane.</p> <p>(4) The ability for these scenarios to be overridden by the Road Network Operator through the functionality providing their interface, as well as by inputs from the incident, demand and access management functionality.</p> <p>(5) The ability to use current, historic and predicted traffic data from the inter-urban network and to change in real-time the actual traffic management commands being sent for output to take account of variations in this data.</p> <p>(6) The ability to provide details of the current and previous implemented traffic management scenarios on some or all parts of the inter-urban road network to the Road Network Operator through the functionality that provides their interface.</p>
3.1.2.13.4	Manage Inter-urban Road Network Speeds & Headways	<p>(1) The ability to provide the management of Vehicle speed and headway settings within the inter-urban road network.</p> <p>(2) The ability to receive commands to implement legal speed settings, plus both suggested speed and headway settings from either the functionality providing the Road Network</p>

ID	Name	Definition
		<p>Operator interface, or the inter-urban traffic management functionality, or as part of an incident, demand management, or environmental strategy.</p> <p>(3) The ability to ensure that requests from the Road Network Operator take priority and override those from the inter-urban traffic control functionality, but not override those that are part of an incident, demand management, or environmental strategy.</p> <p>(4) The ability to send speed and headway settings to the inter-urban functionality that is responsible for the output of messages to Drivers at the roadside, as well as to other functionality from which it can be sent to other parts of the system and to the Broadcaster.</p> <p>(5) The ability to send legal speed settings to the digital map data provider entity in case it needs to be used in future digital map updates.</p>
3.3.9	Manage Demand Management Data Store	<p>(1) The ability to manage the store of Demand Management Data.</p> <p>(2) The ability for the data about the use of transport modes that is received to be loaded directly into the store of Demand Management Data.</p> <p>(3) The ability for the received data to be sent to the functionality responsible for reviewing demand management strategies.</p> <p>(4) The ability to extract data from the Demand Management Data and send it to the appropriate functionality for use in the development of new demand management strategies.</p>
3.1.6.4	Manage Traffic Prediction Data Store	<p>This Function shall be capable of providing the following facilities:</p> <p>(1) The ability to manage the use of the store of Road Traffic Simulation Data.</p> <p>(2) The ability to load into the store the road network model and traffic data from other functionality in a way that keeps the data coherent and consistent.</p> <p>(3) It shall be possible for there to be more than one model of the same road network to enable various road configurations to be assessed for the effect on traffic.</p> <p>(4) The ability to enable the Traffic Simulation Engine functionality to obtain the data it needs to run simulations for each road network model and to store the results.</p> <p>(5) The ability to enable the Transport Planner to have access to the data in the store in a</p>

ID	Name	Definition
		<p>controlled manner so that changes can be made to the road network model and the results extracted for output to other functionality</p> <p>(6) If necessary the ability to be able to exchange data from the store with similar functionality in another instance of the System</p>
3.1.2.9	Output Inter-urban Traffic Data	<p>(1) The ability to periodically receive data about current traffic conditions in the inter-urban road network from the functionality that manages the store of Inter-urban Traffic Data, plus the functionality that manages lane use and maximum speeds within the inter-urban road network.</p> <p>(2) The ability to immediately output the data which has been received to other parts of the System or to entities that are outside of the System.</p> <p>(3) When a request is received from the Information Provider System, the ability to output the latest set of data that is available about inter-urban traffic conditions.</p>
3.1.2.14.4	Output Inter-urban Traffic Commands & Messages	<p>(1) The ability to co-ordinate execution of traffic measures (sent for output) within an area so that a safe and most efficient use is made of the inter-urban road network in the area</p> <p>(2) The ability to co-ordinate control devices individually or in groups</p> <p>(3) The traffic measures should be executed either by the following (external equipment) Variable Message Signs, Barriers, Lighting, and Ramp Metering</p> <p>(4) The ability for the execution of the traffic measures to be overridden by the Road Network Operator through the functionality providing their interface</p> <p>(5) The ability to use current, historic and predicted traffic data/rules from the inter-urban network and to change in real-time the actual traffic management commands being sent for output to take account of variations in this data.</p> <p>(6) The ability to continuously adapt the management of the inter-urban road network to suit the actual detected traffic conditions.</p> <p>(7) The ability to provide details of the current and previous modes of control on some or all parts of the inter-urban road network to the Road Network Operator through the functionality that provides their interface.</p> <p>(8) The ability to monitor the results of the output of commands, so that alternative action can be taken if they are not followed.</p>
3.3.13	Output Demand	<p>(1) The ability to take responsibility for the output</p>

ID	Name	Definition
	Management Information	<p>of information to Drivers and/or Travellers as part of a demand management strategy.</p> <p>(2) The ability for other functionality to provide details of what the information output should contain and to which group(s) of users the information should be output.</p>

**Table 6: Datastore functions**

### 4.3 Event Detection and Handling

A core capability required for the management of demand and capacity on the road network through influencing or directing the behaviour of road users and to ensure that traffic flow across the road network is as close to optimal as possible at all times and to protect people on the network.

Where events occur on the road network that cause traffic flow to deviate from normality (Current or Forecast Events, including routine congestion), Dynamic Traffic Management is employed to ensure that road users both locally near the scene of the incident and across the wider road network are able to continue their journeys with as little disruption as possible.

ID	Name	Definition
3.4.11	Analyse Environmental Data and Implement Actions	<p>(1) The ability to analyse (e.g. check if threshold values have been reached) the environmental data when in the store of D3.3 Environmental Data to see if any action is needed (among others Weather Event detection)</p> <p>(2) The ability to send the results of the analysis and any recommended action to the functionality providing the HMI for the Road Network Operator for confirmation of the action.</p> <p>(3) When conformation of the recommended action is received from the functionality providing the HMI for the Road Network Operator, the ability to send the data to other functionality in the System.</p> <p>(4) The ability to send a copy of the confirmed actions to the functionality that is managing the store of Environmental Data for loading into the data store.</p> <p>(5) If included in the recommended action, the ability to send the data about the environmental conditions to the functionality in the System that provides the HMI through which it can be output to Drivers and/or Travellers..</p>
IDTM 02	Decide Hazardous Location	The ability to decide whether an event location can be classified as a hazardous location.
IDTM 01	Decide Hazardous Goods	The ability to determine whether or not hazardous goods are included in the event about which data has been received.

ID	Name	Definition
3.2.13	Classify and Identify Events	<p>(1) The ability to analyse the data that it receives about traffic conditions in the road network and that is stored in data store D3.14 Inter-urban Traffic data to see if can detect that possibly incidents have occurred.</p> <p>(2) In the analysis of the data to detect events, the ability to enable the use of both data provided by other functionality (among others Environmental Data) and video image data as inputs.</p> <p>(3) The ability to analyse all types of data for patterns that suggest the occurrence of an event and the ability for such patterns to be linked to the same event if they occur in adjacent sections of the road network.</p> <p>(4) The ability for the term "event" to include anything that is likely to impede the normal flow of traffic, including Traffic Congestion, Vehicle Breakdown, Animal incursion, Human Incursion, Hazardous spillage, Debris, Wide/long loads, and Ghost drivers", i.e. Vehicles travelling against the proscribed direction of traffic flow, Exceptional environmental</p> <p>(5) The following incidents should be detected automatically (algorithmically): tbd</p> <p>(6) The ability to send details of a detected incident occurrence to the classification and storage functionality.</p>
IDTM 05	Report Event Analysis Data	This function shall be able to report results of the event and results of event analysis to other internal functions.
IDTM 03	Validate Event Information	The ability to validate event data that has been received is correct and accurately describes the event. Usually this is done with the aid of an operator.- results of event and event analysis are passed to Traffic Operator interface (function 3.1.2.14.1) and confirmed/rejected by the Operator. Operator can decide to request assistance from Traffic Officers (Roadside emergency resources)
3.2.12	Detect Events from Data	<p>(1) The ability to analyse the data that it receives about traffic conditions in the road network and that is stored in data store D3.14 Inter-urban Traffic data to see if can detect that possibly incidents have occurred.</p> <p>(2) The ability to analyse the data that it receives about traffic conditions in the road network and that is stored in data store D3.14 Inter-urban Traffic data to see if can detect critical conditions that could lead to an event.</p> <p>(3) In the analysis of the data to detect events, the</p>

ID	Name	Definition
		<p>ability to enable the use of both data provided by other functionality (among others Environmental Data) and video image data as inputs.</p> <p>(4) The ability to analyse all types of data for patterns that suggest the occurrence of an event and the ability for such patterns to be linked to the same event if they occur in adjacent sections of the road network.</p> <p>(5) The ability for the term "event" to include anything that is likely to impede the normal flow of traffic, including Traffic Congestion, Vehicle Breakdown, Animal incursion, Human Incursion, Hazardous spillage, Debris, Wide/long loads, and Ghost drivers", i.e. Vehicles travelling against the proscribed direction of traffic flow, Exceptional environmental</p> <p>(6) The following incidents should be detected automatically (algorithmically): tbd</p> <p>(7) The ability to send details of a detected incident occurrence to the classification and storage functionality</p>
2.1.2.3	Plan Emergency Event Intervention	<p>(1) The ability to define and/or build the emergency plan that defines how the Emergency Services will respond a particular incident.</p> <p>(2) As part of the definition of the emergency plan, be able to select the required emergency services, use pre-defined response procedures, request (green wave) routes for Emergency Vehicles and request that the routes are implemented.</p> <p>(3) The ability to contact the required emergency services and establish with them the action plans.</p>
2.1.2.4	Process Emergency Event Progress Reports	<p>(1) The ability to provide the full acknowledgement of the response to incidents to the originators.</p> <p>(2) The ability to prepare reports about the current progress with the response to incidents, i.e. how the emergency plan is being implemented.</p> <p>(3) The ability to provide updates to the functionality that provides the management of road traffic in the geographic area where the incident occurred.</p>
2.1.2.1	Identify and Classify Emergencies	<p>(1) The ability to collect incident notifications from a variety of sources.</p> <p>(2) The capability to filter and obtain associated information (e.g. location, cargo status, Vehicle identification, Traveller identification) to produce the data needed for the planning of the appropriate response from the Emergency</p>

ID	Name	Definition
		<p>Services.</p> <p>(3) The ability to provide an initial (first) acknowledgement of incident notification to its source, e.g. eCall from inside or outside the Vehicle.</p> <p>(4) The ability to classify incidents and to provide data about them to other functionality so that the appropriate response can be planned and implemented and traffic management action can be taken</p> <p>(5) The ability to store all gathered information and log the initial responses</p>
RM 06	Allocate resource	<p>(1) receive resource allocation request</p> <p>(2) receive data describing (1) the resource that has to be allocated, (2) the event to which it has to be allocated and (3) the type of action that has to be taken</p> <p>(3) look-up in the Resource Data whether such a resource is available (compare status and capabilities with the requested resource)</p> <p>(4) if such a resource is available, change the status of the resource to <i>allocated</i> and inform the resource owner about the allocation.</p>
RM 02	Allocate Time slot	<p>(1) Receive request for a time slot for Planned Road Works event. The information about event is contained in within a data store Forecast and Planned Event Data.</p> <p>(2) Identify stakeholders involved in the Planned Road Works event (from Forecast and Planned Event Data)</p> <p>(3) Apply rules that are a part of TimeSlot to decide whether there is a conflict-free time slot</p> <p>(4) If no free time slot is available negotiate the conflict with the stakeholders</p> <p>(5) Allocate the free time slot</p> <p>(6) Inform stakeholders about the time slot allocation</p>
RM 05	Deploy resource	<p>The ability to</p> <p>(1) receive a report by the resource that it is ready to be deployed</p> <p>(2) direct the resource to the event scene</p> <p>(3) brief the resource on the event and the required action</p> <p>(4) monitor the arrival time to the event's location</p> <p>(5) upon the arrival of the resource to the event's location mark the resource status as <i>deployed</i></p>
RM 04	De- Allocate resource	<p>The ability to</p> <p>(1) receive a report from the deployed resource when the action for which the resource has been allocated has been completed</p> <p>(2) report to resource owner that the resources is</p>



ID	Name	Definition
		not required (3) change the status of the resource as <i>available</i>

**Table 7: Event Detection and Handling**

## 4.4 Prediction

A supporting capability for the management of people and physical resources to ensure sufficient coverage of the priority areas of the road network based on road network intelligence.

ID	Name	Definition
3.1.6.3	Create Traffic Predictions with Simulation Methods	<p>(1) The ability to use a road network model, traffic data and environmental data to provide predictions of traffic conditions for the road network. The following predictions shall be possible:</p> <ul style="list-style-type: none"> <li>a. Possible critical situations</li> <li>b. Possible capacity bottlenecks</li> <li>c. Throughput, etc.</li> <li>d. Safe driving speed</li> </ul> <p>(2) The ability to provide the prediction on the basis the current and historical traffic data plus road network data</p> <p>(3) The ability to provide short and medium term predictions.</p> <p>(4) The ability to use this data as input to predict what the traffic conditions shall be like as a result of various traffic management scenarios that are provided by the Transport Planner, or have been used in the past in all or part of the road network, e.g. capacity reduction due to the roadworks</p> <p>(5) When completed the ability to send the predicted traffic conditions and associated scenarios to the functionality managing the store of Traffic Simulation Data.</p>
3.4.4	Predict Environmental Conditions	<p>(1) The ability to use data collected and stored by other functionality to predict the environmental conditions that will occur in and around the road network managed by the System.</p> <p>(2) The ability to use this collected and stored data with one or more algorithms and static data provided by the Road Network Operator to predict the environmental conditions that will be experienced by Travellers and/or Drivers.</p> <p>(3) The ability to send the data providing the predicted environmental conditions for storage by other functionality in the System.</p>
3.1.2.15	Predict Short & Medium	The ability to create short and medium term

ID	Name	Definition
	Term Inter-urban Conditions	<p>predictions of inter-urban traffic data. . The following predictions should be possible: traffic conditions (i.e. traffic flows, road segment use, journey times, etc.), event location, frequency and probability, follow up incidents as an event consequence</p> <ol style="list-style-type: none"> <li>(1) The ability to create the predictions of short and medium term inter-urban traffic data using algorithms that may be different in content and scope</li> <li>(2) The ability to predict effect of a scenario</li> <li>(3) The ability to request and use current inter-urban traffic data as the starting point for the predictions of short and medium term inter-urban traffic data.</li> <li>(4) The ability to repeat the creation of the predicted short and medium term inter-urban traffic data at (frequent?) periodic intervals.</li> </ol>
3.1.6.2	Process Road Traffic Data	<ol style="list-style-type: none"> <li>(1) The ability to receive real-time traffic data from inter-urban functionality.</li> <li>(2) The ability to process the received data so that it can be used in the road network model by the Traffic Simulation Engine functionality.</li> <li>(3) It shall be possible for the processing to include the generation of origin/destination data for the road network and indications of unusual changes in current traffic data based on historical data.</li> <li>(4) When the data has been processed, the ability for the data to be sent to the functionality that manages the store of Traffic Simulation Data</li> <li>(5) It shall be possible for road network (model) data to be provided and for historic traffic data to be provided periodically by the functionality managing the store of Traffic Simulation Data for use in the processing of the traffic data.</li> </ol>
3.1.6.6	Process Traffic Prediction Results	<ol style="list-style-type: none"> <li>(1) The ability to receive from the functionality managing the store of Traffic Simulation Data the results of a simulation that have been produced by the Traffic Simulation Engine functionality.</li> <li>(2) The ability to process these results to provide coherent and comprehensive information about forecasts of traffic conditions and traffic management scenarios.</li> <li>(3) The ability to automatically send this information to the appropriate functionality in the System.</li> </ol>

**Table 8: Prediction**

---

## 4.5 Scenarios

A core capability required for the management of activities which are undertaken where an event occurs on a live carriageway that causes traffic flow to deviate from normality or occurs off-network with an impact on the network. Incident management requires an on-road response to restore the network to normality. Additionally, the setting of signs and signals warning road users of an incident is considered part of Incident Management activity.

ID	Name	Definition
IDTM 09	Define Scenario	<ul style="list-style-type: none"><li>(1) Enable the initial definition of a control scenario (using information on the road network and available traffic measures, intended effect) for normal traffic situations</li><li>(2) Enable the definition of scenario's to deal with the following event types:<ul style="list-style-type: none"><li>a. planned and forecasted events: road works, crowd generation events,</li><li>b. traffic events: congestion, collision, vehicle breakdown, vehicle fire</li><li>c. incursion events: animal or human incursion, hazardous spillage, debris</li><li>d. ambient environment events, such as fog, heat, rain, wind, ice, snow</li><li>e. emergency events: vehicle accident, attack, disaster</li><li>f. infrastructure events: failure, damage, unplanned road maintenance</li></ul></li><li>(3) Test the scenario by simulation and adjust the scenario according to the outcome</li><li>(4) adjust the scenario on the basis of real outcomes in practise when the scenario has been deployed</li></ul>
3.1.2.13.7	Manage Planned Inter-urban Traffic Strategy Change	<ul style="list-style-type: none"><li>(1) The ability to provide facilities that enable inter-urban traffic management scenarios to be implemented automatically in a timed sequence.</li><li>(2) The ability for the sequence mechanism to permit the implementation to be by any combination of time of day, day of week, day of month, or day of year.</li><li>(3) The ability for the content and detail of the sequences of management comments that are to be implemented by time of day, to be received from the functionality that provides the Traffic Operator interface.</li><li>(4) The ability to provide on request a response to the functionality that provides the Traffic Operator interface details of the time of day sequences that are currently available for use.</li><li>(5) The ability to send requests for implementation of traffic control scenarios to the inter-urban</li></ul>

ID	Name	Definition
		traffic management and access control functionality.
3.2.6	Assess Events and Devise Responses	<p>(1) The ability to manage the assessment of incident data and to devise scenarios in response to incidents that have been detected by other functionality.</p> <p>(2) The ability to periodically review the data that has been collected about incidents and decide if any mitigation action is needed.</p> <p>(3) When mitigation action is needed the ability to either use an existing incident management scenario, or devise a new one.</p> <p>(4) The ability for an incident management scenario to involve a number of measures including changes to the current traffic management scenario, output of warning messages, plus the sending of comments and warnings to other functionality within the System.</p> <p>(5) The ability for the recipients of the warnings and comments shall be defined by the Road Network Operator through the functionality providing the HMI.</p> <p>(6) The ability for the recipients of the warnings and comments to vary from one scenario to another.</p> <p>(7) The ability to check the data and information that it sends for output as part of a scenario to ensure that it is consistent, i.e. all of the traffic measures and warning messages are coherent and do not contradict each other.</p> <p>(8) Before implementing a scenario, the ability to require that confirmation of its use is received from the functionality providing the HMI for the Road Network Operator.</p> <p>(9) The ability to create incident management scenarios either in anticipation of an incident or event, or because none of the existing scenarios are suitable, following a request from the Road Network Operator received through the functionality providing their HMI.</p> <p>(10) The ability to continually monitor the data that is being collected so that it can remove scenarios when incidents or events are not longer in progress.</p> <p>(11) When all the scenarios that have been implemented for a particular incident or event have been removed the ability to inform the Road Network Operator to signify that the incident or event has finished, using the functionality providing their HMI.</p>

ID	Name	Definition
3.2.7	Provide Event Mitigations to Traffic Management	<ul style="list-style-type: none"> <li>(1) The ability to manage the output of instructions from an incident scenario to other functionality in the System in response to incidents that have been detected and classified by other functionality.</li> <li>(2) The ability for the instructions included in the incident management scenario to be output to require the replacement of, or changes to, any traffic management scenario that are currently in operation.</li> <li>(3) The ability for the output of the incident management scenario to begin as soon as the scenario information is received.</li> <li>(4) The ability to keep a local store of the strategies currently being implemented and delete them when their expiry time has passed, or when a strategy modification or removal indication arrives from the incident management functionality.</li> <li>(5) The ability to use different scenario's in different parts of the road network</li> <li>(6) The ability to use different scenario's in overlapping parts of the network</li> </ul>

**Table 9: Scenarios**

## 4.6 Demand

A core capability required for the management of activities that provide information about the state of the road network. Information is provided to internal consumers such as operational colleagues and to external operational partners (such as the emergency services or service providers) to enable HA-RWS to fulfil their role as network operator.

HA also provides information to the general public, both pre-trip and on-road, as well as to third party organisations and the media.

RWS provides information, via the National Data Warehouse, to value-added service providers who provide traffic information to the general public.

ID	Name	Definition
3.3.6	Analyse Data to find Demand Management Scenario	<ul style="list-style-type: none"> <li>(1) The ability to decide which Demand Management Strategy that is to be implemented.</li> <li>(2) The ability to make the decision about which Strategy to implement by analysing the data being collected and stored in the store of Demand Data.</li> <li>(3) If no suitable Demand Management Strategy can be found to implement, the ability to respond to the request with an indication that</li> </ul>

ID	Name	Definition
3.3.1	Receive Information on Travel Factors	<p>the Transport Planner should be informed</p> <ol style="list-style-type: none"> <li>(1) The ability to receive data about the use of transport modes by Travellers in the geographic area served by the System from other functionality in the System, and/or external entities such as the Weather Service and Multi-Modal Systems.</li> <li>(2) The ability to check the received data for consistency before being sent to another part of the System functionality for storage.</li> <li>(3) The ability to integrate consequences of the changed Travel factors by calculating (forecasting) the capacity demand</li> </ol>
3.3.11	Simulate Demand Management Scenario	<ol style="list-style-type: none"> <li>(1) The ability to simulate the imposition of a demand management strategy by calculating among others Capacity, Spare Capacity, Bottlenecks and Impact in terms of traffic flows, speed etc.</li> <li>(2) The ability to carry out its simulations at the request of the Transport Planner who must specify the existing strategy that is to be simulated.</li> <li>(3) The ability to perform these simulation on (national, regional or sub-regional parts of the) network</li> <li>(4) The ability to send the results of the simulation to the functionality providing the HMI for the Transport Planner</li> <li>(5) The ability to send the results of the simulations Traffic Officer</li> </ol>
3.3.10	Review Demand Management Scenario Effects	<ol style="list-style-type: none"> <li>(1) The ability to review the effectiveness of a scenario</li> <li>(2) The ability to carry out this review at the request of the Transport Planner who must have specified the data about the use of transport modes that is to be analysed.</li> <li>(3) The ability to send the results of the analysis of the effectiveness of demand management strategies to functionality providing the HMI for the Transport Planner.</li> </ol>
3.3.8	Produce Demand Management Scenario	<ol style="list-style-type: none"> <li>(1) The ability to produce new scenario as a result of a request received from the functionality providing the HMI for the Transport Planner.</li> <li>(2) The ability for the new demand management scenarios that are produced to encourage a re-distribution of the use of travel modes away from the current highly used mode(s).</li> <li>(3) The ability to use data about the current usage of different transport modes in the preparation of the new demand management scenarios.</li> <li>(4) The ability to assess the data about the current</li> </ol>

ID	Name	Definition
		usage of different transport modes against "rules" for distribution provided by the Transport Planner through the functionality providing their HMI. (5) The ability to send the resulting new demand management strategies to the functionality that manages the store of Demand Management Data.
3.3.7	Demand Management Scenario Implementation	(1) The ability to implement demand management strategies when requested by the Road Network Operator. (2) The ability to achieve the implementation of demand management strategies by sending data about what action is required to other functionality in the System

**Table 10: Demand**

## 4.7 Performance

ID	Name	Definition
IDTM 08	Report Network Performance Data	The ability to report results of the network performance comparison.
IDTM 06	Gather Network Performance Data	The ability to gather/collect data on the performance of the network and prepare it for comparison. The data that must be collected must enable to determine among others (1) frequencies of occurrence, by time, type and location of events (2) identification of "high risk" locations on the road network; (3) performance of the event detection system (4) network traffic throughput and related traffic quality characteristics
IDTM 07	Compare Network Performance Data	(1) The ability to compare gathered network performance data and compare it earlier defined set thresholds. If thresholds are passed this may result in traffic measures to deploy. (2) The ability to compute frequencies of event, by time, type and location of events (3) identification of "high risk" locations on the road network; (4) performance of the event detection system
3.1.6.1	Process Road Network Static Data	(1) The ability to receive road network static data from inter-urban functionality (2) The ability to process the received data so that it can be used in the road network model by the

---

ID	Name	Definition
		Traffic Simulation functionality. (3) When the data has been processed it shall be sent to the functionality that manages the store of Traffic Simulation Data from where it can be obtained by the Traffic Simulation functionality.

**Table 11: Performance**



---

## 5. Annex B: External Interfaces

CHARM System (ChS) communicates with External System (ES) through (external) interfaces. An interface is specified by (1) defining which data and in what order is exchanged (functional part), and (2) defining what mechanism is used to exchange the data (the technical part).

In this document, the Functional Specification specifies only the functional part of the interface. The technical part (data representation, application and communication protocols) will be specified in Application and Infrastructure Specification (still to be developed).

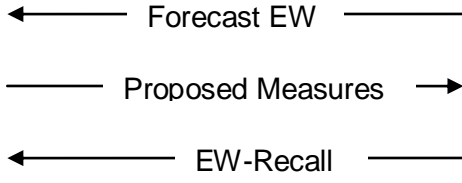



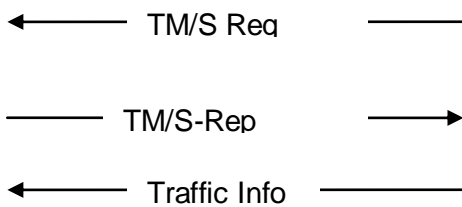
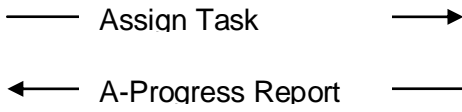
In exchange of data the participating system can be classified either as a Supplier (will provide data) or as a Consumer (will receive data). In some exchange situation, the exchange is symmetrical, i.e. The System is for some exchanges Supplier, for others the Consumer.

The exchange of information can be initiated by the Supplier (push) or by the Consumer (pull).

The specification of functional part of the interface uses a simple notation: an arrow from X to Y represents provisioning of data by system X to Y. The data to be passed is denoted by the arrow's label. The diagram notation does not denote whether the data has been pushed or pulled.

## 5.1 Functional Part of interface definition

Id	Name	Definition			Comment
		ChS Role	ChS	ES	
EIF 02	Planned Road Works Event	Consumer Push	← Timeslot Req	—	ES may request a timeslot for road works. ChS may grant this timeslot or it may propose other timeslots. If one of the counterproposals is acceptable to ES it requests this timeslot. Otherwise, it makes a new proposal. Once the ChS grants the time the road works may proceed on the agreed time. ES reports start of the roadworks.
			— TS-Request Rep	→	
			← Start of Roadworks	—	
			← TS-Extension	—	ES may request an extension of the time slot which may be granted or rejected.
			— TSER Rep	→	
			← End of Roadworks	—	The ES shall reports completion of road works
			— TS-Revocation	→	ChS may revoke a granted timeslot
			← RW-Recall	—	ES may recall (return) an already granted timeslot
EIF 03	Forecast Crowd Generating Event	Consumer Push	← Forecast CG Event	—	ES may report a forecasted/planned crowd generating event . ChS will return information about scenario that will be executed during the event.
			— Proposed Measures	→	
			← CG-Recall	—	ES may recall the CG Event

EIF 04	Forecast Weather Event	Consumer Push		<p>ES may report a forecasted/planned Extreme Weather event. ChS will return information about scenario that will be executed during the event.</p> <p>ES may recall the EW Event</p>
EIF 05	Event Details	Supplier, pull		ChS provides Event Details available to ES
EIF 06	Environmental Information	Supplier, pull		ChS provides Environmental Info available to ES
EIF 07	Traffic information	Supplier, push		ChS Supplies ES with Traffic Info
EIF 08	Traffic CS	Consumer /Supplier, Push		<p>A ES can request the ChS to perform a traffic measure, or predefined Scenario</p> <p>The Request can be granted or rejected. Vice versa, ChS can also request ES to perform traffic measures</p> <p>ES may inform ChS about the object status; vice versa: ChS can inform ES about the traffic situation in its area of control;</p>
EIF 09	Tunnel CS			
EIF 10	Bridge CS			
EIF 11	Roadside Emergency Resources CS	Supplier, Push		<p>ChS may assign a task to a Emergency Resource</p> <p>ES reports on the task's progress</p>

EIF 12	Emergency Service CS	Supplier, Push	<p>— Assistance Req —→</p> <p>← Assistance Rep —</p> <p>← A-Progress Report —</p> <p>— Assistance Recall —→</p>	<p>ChS may request assistance by an emergency resource.</p> <p>ES accepts or rejects the request.</p> <p>If the request has been accepted ES reports on the task's progress</p> <p>A already accepted assistance request may be recalled by the CS</p>
EIF 13	Barriers	Supplier, Push	<p>— Request B-State Change →</p> <p>← B-Status report —</p>	<p>ChS may command ES to Open/Close the barrier</p> <p>The ES send a report when the state change is completed</p>
EIF 14	Signs and Signals	Supplier, Push	<p>— Request S&amp;S State Change</p> <p>← S&amp;S-Status —</p>	<p>ChS may command ES to display a given sign or signal.</p> <p>The ES send a report when the state change is completed, or a failure code when the signs and signals could not be set and what the current signs and signals displayed are.</p>
EIF 14	Lighting	Supplier, Push	<p>— Request L- State →</p> <p>← L-Status report —</p>	<p>ChS may command ES to setup a given level of lighting</p> <p>The ES sends a report when the level of lighting has been reached, or a failure code</p>
EIF 15	Ramp Metering	Supplier, Push	<p>— Request RM-State Change →</p> <p>← RM-Status —</p>	<p>ChS may command ES to display a given red light cycle</p> <p>The ES sends a report when it's status has been adjusted.</p>
EIF 16	Traffic Monitoring	Consumer Push	<p>← Traffic Data —</p>	The ES sends a continuous stream of traffic data
EIF 17	Camera Images	Consumer Push	<p>← Camera Images —</p>	The ES sends a videostream

EIF 18	Camera Control	Consumer Push	<p>———— Send PTZ Command ———→</p> <p>←———— C-Status report ———</p>	<p>ChS sends a PTZ (Pan, tilt, or zoom) command to the ES</p> <p>The ES sends the new status</p>
EIF 19	Fog Data Collection	Consumer Push	<p>←———— Fog data ———</p>	The ES sends fog data, if present
EIF 20	Digital Maps Updates	Consumer Pull	<p>———— Request Map Update ———→</p> <p>←———— Digital Map ———</p>	<p>ChS sends a request for a digital map update to the ES</p> <p>The ES responds by sending the digital map update</p>
EIF 21	Other Stakeholders	Consumer Pull Supplier, Push	<p>◀ Request for OS-Information ———</p> <p>———— Traffic Info ———→</p>	<p>The ES sends a request for information on the traffic situation</p> <p>The ChS supplies traffic information</p>
EIF 22	Emergency Contact	Consumer Pull	<p>———— Request Emergency Support ———→</p> <p>←———— Acknowledgment ———</p>	<p>A request for emergency support is sent by the ChS</p> <p>The ES confirms that emergency support will be provided.</p>

---

## 5.2 Interface data

Below is a summary of the data required for interfacing with external systems, based on the interfaces described above.

These data items will be defined at a later stage of CHARM.

- T-Question
- T-Answer
- Timeslot Req
- TS-Request Rep
- Start of Roadworks
- Scenario
- TS-Extension Req
- TSER Rep
- End of Roadworks
- TS-Revocation
- RW-Recall
- Forecast CG Event
- Proposed Measures
- CG-Recall
- Forecast EW
- EW-Recall
- Event Details
- Environmental Info
- Traffic Info
- TM/S Req
- Assign Task
- A-Progress Report
- Assistance Req
- Assistance Rep
- A-Progress Report
- Assistance Recall
- Request B-State Change
- B-Status report
- Request S&S State Change
- S&S-Status
- Request L- State
- L-Status report
- Request RM-State Change
- RM-Status
- Traffic Data
- Camera Images
- Send PTZ Command
- C-Status report
- Fog Data
- Request Map Update
- Digital Map
- Request for OS-Information

## 6. Annex C: Function <->Activity relation

The table below describes the relation between functions and activities.

Activity Reference	Activity Name	Required Functions
CM01	Record (S)RW Forecast Event Information	D2.2, S3.9
CM02	Allocate (S) RW Forecast Event	D2.2, S3.9, 2.1.2.1, PI 04, PI 02, RM 02, RM 06,
CM03	Record CG Forecast Event Information	D2.2, S3.9
CM04	Allocate CG Forecast Event	D2.2, S3.9, 2.1.2.1, PI 04, PI 02
CM05	Record EW Forecast Event Information	D2.2, S3.9, 2.1.2.1, PI 04, PI 02
CM06	Allocate EW Forecast Event	D2.2, S3.9, PI 02, RM 06
CM07	Record Current Event Information	D2.2, S3.9, 2.1.2.1, PI 04, PI 02, 2.1.2.3, 2.1.2.4, 2.1.9, Emergency Contact System
CM09	Allocate Current Event	PI 02, RM 06
CM10	Record Current Event Information	PI 04, PI 02, 2.1.2.5, 2.1.21, 3.2.13, IDTM 05, 2.1.2.5, 2.1.1.2, RM 05
CM11	Plan Current Event Response	
CM13	Allocate Task	RM 05, RM 06
DTM01	Close Lanes for Road Works	3.1.2.14.2, 3.1.2.13.5, 3.1.2.14.4, 3.3.6, IDTM 09, S3.3, IDTM 04
DTM03	Monitor Traffic Flow Network	3.1.2.10, 3.1.2.16
DTM05	Allocate Traffic Scenario	3.2.7, 3.3.6, 3.2.10
DTM06	Verify On Road Conditions	RM 05
DTM07	Deploy Deployment Traffic Scenario	3.1.2.1.3.5
DTM08	Manage Demand and Capacity	3.1.2.14.2, DI 05, DI 09, Information Provider System, D3.3, DI 09, 3.2.9, 3.4.10, 3.1.2.14.4, 3.2.7, PI 04, 3.2.12, 3.2.7, 3.2.6, 3.2.8, D3.12, 3.1.2.13.5,

Activity Reference	Activity Name	Required Functions
		3.1.2.14.1, RI 03, PI 05, 3.3.6, IDTM 09, S3.3, IDTM 04, 3.1.2.13.7, D1.3, 3.1.6.3, RI 05
DTM10	Discover and Verify Potential Current Event	IDTM 03, PI 2, DI 03-09
DTM11	Determine Current Event Impact (National)	3.3.11, DI 01, 3.1.6.3, 3.1.2.15, S3.3
DTM12	Determine Current Event Impact (Regional)	3.1.6.3, DI 01, 3.1.6.3, 3.1.2.15, S3.3
DTM13	Regional	3.1.2.14.2, 3.1.2.14.3, 3.1.2.14.4, DI 05, DI 09, RM 01
DTM14	Manage National Diversions & On-Road Messages	DI 05, DI 09, Information Provider System, 3.2.7, 3.1.2.14.2, 3.1.2.13.5, 3.1.2.14.4, IDTM 09, 3.1.2.13.7
DTM15	Manage Regional Diversions & On-Road Messages	DI 05, DI 09, Information Provider System, 3.2.7, 3.1.2.14.2, 3.1.2.13.5, 3.1.2.14.4, IDTM 09, 3.1.2.13.7, 3.1.2.10, 3.1.2.16, D3.12
DTM16	Plan Current Event Response	3.2.6, 3.2.7, 3.3.6, 3.2.10, 2.1.2.1, 2.1.2.3, 2.1.2.4, RM 01
DTM17	Verify On Road Conditions	2.1.2.5
DTM18	Manage Demand and Capacity	3.1.2.14.2, DI 05, DI 09, Information Provider System, D3.3, DI 09, 3.2.9, 3.4.10, 3.1.2.14.4, 3.2.7, PI 04, 3.2.12, 3.2.7, 3.2.6, 3.2.8, D3.12, 3.1.2.13.5, 3.1.2.14.1, RI 03, PI 05, 3.3.6, IDTM 09, S3.3, IDTM 04, 3.1.2.13.7, D1.3, 3.1.6.3, RI 05, 3.1.2.14.2, 3.1.2.14.3, 3.1.2.14.4
DTM20	Restore Normality	PI 01, RM 04
EP01	Determine Capacity Network	3.3.11
EP02	Determine Demand	3.1.2.15
EP03	Determine Bottlenecks (Dem > cap)	3.1.6.3, 3.3.11, 3.3.11
EP04	Plan Normality Traffic Scenarios	IDTM 09, 3.1.2.13.7
EP05	Determine (S)RW Forecast Event Impact	3.1.6.3, 3.1.2.15, IDTM 09
EP06	Determine (S)RW Forecast Event Stakeholders	PI 02, RM 03



Activity Reference	Activity Name	Required Functions
EP07	Plan (S)RW forecast Event Traffic Scenarios	IDTM 09, 3.1.2.13.7, RM 02, 3.3.8, 3.1.2.1.3.1, 3.1.2.1.3.5
EP08	Determine CG Forecast Event Impact	3.1.2.15, IDTM 09, 3.1.6.3
EP09	Determine CG Forecast Event Stakeholders	PI 02
EP10	Plan CG forecast Event Traffic Scenarios	IDTM 09, 3.1.2.13.7, RM 02, 3.3.8, 3.1.2.1.3.1, 3.1.2.1.3.5
EP11	Determine EW Forecast Event Impact	3.1.2.15, IDTM 09, 3.1.6.3
EP12	Determine EW Forecast Event Stakeholders	PI 02
EP13	Plan EW forecast Event Traffic Scenarios	IDTM 09, 3.1.2.13.7, 3.1.6.3
EP14	Plan Traffic Forecast	RM 05, PI 01, 3.1.6.3, 3.1.6.3, 3.1.2.15, 3.1.6.5
EP15	Plan Positioning Traffic Officers on the Network	D3.12, IDTM 09, 3.2.7
EP16	Evaluate Traffic Scenarios	3.1.2.10, D3.11, 3.1.6.4, IDTM 09, 3.1.2.13.7, 3.4.1a, 3.4.1, D3.3, DI 03-09
EP17	Evaluate Network Performance	3.1.2.10, D3.11, 3.1.6.4, 2.1.2.5, IDTM 05-08, Report Event Analysis Data, D3.4
IM02	Setting Signs and Signals (automatically)	3.2.12, 3.1.2.13.5, 3.1.2.14.2, 3.1.2.14.4, 3.3.8
IM05	Protect Current Event Scene (Signs & Signals)	DI 05, DI 09, Information Provider System, 3.1.2.14.2, 3.1.2.14.4, 3.1.2.14.2, 3.1.2.13.5, 3.1.2.14.4, PI 05, 3.3.6, IDTM 09, S3.3, IDTM 04, 3.1.2.13.5, 3.1.2.14.2, 3.1.2.14.4, RI 05, 3.1.2.13.5, 3.1.2.14.2, 3.1.2.14.4
IP00	Disseminate Traffic Flow Information	PI 04, 3.1.2.10, 3.1.4.1, IDTM 04, S0.2, D2.2, S3.9, 3.2.9, 3.4.10, DI 09, DI 02, DI 05, Information Provider System, 3.2.11, D3.4, 3.1.6.3, 3.3.6, IDTM 09, IDTM 07, IDTM 08, DI 01

Activity Reference	Activity Name	Required Functions
IP02	Process Traffic Flow Information	3.2.9, 3.4.1, DI 09, 3.1.2.6, PI 04, 3.1.2.16, D3.14, 3.1.2.15, 3.1.6.3, D3.12, 3.1.2.10, 2.1.2.4
IP03	Disseminate Traffic Flow Information	3.1.2.13.5, 3.1.2.14.2, 3.1.2.14.4, PI 04, 3.1.2.10, 3.1.4.1, IDTM 04, S0.2, D2.2, S3.9, 3.2.9, 3.4.10, DI 09, DI 02, DI 05, Information Provider System, 3.2.11, D3.4, 3.1.6.3, 3.3.6, IDTM 09, IDTM 07, IDTM 08, DI 01
IP04	Discover Potential Current Event	3.2.12, 3.2.11, 2.1.2.5, 2.1.21, 3.2.13, IDTM 05
IP05	Process Traffic Flow Information	3.2.9, 3.4.1, DI 09, 3.1.2.6, PI 04, 3.1.2.16, D3.14, 3.1.2.15, 3.1.6.3, D3.12, 3.1.2.10, 2.1.2.4
IP06	Disseminate Traffic Flow Information	3.1.2.13.5, 3.1.2.14.2, 3.1.2.14.4, PI 04, 3.1.2.10, 3.1.4.1, IDTM 04, S0.2, D2.2, S3.9, 3.2.9, 3.4.10, DI 09, DI 02, DI 05, Information Provider System, 3.2.11, D3.4, 3.1.6.3, 3.3.6, IDTM 09, IDTM 07, IDTM 08, DI 01
IP07	Process Traffic Flow Information	3.2.9, 3.4.1, DI 09, 3.1.2.6, PI 04, 3.1.2.16, D3.14, 3.1.2.15, 3.1.6.3, D3.12, 3.1.2.10, 2.1.2.4
IP08	Disseminate Traffic Flow Information	PI 04, 3.1.2.10, 3.1.4.1, IDTM 04, S0.2, D2.2, S3.9, 3.2.9, 3.4.10, DI 09, DI 02, DI 05, Information Provider System, 3.2.11, D3.4, 3.1.6.3, 3.3.6, IDTM 09, IDTM 07, IDTM 08, DI 01
IP09	Process Traffic Flow Information	3.2.9, 3.4.1, DI 09, 3.1.2.6, PI 04, 3.1.2.16, D3.14, 3.1.2.15, 3.1.6.3, D3.12, 3.1.2.10, 2.1.2.4
IP10	Disseminate Traffic Flow Information	3.1.2.13.5, 3.1.2.14.2, 3.1.2.14.4, PI 04, 3.1.2.10, 3.1.4.1, IDTM 04, S0.2, D2.2, S3.9, 3.2.9, 3.4.10, DI 09, DI 02, DI 05, Information Provider System, 3.2.11, D3.4, 3.1.6.3, 3.3.6, IDTM 09, IDTM 07, IDTM 08, DI 01
IP11	Disseminate Traffic Flow Information	PI 04, 3.1.2.10, 3.1.4.1, IDTM 04, S0.2, D2.2, S3.9, D3.4, 2.1.2.1, PI 02, D2.2, S3.9
RM00	Briefing	RM 03
RM01	Allocate Traffic Officer	RM 01, RM 04, 2.1.2.5
RM02	Deploy Traffic Officer	RM 05, RM 03, PI 01
RM03	Allocate Traffic Officer	RM 01, RM 02, RM 04
RM04	Deploy Traffic Officer	RM 05, RM 03, PI 01

---

Activity Reference	Activity Name	Required Functions
RM05	Allocate Towing Service	RM 01, RM 02, RM 04
RM06	Deploy Towing Service	RM 05, PI 2, DI 03-09
RM07	Allocate Traffic Officer	RM 01, RM 02
RM08	Deploy Traffic Officer	RM 05, RM 03, PI 02, DI 03-09, PI 01
RM11	Allocate On-Road Team Manager	RM 01, RM 02, RM 04, 2.1.2.5
RM12	Deploy On-Road Team Manager	RM 05, PI 2, DI 03-09
RM13	Allocate Emergency Contractors	RM 01, RM 02, RM 04
RM14	Deploy Emergency Contractors	RM 05, RM 03, PI 2, DI 03-09, PI 01

**Table 12 Function Activity relation**

---

## 7. Annex D: CHARM User Needs

The following Table defines the CHARM User Needs and their relation to CHARM functions and datastores.

The column Ref is either the FRAME User Need Id (as defined in [FUN]) or CHARM User need (Prefix A or suffix a).

The column Function, Data store identifies which Functions and Datastores are needed directly to support the User Need.

Reference	Definition	Function, Datastore ID
2.1.0.1	The system shall be able to exchange traffic and travel information between adjacent TICs to enhance local information.	PI 04
2.1.1.1	The system shall be able to produce information for travellers on the traffic and travel conditions of all relevant transport modes.	3.2.9, 3.4.1, DI 09
2.1.1.3	The system shall be able to collect traffic data for road network use analysis and prediction calculations.	3.1.2.10, D3.11, 3.1.6.4
2.1.2.2	The system shall be able to develop and implement traffic environmental management scenarios based on current and predicted traffic conditions.	IDTM 09, 3.1.2.13.7
2.1.2.5	The system shall be able to simulate potential capacity reduction, e.g. due to road works.	3.1.6.3
2.1.3.1	The system shall be able to measure the effect of a strategy, and to modify it when necessary.	3.1.2.15, IDTM 09
2.1.4.1	The system shall collect and report data as required by legally appointed authorities.	3.1.2.10, 3.1.4.1, IDTM 04, S0.2, D2.2, S3.9
2.1.4.2	The system shall be able to archive (a summary of) historical data on transport demand and transport supply for all transport modes.	3.1.2.6
6.1.0.1	The system shall provide emergency, or urgent, information to all road users free of charge.	3.2.9, 3.4.10, DI 09
6.1.0.3	The system shall be able to provide accurate, credible, timely, and easy to comprehend traffic and travel information where it may be of benefit to the user.	3.2.9, 3.4.10, DI 09

Reference	Definition	Function, Datastore ID
6.1.0.4	The system shall be able to provide information on alternative routes where they are quicker, cheaper, shorter, scenic, etc.	3.2.9, 3.4.10, DI 09, DI 02
6.1.2.3	The system shall be able to provide information to all drivers including route restrictions, travel times, etc.	3.2.9, 3.4.10, DI 09, DI 02
6.1.2.4	The system shall be able to support a database of events with links between events that occur concurrently and at the same or adjacent locations.	D3.4
6.1.2.5	The system shall be able to analyse, process and retrieve data from different combinations of sources (including floating car).	PI 04
6.1.2.6	The system shall be able to provide road and traffic information adapted to different classes of users, e.g. travellers, radio broadcasters, service operators.	DI 05, DI 09, Information Provider System
6.1.2.7	The system shall provide information using graphical representation or text. Graphical form shall include the use of maps as well as text.	DI 05, DI 09, Information Provider System
6.1.2.8	The system shall provide information in the native language at the output location, and/or from a user selected choice of other appropriate foreign languages.	DI 05, DI 09, Information Provider System
6.1.3.7	The system shall provide information via (public) terminals located at strategic locations: e.g. home, office, inter-modal interchanges (.e.g. bus, railway and metro stations), vehicle, restaurant, etc. (To only be fulfilled in a Physical Viewpoint.)	DI 05, DI 09, Information Provider System
6.1.3.8	The system shall be able to provide customised pre-trip information to hand-held and in-vehicle devices.	DI 05, DI 09, Information Provider System
6.2.0.1	The system shall provide emergency, or urgent, information to all users free of charge.	DI 05, DI 09, Information Provider System
6.2.0.4	The system shall provide traffic information to the traveller during his/her trip in a timely manner, and include travel conditions, accidents, special events, car park status, etc.	DI 05, DI 09, Information Provider System
6.2.0.5	The system shall be able to provide urban and inter-urban traffic and travel information to drivers about the domain they are not currently in.	DI 05, DI 09, Information Provider System
6.2.2.1	The system shall be able to inform travellers on the current average travel time between fixed points.	DI 05, DI 09, Information Provider System
6.2.2.10	The system shall be able to collect data from a variety of different sources, e.g.	2.1.2.1, PI 04, PI 02

Reference	Definition	Function, Datastore ID
	road/traffic management, police, weather services, floating car etc.	
6.2.2.11	The system shall be able to provide operators with an overall view of all active events in an area.	3.2.11, D3.4
6.2.2.4	The system shall provide road and traffic safety advice based on current weather and traffic conditions.	D3.3, DI 09, 3.2.9, 3.4.10
6.2.2.5	The system shall be able to provide information to all drivers including route restrictions, travel times, etc.	DI 09, 3.2.9, 3.4.10, 3.1.2.13.5,
6.2.2.7	The system shall be able to support a database of events with links between events that occur concurrently and at the same or adjacent locations.	D3.4
6.2.2.8	The system shall be able to provide road information according to different geographic scales, e.g. local, regional, national, international.	DI 05, DI 09, Information Provider System
6.2.2.9	The system shall be able to adapt the information to different classes of users, e.g. travellers, radio broadcasters, service operators.	DI 05, DI 09, Information Provider System
6.2.3.1	The system within the vehicle, or in the centre, shall support various types of presentation to the user.	DI 05, DI 09, Information Provider System
6.2.3.5	The system shall be able to provide customised on-trip information to hand-held and in-vehicle devices.	DI 05, DI 09, Information Provider System
6.2.3.8	The system shall be able to provide road and traffic information using road-side equipment, e.g. VMS.	3.1.2.14.2, 3.1.2.14.4
7.1.0.12	The system shall be able to use different methodologies to control separate areas of the road network.	3.2.7
7.1.0.13	The system shall be able to manage the urban/inter-urban interface.	PI 04
7.1.0.5	The system shall manage road traffic in such a way that congestion (travel time) may be reduced.	3.2.12, 3.2.7, 3.2.6, 3.2.8
7.1.0.7	The system shall be able to exchange information between TICs and TCCs, including across national boundaries.	PI 04
7.1.0.8	The system shall enable the data that it stores to be extracted by an operator onto a variety of media and used for other purposes, or by other organisations.	Outside of scope of Functional Specification. In scope of Application and/or Infrastructure Specification

Reference	Definition	Function, Datastore ID
7.1.1.1	The system shall be able to monitor sections of the road network to provide the current traffic conditions (e.g. flows, occupancies, speed and travel times etc.) as real time data.	3.1.2.10, 3.1.2.16
7.1.1.3	The system shall monitor traffic in all or part of the road network that uses an "inter-urban" style of road management, e.g. no junctions and pedestrian facilities, but with lane use management.	3.1.2.10, 3.1.2.16
7.1.1.4	The system shall be able to monitor traffic flow at, and the operation of, the road intersections of the network over which it has the control.	3.1.2.10, 3.1.2.16
7.1.2.1	The system shall be able to use consistent historical data to complement real-time data, when necessary.	3.1.2.16, D3.14
7.1.2.2	The system shall be able to predict short, medium, and long-term traffic conditions.	3.1.2.15
7.1.2.3	The system shall be able to use historical data to complement predicted data, when necessary.	3.1.2.16, D3.14
7.1.2.4	The system shall be able to analyse road and traffic data to predict possible critical situations.	3.1.6.3
7.1.2.7	The system shall be able to provide historical and predicted data.	3.1.6.3
7.1.3.1	The system shall enable a TCC operator to control, possibly remotely, infrastructure elements (e.g. traffic lights, VMS).	3.1.2.14.2
7.1.3.2	The system shall enable a TCC operator to log all significant incidents and to record free text messages prior to their output to travellers.	D3.12
7.1.3.3	The system shall be able to provide a graphical representation of the road network (including equipment, incidents, traffic condition etc....) to TCC operators.	3.1.2.13.1
7.1.3.4	The system shall be able to activate control devices (e.g. traffic lights, VMS), either individually or in groups.	3.1.2.13.5, 3.1.2.14.4
7.1.3.5	The system shall enable TCC operators to make temporary changes to the normal control strategy in real-time.	3.1.2.14.1
7.1.3.7	The system shall be able to support a database of all known (future) events.	D2.2, S3.9
7.1.3.8	The system shall provide TCC/TIC operators with controlled access to all relevant systems.	

Reference	Definition	Function, Datastore ID
7.1.4.1	The system shall be able to control the entries and exits to motorways.	RI 05, 3.1.2.14.5
7.1.4.2	The system shall be able to provide ramp metering (e.g. using traffic signals or barriers) at selected locations (e.g. slip road entrances to high speed roads).	RI 03
7.1.4.3	The system shall provide Tidal Flow Control (reservation of lanes for exclusive use in one direction for a period, then the other direction for another period, on parts of the road network).	3.1.2.13.5, 3.1.2.14.2, 3.1.2.14.4
7.1.4.6	The system shall be able to provide control measures for bridges so that warnings of weather conditions, vehicle restrictions and closure can be provided.	PI 05
7.1.4.8	The system shall be able to provide co-ordinated traffic management operations during periods of mass movement across (many) regions.	3.3.6, IDTM 09,
7.1.4.9	The system shall be able to provide specific traffic management for exceptional vehicles (e.g. very dangerous cargo, wide loads, etc.).	3.3.6, IDTM 09, S3.3, IDTM 04
7.1.5.1	The system shall be able to provide control measures to protect road maintenance work and workers.	3.3.6, IDTM 09, S3.3, IDTM 04
7.1.5.2	The system shall be able to command drivers to change lanes on multi-lane roads.	3.1.2.13.5, 3.1.2.14.2, 3.1.2.14.4
7.1.5.5	The system shall be able to close roads and advise drivers of a suitable diversionary route for a period of time.	3.1.2.13.5, 3.1.2.14.2, 3.1.2.14.4
7.1.5.6	The system shall be able to command drivers of certain classes of vehicle (e.g. heavy vehicles or tourist traffic) to take an alternative route for a period of time.	3.1.2.13.5, 3.1.2.14.2, 3.1.2.14.4
7.1.7.2	The system shall be able to set variable speed limits on parts of the road network.	3.1.2.13.5, 3.1.2.14.2, 3.1.2.14.4
7.1.7.3	The system shall be able to calculate recommended speed limits for given traffic and weather conditions, and road network characteristics.	3.1.6.3
7.2.0.5	The system shall collect and filter emergency calls from travellers in the road network using a variety of types of communication (e.g. road-side telephones, mobile phones, (automatic) on-board 'MayDay' etc.)	2.1.9, Emergency Contact System
7.2.0.6	The system shall minimise the time between the occurrence of an incident and its detection.	3.2.12, 3.2.11
7.2.0.7	The system shall be able to validate that an incident has occurred in order to minimise false alarms.	IDTM 03



Reference	Definition	Function, Datastore ID
7.2.1.2	The system shall be able to co-ordinate the emergency and rescue services once an incident has been detected, until all injured persons have reached a hospital.	2.1.2.1, 2.1.2.3, 2.1.2.4
7.2.1.3	The system shall provide communications between the emergency services, hospitals and TCCs for the provision of incident information.	2.1.2.1, 2.1.2.3, 2.1.2.4
7.2.2.1	The system shall be able to collect and store data on each incident, e.g. location, type, severity, number & type of vehicles involved, the emergency/rescue vehicles needed etc.	2.1.2.5
7.2.2.2	The system shall be able to identify and classify all incidents on the road network.	2.1.21, 3.2.13
7.2.2.3	The system shall be able to provide information on each incident to TICs for onward transmission to travellers.	IDTM 05
7.2.3.1	The system shall be able to produce incident data statistics, e.g. frequencies of occurrence, by time, type and location; identification of "high risk" locations on the road network; performance of the incident detection system.	IDTM 07, IDTM 08
7.2.4.1	The system shall be able to minimise the consequences of an incident on the road network for those travellers who are not involved.	IDTM 09, 3.1.2.13.7
7.2.4.2	The system shall be able to monitor the aftermath of an incident.	3.1.2.10, 2.1.2.4
7.2.5.1	The system shall be able to detect "non-vehicle" incidents before they can escalate into traffic accidents, e.g. bad weather conditions, objects on the road, ghost drivers, etc.	3.2.12
7.2.5.2	The system shall be able to provide local warnings on dangerous sections of the road network.	3.1.2.13.5, 3.1.2.14.2, 3.1.2.14.4, D1.3, 3.1.6.3
7.2.6.1	The system shall be able to advise the emergency services on any hazardous goods that have been involved in an incident.	IDTM 01, IDTM 02, IDTM 04, S3.3,
7.3.0.1	The system shall provide information that will influence travellers' decisions regarding their destinations, time, mode of travel, route etc.	DI 01, DI 09
7.3.0.2	The system shall receive up-to-date information on those factors that will influence the demand management strategy, e.g. traffic levels, car park usage, other modes usage, fares, tolls, etc.	PI 01
7.3.0.5	The system shall be able to simulate potential capacity reduction, e.g. due to road	3.1.6.3, 3.1.2.15

Reference	Definition	Function, Datastore ID
	works.	
7.3.1.2	The system shall be able to recommend alternative routes (e.g. that take into account the needs of heavy vehicles (and hazardous goods)) when it is required to direct certain types of vehicle away from a particular part of the road network.	D3.12
7.3.1.4	The system shall be able to use physical barriers to control the access of vehicles into a zone.	RI 05, 3.1.2.13.5, 3.1.2.14.2, 3.1.2.14.4
7.1.0.10a	The system shall be able to coordinate with urban roads and traffic control.	PI 04
7.1.1.6a	The system shall be able to monitor and record (but not collect, except fog) weather conditions, e.g. wind, fog, rain level, ice, etc.	3.4.1a
7.1.1.8a	The system shall be able to locate the tail end of a traffic queue and estimate its speed of propagation.	3.2.12
7.1.2.4a	The system shall be able to calculate the road capacity in normal and in exceptional circumstances	3.3.11
7.1.2.5a	The system shall be able to collect predicted conditions, in particular the information of fog and/or ice/wind	3.4.1a, 3.4.1, D3.3
7.1.2.6a	The system shall be able to collect predicted short, medium and long-term (e.g. for minutes, hours and days ahead) road travel produced environmental (atmospheric and noise) pollution conditions based on traffic and weather conditions.	3.4.1a, 3.4.1, D3.3
7.1.3.10a	The system shall be able to forecast event clearance time	DI 01, 3.1.6.3
7.1.3.11a	The system shall be able to identify hazardous locations of a network	S3.3
7.1.3.3a	The system shall be able to present all information concerning planning, resource availability etc to all TMC staff	RM 03
7.1.3.8a	The system shall be able to identify parts of the network where the intensity-capacity is critical	3.1.6.3, 3.3.11
7.1.3.9a	The system shall be able to identify parts of the network that have spare capacity	3.3.11
7.1.5.10a	The system shall be able to inform drivers via road-side devices on location of the	3.1.2.13.5, 3.1.2.14.2, 3.1.2.14.4,

Reference	Definition	Function, Datastore ID
	tail end of a traffic queue	
7.1.5.9a	The system shall be able to forecast follow-up incidents or damage to infrastructure as a consequence of an event	3.1.2.15
7.1.7.1a	The system shall be able to show the maximum authorised speed of vehicles on selected carriageways to be shown to drivers	3.1.2.13.5, 3.1.2.14.2, 3.1.2.14.4,
7.1.7.2a	The TO shall be able to set variable speed limits on parts of the road network using emergency traffic means (such as mobile VMS and coning, etc)	3.1.2.13.5, 3.1.2.14.2, 3.1.2.14.4,
7.1.7.7a	The system shall be able to calculate recommended speed limits for given traffic (fully automatic)	3.3.8, 3.2.12
7.1.9.1a	The system shall be able to provide green wave management for all vehicles on some parts of the network	3.1.2.13.5, 3.1.2.14.2, 3.1.2.14.4,
7.2.0.1a	The system shall detect various incidents on the road network.	3.2.12, D3.14, 3.1.210
7.2.0.1b	The system shall respond to various incidents on the road network.	3.2.12, 3.2.13, 3.2.7
7.2.0.9a	The system shall be able to forecast whether an event can cause follow up incidents	3.1.2.15
7.3.0.6a	The system shall be able to forecast traffic demand, on the basis of expected and possible road works, crowd-generating events, weather forecast, expected congestion, and historical traffic data	3.1.6.3, 3.1.2.15, 3.1.6.5
7.3.0.7a	The system shall be able to forecast on the basis of expected and possible road works, crowd-generating events, weather forecast, expected congestion, and historical traffic data where On Road Traffic Officer and their equipment may be required.	D3.12, IDTM 09, 3.2.7
7.6.1.2a	The system shall be able to receive a request for assistance (eCall) message of the emergency services from a road-side device.	2.1.9, 2.1.2.5
A10.1.1	The system shall be able to evaluate handling of events by business units, TO, staff and stakeholders	IDTM 05 Report Event Analysis Data, D3.4
A10.1.2	The system shall be able to register and monitor the status (ability and capacity) of business units and staff with respect to their ability to handle a response to an event	RM 01

Reference	Definition	Function, Datastore ID
A10.1.3	The system shall be able to (de)allocate answering of a query or an information request to the most appropriate business unit that cannot be answered at the first point of contact)	RM 05, RM 06
A10.3.1	The system shall be able to define scenario's, i.e. set of rules (conditions) and associated actions	3.3.8
A10.3.2	The operator shall be able to review/adjust scenario's that can be executed mechanically	3.1.2.1.3.1
A10.3.3	The system shall be able automatically or manually to initiate (dispatch) execution of a scenario	3.1.2.1.3.5
A10.3.4	The system shall be able to generated triggers for scenario's. A trigger generation is based on a comparison of a condition of a scenario and actual traffic situation	3.2.6
A10.3.5	The system shall be able to present one or more scenario's associated with a trigger	3.2.7
A10.3.6	The system shall enable an operator to select the desired scenario	3.3.6
A10.3.7	The system shall be able to present the measures associated with a scenario	3.2.10
A10.3.8	The system shall be able to present traffic situation associated the effect area of a scenario	3.2.7
A10.4.1	The system shall be able to compute conflicts in scheduling of road works	RM 02
A10.4.2	The system shall be able to register and monitor the status (location, ability and capacity) of TO, Business Unit or a Contractors with respect to its ability to handle a response to an event	RM 01
A10.4.3	The system shall be able to support staff in providing confirmation of/reporting on road conditions, e.g. traffic flow, road surface conditions, weather, set speed, road conditions, etc.	2.1.2.5
A10.4.4	The system shall be able to de-allocate staff i, e.g. TO, Business Unit or a Contractor for supporting the TMC response to an event such as road works, current and predicted events	RM 04
A10.4.5	The system shall be able to direct TO or a Contractor to the event scene	RM 05
A10.4.6	The system shall be able to monitor arrival of TO or a Contractor to the event scene	RM 05

Reference	Definition	Function, Datastore ID
A10.5.1	The system shall be able to (de)allocate time slot for execution of road works	RM 02
A10.5.1a	The system shall be able to compute conflicts in scheduling of road works	RM 02
A10.5.2	The system shall be register all stakeholders of an event	PI 02
A10.5.3	The system shall be able inform all event stakeholders on measures taken in response to an event	PI 01
A10.5.4	The system shall be able to register and monitor the status of all stakeholders with respect to their ability to aid the planning of a response to an event	PI 02
A10.6.1	The system shall be able to allocate Current Event tot the appropriate recipient to respond and manage it	RM 06
A10.7.1	The system shall be able to gather, evaluate, store and disseminate information on events and on handling of events response	RM 05
A10.7.3	The system shall be able to disseminate evaluations of handling of events by business units, TO, staff and stakeholders to all authorised parties	PI 01
A10.7.4	The system shall be able to gather, store and disseminate information on expected and possible road works, crowd-generating events, exceptional weather, expected congestion	PI 2, DI 03-09
A10.7.5	The system shall be able to store data on performance of road network	IDTM 07
A10.7.6	The system shall be able to gather, store, evaluate and disseminate information on results of scheduled activities	DI 03-09
A10.7.7	The system shall be able to gather, store and handle performance targets for road network	IDTM 06
A10.7.8	The system shall be able to compare actual to target performance	IDTM 08
A11.1.4	The system shall be able to brief all TMC staff on expected developments, among others expected events, traffic situations and planned traffic measures, planned traffic officers positions	RM 03
A11.1.5	The system shall be able to debrief all TMC personnel on, among others, their compliance with procedures in handling the event, possibility of performance improvement in future handling of similar events, and welfare of staff	RM 07
A12.1	The system shall be able to provide Radio traffic information warnings related to	DI 05, DI 09

Reference	Definition	Function, Datastore ID
	Congestion, Extreme weather and Oncoming vehicle	
A12.10	The system shall be able to instruct with respect to Rolling roadblocks	3.1.2.14.2, 3.1.2.14.3, 3.1.2.14.4,
A12.11	The system shall be able to instruct with respect to Homogenise	3.1.2.14.2, 3.1.2.14.3, 3.1.2.14.4,
A12.12	The system shall be able to inform on Congestion/travel time local and permanent	3.1.2.14.2, 3.1.2.14.3, 3.1.2.14.4,
A12.13	The system shall be able to instruct with respect to No overtaking for lorries (semi static)	3.1.2.14.2, 3.1.2.14.3, 3.1.2.14.4,
A12.14	The system shall be able to instruct with respect to No overtaking for lorries (dynamic)	3.1.2.14.2, 3.1.2.14.3, 3.1.2.14.4,
A12.15	The system shall be able to instruct with respect to Keep in lane	3.1.2.14.2, 3.1.2.14.3, 3.1.2.14.4,
A12.16	The system shall be able to instruct with respect to Dynamic speed limits	3.1.2.14.2, 3.1.2.14.3, 3.1.2.14.4,
A12.17	The system shall be able to instruct with respect to Semi-static speed limits	3.1.2.14.2, 3.1.2.14.3, 3.1.2.14.4,
A12.18	The system shall be able to instruct with respect to Secondary congestion screen	3.1.2.14.2, 3.1.2.14.3, 3.1.2.14.4,
A12.19	The system shall be able to instruct with respect to Height detection at tunnel entrance	3.1.2.14.2, 3.1.2.14.3, 3.1.2.14.4,
A12.2	The system shall be able to provide Fog warning	3.1.2.14.2, 3.1.2.14.3, 3.1.2.14.4,
A12.20	The system shall be able to instruct with respect to Ramp metering	3.1.2.14.2, 3.1.2.14.3, 3.1.2.14.4,
A12.21	The system shall be able to instruct with respect to Lane metering at merge points	3.1.2.14.2, 3.1.2.14.3, 3.1.2.14.4,
A12.22	The system shall be able to instruct with respect to Buffer at intersection	3.1.2.14.2, 3.1.2.14.3, 3.1.2.14.4,
A12.23	The system shall be able to inform on Park & Ride transport possibilities	3.1.2.14.2, 3.1.2.14.3, 3.1.2.14.4,
A12.24	The system shall be able to instruct with respect to Buffer at slip road	3.1.2.14.2, 3.1.2.14.3, 3.1.2.14.4,
A12.25	The system shall be able to instruct with respect to Buffer at exit	3.1.2.14.2, 3.1.2.14.3, 3.1.2.14.4,
A12.26	The system shall be able to instruct with respect to Modify traffic light at connections	3.1.2.14.2, 3.1.2.14.3, 3.1.2.14.4,
A12.27	The system shall be able to instruct with respect to Cross off	3.1.2.14.2, 3.1.2.14.3, 3.1.2.14.4,
A12.28	The system shall be able to instruct with respect to Oncoming traffic in tunnels (Tidal Flow)	3.1.2.14.2, 3.1.2.14.3, 3.1.2.14.4,
A12.29	The system shall be able to instruct with respect to Oncoming traffic at road works	3.1.2.14.2, 3.1.2.14.3, 3.1.2.14.4,
A12.3	The system shall be able to provide High wind warning	3.1.2.14.2, 3.1.2.14.3, 3.1.2.14.4,
A12.30	The system shall be able to instruct with respect to Bus on hard shoulder	3.1.2.14.2, 3.1.2.14.3, 3.1.2.14.4,

Reference	Definition	Function, Datastore ID
A12.31	The system shall be able to instruct with respect to - Special service lanes /bus lanes	3.1.2.14.2, 3.1.2.14.3, 3.1.2.14.4,
A12.32	The system shall be able to instruct with respect to Rush hour lane	3.1.2.14.2, 3.1.2.14.3, 3.1.2.14.4,
A12.33	The system shall be able to instruct with respect to Dynamic road section	3.1.2.14.2, 3.1.2.14.3, 3.1.2.14.4,
A12.34	The system shall be able to provide Parking direction	3.1.2.14.2, 3.1.2.14.3, 3.1.2.14.4,
A12.35	The system shall be able to instruct with respect to Two way lane	3.1.2.14.2, 3.1.2.14.3, 3.1.2.14.4,
A12.36	The system shall be able to instruct with respect to Joint road safety teams, road monitoring	3.1.2.14.2, 3.1.2.14.3, 3.1.2.14.4,
A12.37	The system shall be able to instruct with respect to Street lights (dynamic)	3.1.2.14.2, 3.1.2.14.3, 3.1.2.14.4,
A12.38	The system shall be able to instruct with respect to Ice warning/control (black ice	3.1.2.14.2, 3.1.2.14.3, 3.1.2.14.4,
A12.39	The system shall be able to enforce access to Toll lanes	3.1.2.14.2, 3.1.2.14.3, 3.1.2.14.4,
A12.4	The system shall be able to provide Oncoming vehicle warning	3.1.2.14.2, 3.1.2.14.3, 3.1.2.14.4,
A12.40	The system shall be able to enforce access to lanes by means of Road barriers	3.1.2.14.2, 3.1.2.14.3, 3.1.2.14.4,
A12.41	The system shall be able to inform via Variable message signs	3.1.2.14.2, 3.1.2.14.3, 3.1.2.14.4,
A12.42	The system shall be able to provide roadside Incident information o	3.1.2.14.2, 3.1.2.14.3, 3.1.2.14.4,
A12.43	The system shall be able to provide (roadside and broadcast) Congestion information	3.1.2.14.2, 3.1.2.14.3, 3.1.2.14.4,
A12.45	The system shall be able to provide local and permanent Congestion warning	3.1.2.14.2, 3.1.2.14.3, 3.1.2.14.4,
A12.46	The system shall be able to provide supralocal and permanent Congestion warning	3.1.2.14.2, 3.1.2.14.3, 3.1.2.14.4,
A12.5	The system shall be able to provide Open bridge warning	3.1.2.14.2, 3.1.2.14.3, 3.1.2.14.4,
A12.6	The system shall be able to instruct with respect to Major blocking/priorities	3.1.2.14.2, 3.1.2.14.3, 3.1.2.14.4,
A12.7	The system shall be able to instruct with respect to Close off and divert	3.1.2.14.2, 3.1.2.14.3, 3.1.2.14.4,
A12.44	The system shall be able to instruct with respect to Incident management	3.1.2.14.2, 3.1.2.14.3, 3.1.2.14.4,
A12.8	The system shall be able to instruct with respect to Blanket speed limit (regional)	3.1.2.14.2, 3.1.2.14.3, 3.1.2.14.4,
A12.9	The system shall be able to instruct with respect to Move on	3.1.2.14.2, 3.1.2.14.3, 3.1.2.14.4,
A13.1.1n	The system shall be able to forecast short term consequences of capacity limitations on national network performance	3.3.11
A13.1.2n	The system shall be able to forecast short term consequences of demand fluctuations on national network performance	3.3.11

Reference	Definition	Function, Datastore ID
A13.1.3n	The system shall be able to forecast short term consequences of capacity extension on national network performance	3.3.11
A13.1.1r	The system shall be able to forecast short term consequences of capacity limitations on regional network performance	3.1.6.3
A13.1.2r	The system shall be able to forecast short term consequences of demand fluctuations on regional network performance	3.1.6.3
A13.1.3r	The system shall be able to forecast short term consequences of capacity extension on regional network performance	3.1.6.3
A14.1.1	The system shall be able to define, test and implement all traffic scenarios for normal traffic situation	IDTM 09, 3.1.2.13.7
A14.2.1	The system shall be able to define, test and implement all traffic scenarios related to planned events such road works	IDTM 09, 3.1.2.13.7
A14.3.1	The system shall be able to define, test and implement all traffic scenarios related to forecast events such crowd generating events	IDTM 09, 3.1.2.13.7
A14.4.1	The system shall be able to define, test and implement all scenarios related to traffic events such as congestion, collision, vehicle breakdown, vehicle fire , etc.	IDTM 09, 3.1.2.13.7
A14.4.2	The system shall be able to define, test and implement all scenarios related to incursion events such as animal, or human incursion, hazardous spillage, debris, etc.	IDTM 09, 3.1.2.13.7
A14.4.3	The system shall be able to define, test and implement all scenarios related to ambient environment events resulting from fog, heat, rain, wind, ice, snow, etc.	IDTM 09, 3.1.2.13.7
A14.4.4	The system shall be able to define, test and implement all scenarios related to emergency events such as vehicle accident, attack, disaster, etc.	IDTM 09, 3.1.2.13.7
A14.4.5	The system shall be able to define, test and implement all scenarios related to infrastructure events such as infrastructure failure, damage, maintenance (roadworks)	IDTM 09, 3.1.2.13.7



---

## 8. Annex E: Approach

The method and steps to define the CHARM functions and datastores has been inspired, if not based, on the [ITS FRAME Architecture] methodology, in particular the methodology of defining the Functional View.

To derive the CHARM functions, datastores and dataflows the following steps have been taken:

- User Needs have been defined (in ITS FRAME Architecture parlance “selected”);
- Scoping of Selected User Needs has been performed; and
- Functions, datastores and dataflows have been derived (selected).

### 8.1 User Needs Selection

First the CHARM user needs<sup>2</sup> were selected from the ITS FRAME Architecture and associated with the activities described in the common business model described in the Business Specification. Annex D describes this association.

The selection of the relevant user needs, and their association with the activities was performed in conjunction with the development of the business specification, by business architects and with input from Business Representatives from RWS and the HA.

During the user need / activity association exercise it became apparent that the ITS FRAME Architecture didn't cover completely the scope of CHARM.

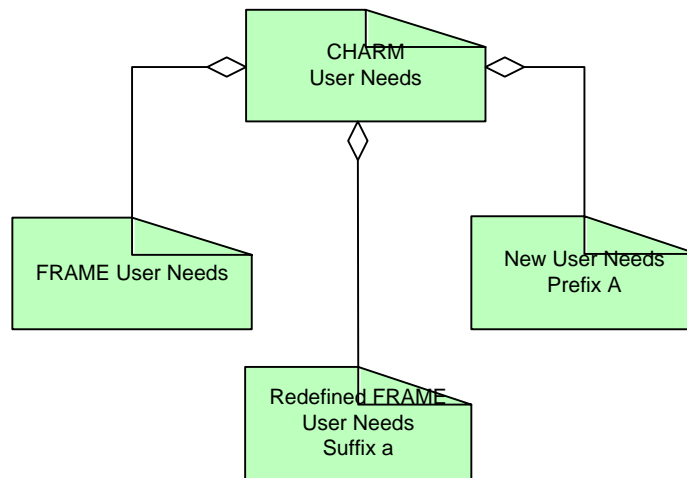
In particular Resource Management activities are not covered in the FRAME Architecture. Also, CHARM's Event Information Processing differs from the FRAME Architecture's (e.g. for Incident management). Consequently, additional specific CHARM user needs were required in order to cover the all of the scope of CHARM<sup>3</sup>. Furthermore, it became apparent that some FRAME Architecture User Needs required slightly redefining to express the CHARM user needs<sup>4</sup>. This relationship is described below:

---

<sup>2</sup> The term User Needs is a FRAME Architecture concept, defined as a “technical” way of stating the Stakeholders' Aspirations.

<sup>3</sup> In Annex A these CHARM specific (new) User Needs have a reference number prefixed with capital letter A.

<sup>4</sup> These redefined FRAME Architecture User Needs are denoted with FRAME Architecture id with suffix a

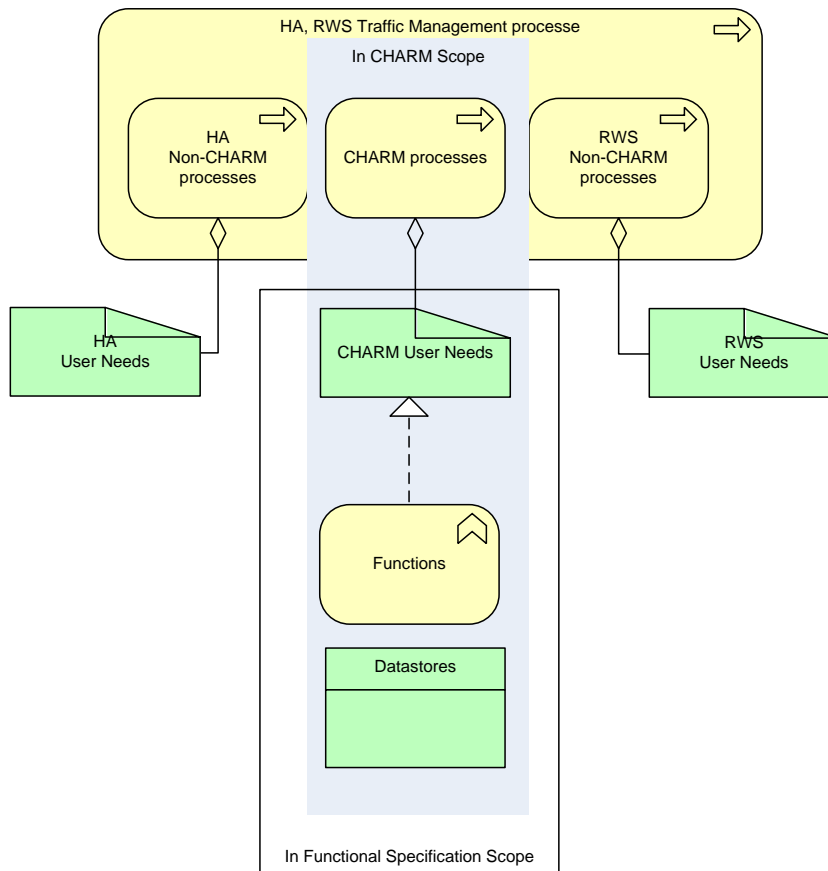


**Figure 5: CHARM user needs composition**

## 8.2 Scoping of user needs

The Business Specification defines the scope of CHARM in business terms, including the business activities that CHARM will support. These activities will be supported by functions, dataflows and datastores.

The scope of the functions defined by this document has been constrained to only those activities that are described as in-scope in the Business Specification. This relationship is described in the diagram below.



**Figure 6: In-scope user needs, functions, datastores**

### 8.3 Selection of functions, datastores and dataflows

Once the CHARM User Needs have been specified (see Annex D: CHARM User needs) the CHARM functions can be selected (derived). This relation is also defined in Annex C.

FRAME Architecture Selection tool [Sel Tool] helps this derivation. It helps to select datastores and dataflows that are needed to support the (selected) User Needs.

However, there is not a one-to-one relationship between the User Needs and the functions of the FRAME Architecture, nor is their cross reference an exact science, in particular only the primary functions will be offered. It is therefore necessary to confirm or reject manually each of the functions that are offered.

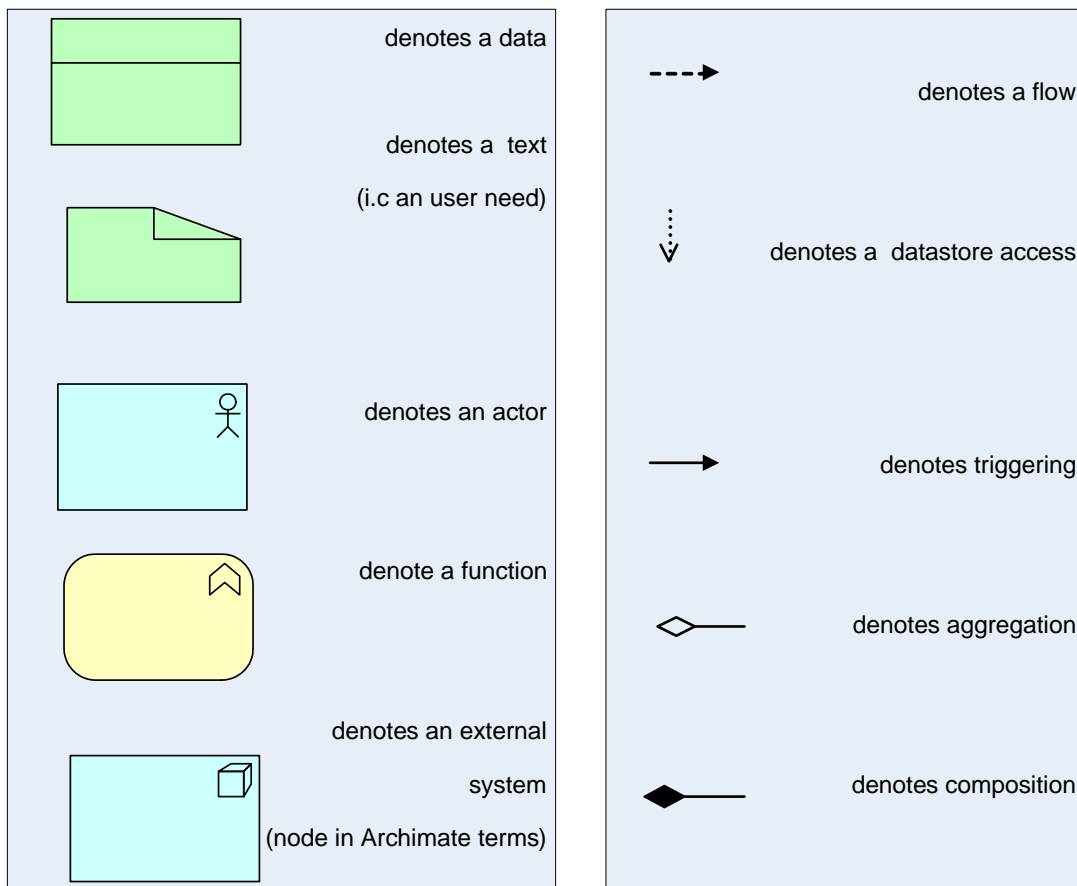
In addition, the FRAME Architecture does not provide functions for the non-Frame Architecture User Needs. For these user needs new functions have to be defined, or it has to be decided which of the FRAME Architecture function do support the non-Frame user needs. This is an activity that is not supported by any tool. The functions and datastores have been proposed by the functional architects.

---

## 9. Annex F: Notations and concepts

### 9.1 Notation

In this document a subset of [Archimate] is notation is used:



**Figure 7: Symbols**

We hope that the terms are self-explanatory. If, not [Archimate primer] provides an introduction to Archimate based modelling.

### 9.2 Concepts and definitions

The FS is based on a number of CHARM-specific concepts and definitions:

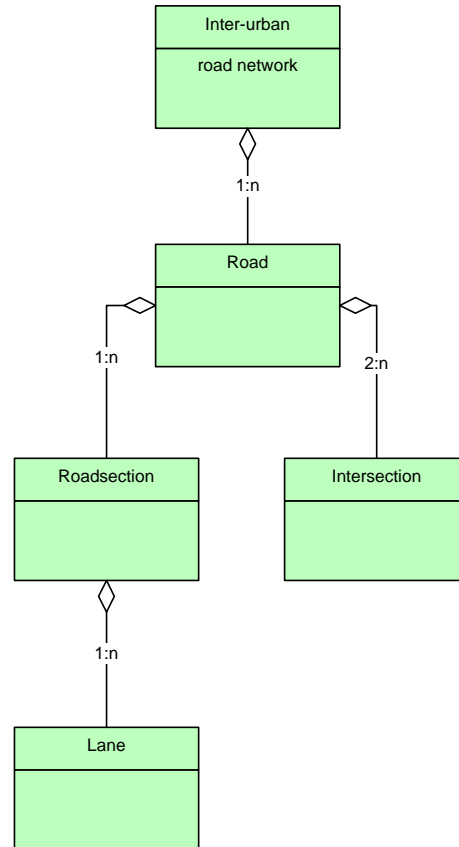
#### *Inter-urban network*

An inter-urban network is a network of roads that support a through traffic quickly and efficiently.

In the FS we will have a need of a very simple model of Inter-urban network, namely an object consisting of Roads that consist of Intersection of 2 or more Roadsections. A

---

Roadsection consists of a number of Lanes.



**Figure 8: Inter-urban road network**

We are well aware that this is a highly simplified model. A full model has other components, corridors, junctions, etc. However for the definition of the functions and datastores in this document a simple model suffices.

### 9.2.1 Traffic measure

Traffic measure is an action (performed by a mechanism or by a human) in which signals are produced that influence traffic at a particular location or in a particular area. These actions can have an advising, warning, facilitating or enforcing effect on the drivers.

### 9.2.2 Scenario

A scenario is a set of related traffic measures that can be invoked by a mechanism or by a human. A scenario has a form of a number of rules (*if condition then traffic measure*). A scenario can be invoked (triggered) on predefined time (s) (time-triggered), or, if certain conditions are met, e.g. When a congestion on a particular location/road segment.

---

### 9.2.3 Event

An event is an occurrence happening at a determinable time and place that has traffic operations consequences. An event influences traffic flow or safety of drivers or has an impact on the environment. In FRAME Architecture, an *incident* is a synonym of event.

Events have as an attribute a name, defining condition and impact.

In FS there is no event *naming* schema. In other words we do not enumerate all events that the system has to detect. Before an implementation may commence the list of all events that the system has to detect must be defined. However, for the definition of the functional specification such a list was not considered necessary.

*Defining condition* is a predicate. If this predicate becomes true the event has taken place.

From a transportation perspective, the *impact* of an event can be classified based upon their impact on traffic operations. There are different ranking systems for classifying events to assist in determining the appropriate level of responses. Event's classification is an attribute of an event.

E.g. a classification system can be based on traffic flow, impact/delay, incident characteristics and types of responders.

FS does use the notion of the classification schema; however no schema as such has been defined.

An event may be a part of a chain of occurrences as an effect of a preceding occurrence and as the cause of a succeeding occurrence.

FS distinguishes planned/forecasted (p/f) or current events.

### 9.2.4 Planned/forecasted (p/f) events

P/f events are events whose occurrence has been forecasted or planned (invoked) in the past. Examples of p/f events are roadwork or maintenance activities, crowd generating events, rush hours, or extreme weather forecasted events.

### 9.2.5 Current event

A current event is either a forecasted or planned event that takes place at the forecasted/planned time instance, or an unplanned randomly occurring event that adversely effects normal traffic operations.

CHARM distinguishes emergency current events (emergency events for short) and non-emergency current events (events for short, if the context is clear makes clear that non-emergency current events are meant).

### 9.2.6 Emergency current event

An emergency current event is an event that has public safety and/ prevention of loss of life and property implications. Examples of emergency current event are traffic accidents and Attacks. Emergency events require as a rule involvement of external agencies

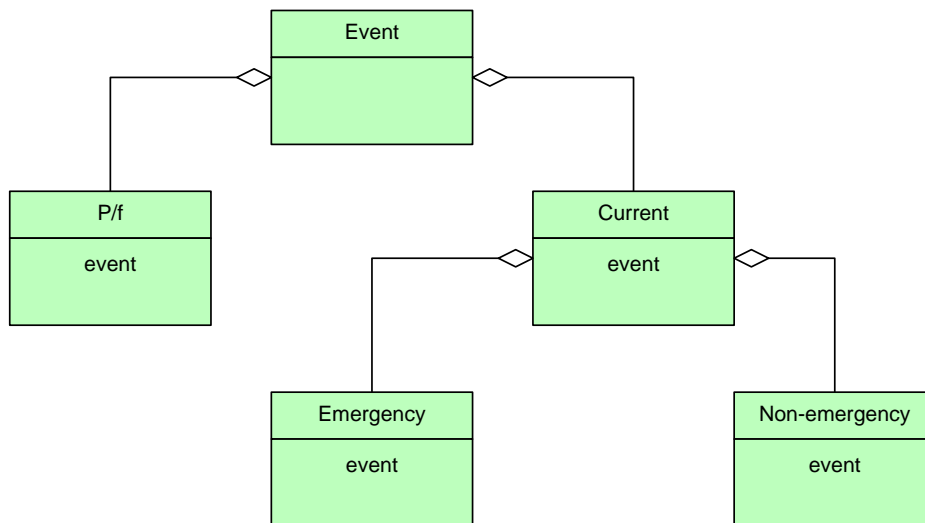
---

(emergency services - law enforcement agency, ambulances, towing service etc.).

### 9.2.7 Non-emergency current events

These events are the container notion for all events that are neither predicted nor forecasted or do not have safety implications. They can be divided into traffic events (congestion, vehicle breakdown), incursions (by animals, humans, hazardous spillage, and debris), and ambient environment events (fog, heat, rain, wind, ice, snow, darkness, etc.)

FS has no schema for these event classifications.



**Figure 9: Event classification**

---

## 10. Annex G: References

Reference Id	Referred Document	Documents Location
FRAME Architecture	European ITS Framework Architecture	<a href="http://www.frame-online.net/">http://www.frame-online.net/</a>
Short Guide		<a href="http://www.frame-online.net/sites/default/files/the-architecture/selection-tool/short-guide.pdf">http://www.frame-online.net/sites/default/files/the-architecture/selection-tool/short-guide.pdf</a>
FUN	FRAME User Needs V4.1	<a href="http://www.frame-online.net/sites/default/files/the-architecture/Version_4-1/FRAME%20User%20Needs%20V4.1%20-%202001.pdf">http://www.frame-online.net/sites/default/files/the-architecture/Version_4-1/FRAME%20User%20Needs%20V4.1%20-%202001.pdf</a>
Sel Tool	The Selection Tool	<a href="http://www.frame-online.net/the-architecture/selection-tool.html">http://www.frame-online.net/the-architecture/selection-tool.html</a>
Archimate	Archimate The Open Group	<a href="http://www.archimate.nl/">http://www.archimate.nl/</a>
Archimate primer	ArchiMate Language Primer	<a href="https://doc.telin.nl/dsweb/Get/Document-43839/ArchiMate_Language_Primer.pdf">https://doc.telin.nl/dsweb/Get/Document-43839/ArchiMate_Language_Primer.pdf</a>



## 11. Annex H: Glossary

Abbreviation	Term	Description
	Access Partner-Owned Information	The process for accessing information from partner organisations as required to undertake processes e.g. the Police National Computer (PNC).
ATM	Active Traffic Management	A series of traffic control measures to cope with congestion and incident management on the network.
HA	Agency	The organisation responsible for building, maintaining and operating the Strategic Road Network in England
APTR	All Purpose Trunk Road	A non-motorway road which is part of the Strategic Road Network.
	Allocate Current Event	For allocating an event to the business unit that is responsible for initiating the response to that event
	Allocate Forecast Event	For allocating a forecast event to the business unit that is responsible for planning the response to that event
	Allocate Task	For allocating any type of task (Queries and Information Requests) to the most appropriate business function within the organisation (that cannot be answered at the first point of contact)
	Assess Current Event Scene	For assessing the impact of a current event on the flow of traffic in the proximity of the event
	Atlas Pro	Provided by the Highways Agency's NTCC; a registered web service providing information to aid journey planning
ANPR	Automated Number Plate Recognition	Automatic Number Plate Recognition camera, systems and supporting infrastructure provide a means to "read" vehicle registration marks of moving vehicles. These systems are currently used by the Highways Agency to determine average journey times over links.
	Capability	A combination of Process, Organisation, Technology and Information required to deliver an organisations objectives
	Central Contact Centre	Under the Agency's TMD Future Operating Model, a new business unit within National Traffic Operations which acts as the central point of contact for people to notify the Agency of information including current event information, forecast event information and general queries in order to improve efficiency and consistency when communicating with customers and partners.
CHARM	Common Highways Agency Rijkswaterstaat Model	A Programme of cooperation between the Highways Agency and Rijkswaterstaat to define, with a view to jointly procure a new generation of traffic

		management systems.
CCTV	Closed Circuit Television	Closed Circuit Television, being a system of television cameras, connected to a control room, used by the HA and RWS for monitoring traffic conditions and supporting incident management
	Closure of carriageways	Again, either undertaken by physical restrictions, signs and signals or a combination of both
	Closure of lanes	Undertaken either by physical coning off of road lanes where an incident scene needs to be protected or by setting signs and signals to inform drivers about lane closures
C&C	Command and Control	<p>a series of computer systems operated by the Agency's Regional Response Centres, to manage their operations, log and store details regarding both traffic and non traffic related information.</p> <p>It also allows the electronic sharing of information with the police via a connection to CJX (a police equivalent of the GSI)</p>
	Contact Management	management of all contact with an organisation (in this case the HA and RWS). Primarily handling notification of current and forecast events and responding to general queries.
	Current Event	Anything likely to have a significant consequence on traffic movements.
	Current Event Notification	<p>Notifications of events on the network that have occurred and require a response. They are received from members of the general public and via system interfaces. Examples of current events include:</p> <ul style="list-style-type: none"> <li>- Road traffic Collisions;</li> <li>- Debris on the live carriageway;</li> <li>- Spillages;</li> <li>- Vehicle fires;</li> <li>- Pedestrians on the road network;</li> <li>- Animals on the road network;</li> <li>- Breakdowns</li> </ul>
	Deploy Resource	For deploying human, physical or technological resources to safely and effectively respond to an event
	Deployment of resources	The deployment of Traffic Officers or other responder organisations to secure the scene of an incident, liaise with police and emergency services and, with the support of service providers, to manage the clear up of the carriageway, repair of any damaged infrastructure and the restoration of the carriageway to normality

DBFO	Design, Build, Finance, Operate	Design Build Finance Operate, being a form of contract between the Secretary of State for Transport and a DBFO Operator for the design, building, financing and operation of part or parts of the Strategic Road Network
	Determine Event Impact	For assessing the impact of an event on the rest of the road network
	Develop and Maintain Operational Procedures	For developing procedures in line with operational policy
	Discover Current Event	For identifying that an event has occurred;
	Discovery	The initial manual or automated identification of a potential incident by an organisation, one of its staff members or by technology
	Dynamic Traffic Management	That activity which is undertaken to manage demand and capacity on the road network through influencing or directing the behaviour of road users and to ensure that traffic flow across the road network is as close to optimal as possible at all times and to protect people on the network.
ERT	Emergency Response Telephones	Telephones situated at regular intervals along the road network that can be used by road users to contact the Agency's Response Centres if they are in need of assistance
	Event	an occurrence located on or off the SRN with the potential to have a Material Effect on the SRN; Events include Current Events and Forecast Events
	Event Information Collection	Encompasses all those processes required to manage the collection of Event-related data and information from internal and external sources.
	Event Information Dissemination	Encompasses all those processes required to manage the dissemination of Event-related data and information to internal and external subscribers.
	Event Information Processing	Encompasses all those processes required to manage the analysis and processing of Event-related data and information from internal and external sources.
	Event Management Update	On-going updates relating to a Current Event from those involved on-road at the scene of the Event.
	Event Planning	the co-ordination of activities to manage the response to forecast events
ERMS	Event Response Management Subsystem	Part of the Agency's NTCC Instation; the system for managing information about events on the network.
FMS	Fault Management System	Part of the Agency's NTCC Instation; the system for monitoring faults in technology.

	Forecast Event	A forecast event is defined as anything likely to have a significant consequence on expected Traffic Data about which there is reasonably accessible prior knowledge.
	Forecast Event Notification	<p>Notifications of future events that are likely to have an impact on the effective operation of the road network that require the Highways Agency to plan and/or co-ordinate a response. They are received from partner and stakeholder organisations via system interfaces. Examples of forecast events include:</p> <ul style="list-style-type: none"> <li>- Weather forecasts;</li> <li>- Routine congestion;</li> <li>- Abnormal load movements;</li> <li>- Road works;</li> <li>- Crowd-generating events;</li> <li>- Non-HA works on the road network;</li> <li>- Construction schemes near the road network</li> </ul>
	Forecast Event Plan	A plan outlining the traffic management activities that need to be undertaken in order to mitigate any predicted increase in demand, events or reduction of capacity as a results of a forecast event.
FOM	Future Operating Model	A view of the processes, organisation, technology and information required to deliver an organisations core and supporting capabilities in the future.
	Future Resource Plan	A forward notification of the required resource available to meet expected demand over the coming months. This will typically include information about numbers of staff and required roles at particular times and shifts.
GPRS	General Packet Radio Service	Packet oriented Mobile Data Service available to users of Global System for Mobile Communications.
HABiT	Highways Agency Business Information Technology	The Agency's Business Information Technology solution.
HATMS	Highways Agency Traffic Management System	A set of systems used in the Agency's Regional Control Centres to undertake traffic and incident management activity.
	Implement Current Event Response	For implementing the planned response to any current event
	Implement Forecast Event Response	For implementing the planned response to any forecast event. This will comprise preparation activities prior to the event occurring and implementation of plans when the event occurs
	implementation of diversions	Setting of signs and signals to divert traffic away from problem areas of the road network. Diversions are either strategic (from one part of the organisation road network to another) or tactical (diversion across "local" roads);

	Incident Management	That activity which is undertaken where an event occurs on a live carriageway that causes traffic flow to deviate from normality or occurs off-network with an impact on the network. Incident management requires an on-road response to restore the network to normality (a Current Event).
ISU	Incident Support Unit	ISU crews perform a variety of roles working from strategically placed depots to help keep drivers moving. After an accident they may be deployed to sweep up broken glass, mop up fuel spills or effect repairs on a damaged safety fence. They also assist traffic officers get drivers away from major accident scenes - for example setting up diversion routes around an incident scene. The ISU is the Agency's primary response team in all areas where the Traffic Officer Service is not operational.
	Information and Training Group	The current organisational unit responsible for managing the NTCC contract and delivering operational training.
	Information Provision	That activity which provides information about the state of the road network to any of the Highways Agency's internal or external information consumers.
	Information Request	Received from the general public on any aspect of the Highways Agency's business. Examples of information requests include: <ul style="list-style-type: none"> <li>- Queries about road works;</li> <li>- Queries about traffic conditions;</li> <li>- Queries about road schemes;</li> <li>- General switchboard queries</li> </ul>
	Initial Response	The deployment of resources appropriate to the reported need, to make the operational environment safe for all involved in the response or the travelling public to prevent escalation, to stabilise the situation, to provide immediate first aid for casualties and support for those involved
ICCS	Integrated Communications Control System	The Agency system used to control communications (both telephony and radio) between the on-road Traffic Officers, RCCs and the Police.
JTMS	Journey Time Monitoring Subsystem	Part of the Agency's NTCC Instation; the system for monitoring journey times using Automated Number Plate Recognition (ANPR) cameras
KPI	Key Performance Indicator	a Performance Measure for which performance below the Target Service Level leads to the accrual of Service Points by the Service Provider
	Maintain Corporate Data	For ensuring a common data definition to support TMD's capabilities
	Maintain Customer/Partner Information	The process for maintaining information about our Customers and partner organisations that is required to undertake other processes

	Manage Briefing/Debriefing	For undertaking pre-shift briefing, immediate post-shift debriefing and longer term “cold” debriefings
	Manage Budgets	For managing the budget to deliver the operational service
	Manage Contracts	For developing and managing contracts with the supply chain;
	Manage Current Event Response	For safely and effectively managing the response to an event that has been discovered
	Manage Current Event Scene	For managing the safe restoration of a current event scene to normality including assessment of progress of police investigations and of required clear up responder resource
	Manage Demand	For understanding where demand on the network will increase and initiating an appropriate response
	Manage Health & Safety	For ensuring that the welfare of staff is paramount in all operational processes and procedures. The direct implementation of health and safety procedures will be managed through line management
	Manage Information Channel	For maintaining communication channels with the general public and partner organisations and disseminating information through them
	Manage National Roster	For managing the allocation of resources (people, vehicles and equipment) to support the organisation’s capabilities. This includes, but is not limited to, national management of resource allocation across the estate based on knowledge of the current and future state of the road network, management of shift patterns, management of patrol strategies etc
	Manage Network Capacity	For understanding where capacity on the network will decrease and initiating an appropriate response
	Manage Procedural Compliance	For ensuring that operational activity complies with agreed standards, processes and procedures
	Manage Programme	For managing programmes of projects delivering change
	Manage Project	For managing projects delivering change
	Manage Services	For managing the services provided by the supply chain
	Manage Strategic Current Events	For managing current events that have a strategic impact on the state of the road network
MAC	Managing Agent Contractor	Combination of Managing Agent and Term Maintenance Contractor forming a single operating company to maintain the network and its structures on behalf of the Agency.
	Meteorological Devices	Roadside devices to monitor weather conditions such as fog and wind

	Monitor Network	For monitoring conditions on the road network in order to identify deviations from normality
NILO	National Incident Liaison Officer	National Incident Liaison Officer, being operatives who are based at the Agency's NTOC and receive and disseminate information about critical and major incidents to senior managers
	National Roster	The national pool of resource that is employed in order to undertake an organisation's core and supporting capabilities.  It includes, people, vehicles and equipment.
NTCC	National Traffic Control Centre	The Agency's National Traffic Control Centre, which delivers information about network conditions to customers (both road users and within the Agency) through identified delivery channels
NTIC	National Traffic Information Centre	A business unit within National Traffic Operations that is responsible for managing the collection, processing and dissemination of information about events on the road network and other aspects of Highways Agency business.
	National Traffic Operations	The Agency's organisational unit based within the National Traffic Operations Centre (NTOC) that is responsible for undertaking contact management, traffic management, and incident management, information provision at a strategic level and event planning at both strategic and tactical levels. National Traffic Operations comprises four subsidiary business units; the Central Contact Centre, Strategic Traffic Operations, the National Traffic Information Service and Operational Planning
NTOC	National Traffic Operations Centre	The location at which centralised operational activity is undertaken.
	Non-Operational Support	All activity undertaken to support TMD but that is neither operational nor directly supports operational activity.
	Normality	The situation when the road network is operating within expected profiles of traffic flow (including routine congestion).
	Operational Performance	For providing information about the performance of the organisation in delivering its core and supporting capabilities
	Operational Planning	An Agency business unit within National Traffic Operations that is responsible for planning the Highways Agency's response to forecast events.
	Operational Support	An Agency organisational unit responsible for undertaking operational support activities such as resource management and delivery of business changes to the operational service.
	Partner organisations	Any organisation with which the Highways Agency or RWS has a working relationship.

	Plan Current Event Response	For identifying the appropriate response to an event that has been discovered.
	Plan Forecast Event Response	For planning the response to an event notified (via Customer and Partner Management) that will occur in the future
	Predict Current Events	For using historical information about the state of the road network to predict the occurrence of events that will reduce capacity, increase demand or risk the safety of road users;
	Protect Current Event Scene	For ensuring that the scene of a current event is safe and that traffic is diverted around the scene
	Recovery	The recovery of vehicles, loads, obstacles and debris from the carriageway and the carrying out of essential repairs to the infrastructure
RCC	Regional Control Centre	Regionally based traffic operations control rooms responsible for managing incidents and ensuring the smooth operation of the motorway network and trunk roads.
	Regional Response Centres	he locations from which regionally based operational activity will be undertaken
	Regional Traffic Operations	The Agency's organisational unit responsible for undertaking tactical traffic and incident management and deploying on-road resource.
	Repair Infrastructure	For undertaking emergency repairs to damaged road network infrastructure (carried out by service provider resource)
	Report Current Event	For reporting events on the road network
	Report Forecast Event	For reporting events that are planned to occur in the future
	Request Agency Information	For receiving and answering queries from the general public and third party organisations
	Resource Deployment	Information required to deploy all types of on-road resource, including details of locations of an event, vehicles involved, infrastructure damage, injuries and required specialist vehicles, equipment or skills.
	Resource Management	the management of people and physical resources to ensure sufficient coverage of the priority areas of the road network based on road network intelligence
	Restoration to Normality	The return of traffic flow and the infrastructure to expected pre-incident standards and levels (normality).
RWIS	Road Weather Information System	An Agency ICT system used to provide information about weather conditions on the road network.



	Roadside Operations	The Agency's organisational unit responsible for providing a fit for purpose on-road resource service for deployment to events on the road network to undertake operational traffic and incident management.
RWS	Rijkswaterstaat	The organisation responsible for building, maintaining and operating the Strategic Road and canal network in the Netherlands
	Scenario	A (traffic management) scenario is a set of related traffic measures that can be invoked (applied) by a mechanism or by a human. A scenario has a form of a number of rules ( <i>if condition then</i> traffic measure). A scenario can be invoked (triggered) on predefined time (s) (time-triggered), or, if certain conditions are met, e.g. when a congestion on a particular location/road segment. A scenario has a name, and attributes (1) the network area (where it may be applied), (2) the time zone (when it may be applied), and (3) traffic conditions under which it may be applied.
	Scene Management	The management of those activities that need to be completed at the scene before the incident location can be cleared, such as the protection of the scene by implementation of diversions or other traffic management measures when required, the relief of trapped traffic, further treatment and evacuation of casualties, the removal of hazardous chemicals, the investigation of the incident and the collection of evidence
SRW	Schedule Of Road Works	Authorised maintenance and repair works carried out to the highway, or maintenance and repair works carried out to the highway by other Operational Partners. This also refers to the Agency system in which road works are recorded
	Set Signs & Signals	For managing the setting of signs & signals to influence driver behaviour and manage traffic flow and routes
	Setting of Signs and Signals	Using roadside technological devices to deliver on-road messages to road users. These include textual messages informing road users of impending road conditions or safety information, changes to speed limits to minimise congestion, pictorial information, information about lane closures and carriageway layouts
	Signals	Providing speed limit, message, lane closure and other information to influence road users. Both automated in response to data from loops but can be manually set;

	State of the Road Network	A bespoke view of the state of the road network including information about traffic flow, traffic speed, journey times, current, forecast and predicted events, hotspots, CCTV images and footage etc.
SRN	Strategic Road Network	All roads maintained and operated by the organisations
STO	Strategic Traffic Operations	An Agency business unit within National Traffic Operations responsible for undertaking dynamic traffic management and incident management at a strategic level.
	System	A logical entity that could be comprised of extant applications as-is, enhancements to existing applications, new applications, shared components/common services between multiple systems or any combination thereof.
TDCMS	Traffic Data Collection and Monitoring Subsystem	Part of the Agency's NTCC Instation; the system for monitoring traffic flow using on-road sensor loops
	Traffic England	Provided by the Agency's NTCC; a publicly available website providing information about traffic flow conditions on the road network and details of any incidents that may affect journeys
TiS	Traffic Information Services	A special purpose company, wholly owned by Serco that was established to deliver the Agency's NTCC.
TM	Traffic Management	The combination of semi-automated control of traffic signs and signals, application of demand management techniques (including traffic cones), and traffic Information and advisories to achieve an optimal traffic flow throughout a defined management area.
TMD	Traffic Management Directorate	(from Feb 2010) An Agency directorate, comprising of the 7 traffic officer service regions, plus a national group incorporating the NTCC plus HAIL, NILO and support to traffic officer operations, with responsibility for delivering a world class Traffic Management service to all customers through traffic information, active management of traffic flows and incident response.
TMU	Traffic Management Unit	A system, used by the Agency's NTCC, comprising of loops to collect Traffic Data.
	Traffic Radio	Provided by the Agency's NTCC; radio broadcasts of event information using information from NTCC systems (although this service will not be continuing
VMS	Variable Message Sign	Variable Message Signs, being electronic roadside signs that convey messages
	Verification	The clarification and confirmation of the location, extent and key details of the incident as far as is possible so that appropriate resources can be

		deployed
	Verify Current Event	For confirming the details of the event
	Virtual Patrolling	The use of technology to identify events occurring on the network.