

INFORMATION SOCIETY TECHNOLOGIES (IST) PROGRAMME



PRIME

Prediction Of Congestion And Incidents In **R**real Time, For **I**ntelligent Incident **M**anagement And **E**mergency Traffic Management

Project reference: IST 13036

Annex 5 (APPENDIX): KAREN User
Needs Overview
Deliverable No: D3.1

VERSION 2.0

Enhanced User Needs and Scenario Planning: Annex 5

Dissemination: Public

Submission Due Date: 30/04/00

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Executive Summary

This annex is part of deliverable 3.1 of the PRIME project: Enhanced User Needs and Scenario Planning. In this annex, the KAREN user needs relevant to the PRIME project are presented. They were analysed as part of the PRIME user needs analysis (In annex 2, the PRIME user needs, resulting from the analysis, are discussed). The second part of this annex contains a summary of results of the questionnaire held at the Southampton site within the ROMANSE project, that was part of the 4FP project EUROSCOPE.

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1 Introduction

This annex is part of Deliverable 3.1 (Enhanced User Needs Analysis and Scenario Planning), that consists of:

- Summary Report
- Annex 1: Introduction to PRIME
- Annex 2: Results from User Needs Analysis
- Annex 3: Scenario Planning
- Annex 4 (APPENDIX): PRIME questionnaire
- Annex 5 (APPENDIX): Overview of the KAREN User Needs list and Summary of ROMANSE Questionnaire.

In this introduction, the PRIME project is introduced, and the contents of this annex are described.

1.1 Objectives

PRIME builds on recent achievements in management of incidents and road emergencies in EU projects, and enhances weak links in the incident and road emergency management chain. Project innovations include:

- Methods for estimating real-time incident probability, which can activate traffic management strategies to reduce the likelihood of incidents
- Improved systems for detecting incidents
- Improved integration of incident verification to increase the reliability of incident management
- Integration of aspects of motorway and non-motorway incident management strategies to increase the effectiveness of incident management and traffic management strategies in urban/interurban areas.

1.2 Project Work

The project is developing models of incident probability to estimate the likelihood of occurrence of incidents in real time. Estimation is based on geometric, weather and traffic characteristics. The operator can use the output from the models to support traffic management decisions that seek to reduce the probability of incident occurrence. Reducing this probability is expected to benefit the system, even if the immediate benefit may not always be visible to the drivers. For instance, the operator may activate traffic management and control strategies that increase the delay for certain drivers in the urban network but improve flow in the motorway. Other strategies may request certain drivers to divert away from their route, to achieve improved overall performance that reduces the likelihood of incidents.

Improved sensing and algorithms can lead to increased reliability of incident management. More-efficient sensing hardware can increase the productive use of advanced equipment thus increasing the quality of information that is provided to incident detection. Improved algorithms can further improve existing detection and false alarm rates, even for incidents that were previously not very well detected, such as in high-weaving or low-flow areas.

Improving the integration of verification messages, particularly those from cellular phones, leads to increased effectiveness of incident management. Increased use of cellular phones by drivers has helped authorities identify the occurrence of incidents but has often not supported high quality of information. Systematising and automating aspects in the provision of information provided by drivers to traffic authorities constitute the building blocks for a system that more-effectively takes advantage of the improved technology becoming available to motorists.

Integrating incident management strategy aspects, previously built for either non-motorway networks or motorways, can be used to increase the effectiveness of strategies in emergency traffic management

applications, and increase road safety. These methods integrate road infrastructure (e.g., machine vision hardware and communications installations, VMS) and portable devices (e.g., GSM) and are based on widely available communications and positioning mechanisms, and media-independent, open architectures adapting mobile network intelligence for optimal use in transport. Simulation tests determine possible conflicts between old and improved traffic management policies.

Innovative ITS components are designed for integration with already developed systems at project sites, responding to enhanced user needs and targets. The functional and communications specifications, interfaces and architecture of the new system are identified.

A prototype is developed including databases, models and algorithms and tested with off-line site data and on-line applications.

Tests focus on the capabilities of intelligent techniques, and on the effective integration of new information, such as probability estimation and verification information, that were not possible with classical techniques. Effectiveness of the tests increases by identifying the barriers, technical and institutional, to integration.

Evaluation assesses the performance, cost-effectiveness and interoperability of the new methods. This is achieved with the adaptation of data and conditions from three main EU sites, i.e. Munich, Southampton and Thessaloniki, with transferability examined at Athens and Barcelona.

1.3 This annex

In chapter 2, the list of relevant user needs from the KAREN project is presented. Chapter 3 contains the summary results of the ROMANSE questionnaire.

2 KAREN User Needs overview

In the following table, a selection of the KAREN list of European user needs is presented. These are the user needs that apply to the PRIME project. In annex 2 the relevance of the selection to PRIME is discussed.

Notes:

1. "The system shall do X" implies fundamental
2. "The system shall be able to do X" or "The system shall enable X" implies optional

Table 2.1 Relevant KAREN user needs

Allocation	No.	Description
Related sets of User Needs within Fundamental Services within KAREN Groups	New KAREN Reference Number	Description of the User Need
1. General		This groups contains the properties that either the Framework Architecture should possess, or that systems built in conformance to the Framework Architecture should possess.
1.1 Architectural Properties	1.1.1	The Framework Architecture description shall include functional, information, physical and communication perspectives.
	1.1.2	The Framework Architecture description shall include a number of reference models to describe the relationships between the services needed within the traffic and transport system.
	1.1.3	The Framework Architecture description shall include a glossary to explain all the main concepts described in the architecture.
	1.1.4	The Framework Architecture shall be provided in a form which enables it to be up-dated after delivery.
	1.1.5	The Framework Architecture shall be technology independent.
	1.1.6	The Framework Architecture shall facilitate the creation of modular and flexible designs, i.e. so that manufacturers can produce their own versions of equipment.
	1.1.7	The Framework Architecture shall allow equipment performing the same service to be provided by various suppliers.
	1.1.8	The Framework Architecture shall allow the same service to be provided by various service providers.
	1.1.9	The Framework Architecture shall allow the user to select from one of a number of suppliers of the same service.
	1.1.10	The Framework Architecture shall support interaction between services provided by private and public bodies.
	1.1.11	The Framework Architecture shall allow current organisational responsibilities and legal liabilities to be retained.
	1.1.12	The Framework Architecture shall, where possible, describe migration path(s) that can be followed to enable architectures defined for existing traffic and transport management, as well as other ITS control and information systems, to become compliant.
	1.1.13	The Framework Architecture shall allow the use of existing and emerging communication infrastructures, or describe possible migration paths to explain how they can become compliant.
	1.1.14	The Framework Architecture shall support the integration of Traffic Information Centres and Traffic Control Centres into national and international networks.

	1.1.15	The Framework Architecture description shall identify clearly the relevant interfaces to other modes of transport.
1.2 Data Exchange	1.2.1	The Framework Architecture shall provide a high level description of the message sets and data communication protocols to be used in data transfers.
	1.2.2	The Framework Architecture shall provide a high level description of data stores and data flows, and shall have a single data dictionary.
	1.2.3	Systems that conform to the Framework Architecture shall exchange information in a manner that permits a given geographic location to be understood by all parties.
	1.2.4	Systems that conform to the Framework Architecture shall exchange information in a manner that permits road and traffic conditions to be understood by all parties.
	1.2.5	The Framework Architecture shall provide a high level description of the message sets used to exchange data with external interfaces.
	1.2.6	The Framework Architecture shall support the use of seamless communications. This shall mean that the use of different communication networks is transparent i.e. switches are made without the intervention of the final user.
1.3 Adaptability	1.3.1	Systems that conform to the Framework Architecture shall be able to provide facilities that accommodate the needs of disabled and elderly persons, when relevant.
	1.3.2	Systems that conform to the Framework Architecture shall be able to provide facilities to enable data about the travel network to be entered and updated.
	1.3.3	The Framework Architecture shall not constrain its functionality to be implemented in a single topographical domain, be it urban, inter-urban or rural.
	1.3.4	The Framework Architecture shall not constrain its functionality to be implemented by specific local organisations.
	1.3.5	The Framework Architecture shall not constrain its user interfaces to be of a particular type, or from a particular manufacturer.
	1.3.6	The Framework Architecture shall not require that each of its user interfaces must operate on a specific item of equipment, unless it is for safety reasons.
1.4 Constraints	1.4.1	The Framework Architecture shall require all systems developed from it to comply with current laws concerning data security, user anonymity and the protection of individual privacy.
	1.4.2	The Framework Architecture shall require all systems developed from it to comply with the traffic laws and regulations that apply in Europe.
	1.4.3	The Framework Architecture shall conform to relevant MoU, European directives and guidelines, and European (de facto-) standards.
1.5 Continuity	1.5.1	The Framework Architecture shall provide functionality such that the quality of information content is continuous and consistent, both in time and space (i.e. as the traveller moves).
	1.5.2	The Framework Architecture shall provide functionality that can accommodate environmental stress and infrastructure failures.
1.6 Cost/Benefit	1.6.1	Whenever possible and practical, the Framework Architecture shall use the same data as input to several parts of its functionality.
	1.6.2	The Framework Architecture shall avoid the need for unnecessary multiple data sources or redundant data management.
	1.6.3	The Framework Architecture shall require all systems developed from it to be able to use the most cost-effective means of communication available.

	1.6.4	The Framework Architecture shall require all systems developed from it to enable operating costs to be reduced whenever possible, when compared with the systems that they replace.
	1.6.5	The Framework Architecture shall require all systems developed from it that require payment from a user to be able to manage fees/fares.
	1.6.6	The Framework Architecture shall require all systems developed from it that require payment from a user to be able to receive fees/fares.
	1.6.7	Systems upgraded to conform to the Framework Architecture, and providing the same services, shall produce financial benefit to their owners.
1.7 Expandability	1.7.1	The Framework Architecture shall allow systems developed from it to have an evolutionary development strategy that enables their continuous upgrading.
	1.7.2	The Framework Architecture shall provide services that are not constrained to operate in a particular geographic region.
1.8 Maintainability	1.8.1	The Framework Architecture shall require all systems developed from it to be capable of being repaired.
	1.8.2	The Framework Architecture shall require all systems developed from it to be easily maintainable with minimum disturbance.
1.9 Quality of Data Content	1.9.1	The Framework Architecture shall enable all information systems developed from it to provide data with a stated accuracy, either as additional information or as part of the documentation, at all times.
	1.9.2	The Framework Architecture shall require all systems developed from it to check all input data for validity, whenever possible, and to report failures.
	1.9.3	The Framework Architecture shall enable all systems developed from it to check data values by comparing different sources, when available, so as to ensure high-accuracy and completeness.
	1.9.4	The Framework Architecture shall require all systems developed from it to manage local/regional/national databases in a consistent way.
1.10 Robustness	1.10.1	The Framework Architecture shall allow all systems developed from it to be able to detect errors in operation, when higher integrity is required, e.g. for financial, security or safety reasons.
	1.10.2	Systems that conform to the Framework Architecture shall be able to monitor each safety-related component (including software), warn the user in case of problems, and disable it, or reduce it to a safe state.
	1.10.3	The Framework Architecture shall require all safety-related systems developed from it to be fault-tolerant.
	1.10.4	The Framework Architecture shall require all systems developed from it to be reliable with respect to the legal and/or quality requirements necessary for each application.
	1.10.5	The Framework Architecture shall require all systems developed from it to be able to operate in all potential climatic and traffic conditions.
1.11 Safety	1.11.1	The Framework Architecture shall provide functionality that operates in a manner that does not generate a safety hazard for its users.
	1.11.2	The Framework Architecture shall provide functionality that operates in a manner that does not encourage unsafe behaviour.
	1.11.3	The Framework Architecture shall provide functionality that operates in a safe manner during degraded modes of operation.
	1.11.4	The Framework Architecture shall provide functionality that is ultimately under the control of the human operator.

1.12 Security	1.12.1	The Framework Architecture shall require that systems developed from it are capable of surviving accidental and intentional attacks on their integrity.
	1.12.2	The Framework Architecture shall require systems developed from it to provide protection against unauthorised access.
1.13 User Friendliness	1.13.1	The Framework Architecture shall require all systems developed from it to have user interfaces with similar "look and feel" and similar end user assistance.
	1.13.2	The Framework Architecture shall require all systems developed from it to be simple and efficient for travellers to use, and easy to understand.
	1.13.3	The Framework Architecture shall require all interactive systems developed from it to have a user interface syntax that is easy to learn and to remember (especially for users with specific needs).
	1.13.4	Systems developed from the Framework Architecture shall produce their output within a time that is sufficient to be useful, and within normal expectations,
	1.13.5	The Framework Architecture shall require all systems developed from it to provide facilities that enable their users to control the speed and frequency of information presentation.
	1.13.6	The Framework Architecture shall ensure that the safety and security of systems developed from it are not compromised by their ease of use.
1.14 Special Needs	1.14.1	The Framework Architecture shall require systems developed from it to accommodate those users with one or more impairments (e.g. of upper/lower limbs/body, stature, coordination or power, vision, hearing, speech, cognition, epilepsy, etc.) where relevant.
	1.14.2	The Framework Architecture shall require system developed from it to accommodate those users who travel with baggage and/or extra equipment (e.g. mothers with push-chairs, disabled persons in wheel-chairs, (guide) dogs, etc.) where relevant.
	1.14.3	The Framework Architecture shall require systems developed from it to be able to take their input from a variety of alternative devices (e.g. keys, voice, buttons, touch-screen, smart card, etc.) to suit travellers with special needs, where relevant.
	1.14.4	The Framework Architecture shall require systems developed from it to be able to provide output in a variety of alternative modes (e.g. (enlarged) text, symbols, graphics, speech, tactile, HUD, etc.) to suit travellers with special needs, where relevant.
	1.14.5	The Framework Architecture shall require systems developed from it to be able to repeat information on request, in particular for those with special needs, where relevant.
	1.14.6	The Framework Architecture shall require systems developed from it to be able to recognise the identity of a traveller using a variety of alternative methods, where relevant.
	1.14.7	The Framework Architecture shall require systems developed from it to be able to have adaptable user interfaces that may be customised by the traveller, in particular those with special needs, where relevant.
	1.14.8	The Framework Architecture shall require systems developed from it to be able to be able to read pre-recorded personal details (e.g. impairment and/or medical details), in particular of those with special needs, where relevant.
5 Emergency Services		This group contains 'May Day' and stolen vehicle management (for any vehicle), the prioritising of emergency vehicles, and hazardous goods (i.e. goods that need to be tracked) incident management. These User Needs have links with Groups 6-10.
5.1 Emergency Notification and Personal Security	5.1.0.1	The system shall be able to make a 'May Day' call.

	5.1.0.2	The system shall be able to detect that the vehicle has been involved in an accident, identify its location, and initiate a 'May Day' call automatically.
	5.1.0.3	The system shall enable the driver, or any other vehicle occupant, to make a 'May Day' call, and to receive confirmation that the call has been acknowledged, from outside the vehicle, i.e. at the roadside.
	5.1.0.4	The system shall be able to give the driver an immediate acknowledgement to his/her emergency call, i.e. to indicate that assistance is on the way.
	5.1.0.5	The system shall be able to identify the driver / vehicle making an emergency call.
	5.1.0.6	The system shall be able to provide two-way data and/or voice communications between the vehicle and the emergency control centre.
	5.1.0.7	The system shall be able to send a 'May Day' call automatically if a critical vehicle component goes into an unsafe condition, or some other emergency is detected, e.g. driver ill (see 8.5.0.2).
	5.1.0.8	The system shall be able to minimise the response time for rescuing drivers who have requested assistance from the emergency services, e.g. breakdown, medical emergency, accident etc.
5.3 Hazardous Materials and Incident Notification	5.3.0.1	The system shall monitor the movements of hazardous goods, and provide appropriate support in the case of an incident.
	5.3.0.2	The system shall be able to provide the location of hazardous goods.
	5.3.0.3	The system shall be able to receive data on the status, character and quantity of hazardous cargo on vehicles within a pre-defined area of interest, and inform the relevant authorities of any non-compliance.
5.3.1 Incident Management	5.3.1.1	The system shall be able to detect that the vehicle has been involved in an accident, identify its location and cargo, and generate an emergency alert automatically.
	5.3.1.2	The system shall be able to identify its location and cargo, and generate an emergency alert on the command of the vehicle driver.
	5.3.1.3	The system shall be able to advise the emergency services on any hazardous goods that have been involved in an incident.
	5.3.1.4	The system shall be able to provide relevant information to the emergency services on the type of hazardous good(s) involved in an incident.
	5.3.1.5	Systems shall exchange information on hazardous goods in a manner that is understood by all parties.
6 Travel Information and Guidance		This group contains all the activities concerned with the handling of pre-trip and on-trip information, including mode choice and change, and route guidance
6.1 Pre-trip Information	6.1.0.1	The system shall provide emergency, or urgent, information to all road users free of charge.
	6.1.1.2	The system shall be able to provide trip information on other modes of transport, e.g. for demand-spreading, or when major events occur, or due to weather conditions, strikes, cultural or sports events etc.
	6.1.1.3	The system shall be able to provide current and forecast traffic and travel information at local, regional, national and international levels.
	6.1.1.4	The system shall be able to provide extensive trip information, e.g. prices, fares, routes, incidents, roadworks, forecast & current traffic situations, traffic control, demand mgt measures, local warnings, special events, weather conditions, hotels etc.
6.1.2 Information Handling	6.1.2.1	The system shall inform the User when changes occur to the criteria upon which the pre trip information had been given.

	6.1.2.3	The system shall be able to provide route information to all drivers, e.g. restrictions, travel times, etc.
	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.
	6.1.2.5	The system shall be able to analyse, process and retrieve data from different combinations of sources (including floating car).
	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.
	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.
	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.
	6.1.2.9	The system shall provide Information Management tools for the operator.
6.1.3 Traveller Interaction	6.1.3.7	The system shall provide information via (public) terminals located at strategic locations: e.g. home, office, bus station, railway, metro station, vehicle, restaurant, etc.
	6.1.3.8	The system shall be able to provide customised pre-trip information to hand-held and in-vehicle devices.
	6.1.3.9	The system shall communicate with other information systems using "open" standard protocols.
	6.1.3.10	The system shall provide information for fixed and mobile terminals using "open" standard communication protocols.
6.2 On-trip Driver Information	6.2.0.1	The system shall provide emergency, or urgent, information to all road users free of charge.
	6.2.0.2	The system shall be able to require payment for non-emergency, or non-urgent, information.
	6.2.0.3	The system shall be able to be activated automatically by another system, e.g. traffic management.
	6.2.0.4	The system shall provide traffic information (e.g. travel conditions on roads and other modes, accidents, special events, car park status, etc.) to the traveller during his/her trip in a timely manner. .
	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.
	6.2.0.6	The system shall inform the User when changes occur to the criteria upon which the trip information had been given.
6.2.1 Mode Change	6.2.1.1	The system shall be able to provide alternative routes or mode-switch recommendations when it detects, or is informed, that road network problems have occurred.
	6.2.1.2	The system shall be able to display alternative routes or modes at modal interchange points, or at places where tourism information is available.
6.2.2 Information Handling	6.2.2.1	The system shall be able to inform travellers on the current average travel time between fixed points.
	6.2.2.4	The system shall provide road and traffic safety advice based on current weather and traffic conditions.
	6.2.2.5	The system shall be able to provide all drivers with information on current road travel conditions, e.g. route restrictions, travel times, etc.
	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.
	6.2.2.10	The system shall be able to collect data from a variety of different sources, e.g. 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.

6.2.3 Traveller Interaction	6.2.3.3	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, when applicable.
	6.2.3.4	The system shall provide information using "open" standard communication protocols.
	6.2.3.5	The system shall be able to provide customised on-trip information to hand-held and in-vehicle devices.
	6.2.3.8	The system shall be able to provide road and traffic information using road-side equipment, e.g. VMS.
	6.2.3.9	The system shall be able to provide in-vehicle road, traffic, route guidance and parking information via locally sited equipment, e.g. beacon.
6.3 Personal Information Services		This is a special case of Groups 6.1, 6.2, 6.4 and 10.4 (ISO Services 1, 2, 3 and 5)
6.4 Route Guidance and Navigation	6.4.0.1	The system shall provide travellers with recommended routes to specified destinations.
	6.4.1.3	The system shall be able to compute the total predicted journey time over the route selected.
7 Traffic, Incidents and Demand Management		The activities associated with traffic control, incident management and demand management, including monitoring, planning, flow control, exceptions management, speed management, lane and parking management, HOV, road pricing and zoning, and VRUs
7.1 Traffic Control	7.1.0.1	The system shall support the existing and new traffic management needs of authorities by providing a flexible yet comprehensive approach to determine traffic management strategies (including bridge and tunnel control).
	7.1.0.2	The system shall be able to implement identified control strategies that conform with specified policy.
	7.1.0.3	The system shall not do anything to reduce road safety.
	7.1.0.4	The system shall manage road traffic in such a way that levels of environmental (i.e. atmospheric and noise) pollution may be reduced.
	7.1.0.5	The system shall manage road traffic in such a way that congestion (travel time) may be reduced.
	7.1.0.6	The system shall be able to help co-ordinate the activities of TICs and TCCs.
	7.1.0.7	The system shall be able to exchange information between TICs and TCCs, including across national boundaries.
	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.
	7.1.0.9	The system shall ensure that traveller information service providers are aware of the traffic management strategy, so that they can provide information that conforms to it.
	7.1.0.10	The system shall be able to control urban roads and traffic.
	7.1.0.11	The system shall be able to control inter-urban roads and traffic.
	7.1.0.12	The system shall be able to use different traffic management techniques to control separate areas of the road network.
	7.1.0.13	The system shall be able to manage the urban/inter-urban interface.
7.1.1 Monitoring	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.
	7.1.1.2	The system shall monitor urban roads and traffic.
	7.1.1.3	The system shall monitor inter-urban roads and traffic.
	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.
	7.1.1.5	The system shall be able to monitor the entire road network (network state surveillance tool).

	7.1.1.6	The system shall be able to monitor and record weather conditions, e.g. wind, fog, rain level, ice, etc.
	7.1.1.7	The system shall be able to monitor and record environmental (atmospheric and noise) pollution conditions, and provide an alarm when a certain threshold is exceeded.
	7.1.1.8	The system shall be able to measure the range of visibility and detect reductions caused by adverse weather and pollution conditions (but not darkness).
7.1.2 Planning	7.1.2.1	The system shall be able to use consistent historical data to complement real-time data, when necessary.
	7.1.2.2	The system shall be able to predict short, medium, and long-term traffic conditions, e.g. for minutes, hours and days ahead.
	7.1.2.3	The system shall be able to use historical data to complement predicted data, when necessary.
	7.1.2.4	The system shall be able to analyse road and traffic data to predict possible critical situations.
	7.1.2.5	The system shall be able to predict weather conditions, in particular the formation of fog and/or ice.
	7.1.2.6	The system shall be able to predict 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.
	7.1.2.7	The system shall be able to provide historical and predicted data.
7.1.3 Traffic Control Centres	7.1.3.1	The system shall enable a TCC operator to control, possibly remotely, infrastructure elements (e.g. traffic lights, VMS).
	7.1.3.2	The system shall enable a TCC operator to log all significant events and to record free text messages prior to their output to travellers.
	7.1.3.3	The system shall be able to provide a graphical representation of the road network which includes relevant features (e.g. equipment, events, traffic condition etc.) to TCC operators.
	7.1.3.4	The system shall be able to activate control devices (e.g. traffic lights, VMS), either individually or in groups.
	7.1.3.5	The system shall enable TCC operators to make temporary changes to the normal control strategy in real-time.
	7.1.3.6	The system shall be able to implement planned control strategies for planned events, e.g. sport, cultural, etc.
	7.1.3.7	The system shall be able to support a database of all known (future) events.
7.1.4 Traffic Flow Control	7.1.4.1	The system shall be able to control the entries and exits to motorways.
	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).
	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).
	7.1.4.4	The system shall be able to provide advice to drivers as they approach car parks (on-street and off-street, as well as motorway service area parking).
	7.1.4.5	The system shall be able to provide priority to selected travellers (e.g. cyclists, pedestrians) and/or vehicles (e.g. PT, emergency) through the road network, including on motorways (when applicable).
	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.
	7.1.4.7	The system shall be able to provide control measures for "tunnel" environments i.e. vehicle restrictions, fire detection, atmospheric pollution and closure.

	7.1.4.8	The system shall be able to provide co-ordinated traffic management operations during periods of mass movement across (many) regions.
	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.) when requested.
7.1.5 Exceptions Management	7.1.5.1	The system shall be able to provide control measures to protect road maintenance work and workers.
	7.1.5.2	The system shall be able to command drivers to change lanes on multi-lane roads.
	7.1.5.3	The system shall be able to change the direction of traffic flow on a carriageway in an orderly manner so that it does not create a safety hazard to any road user.
	7.1.5.4	The system shall be able to reverse the direction of traffic flow on parts of the urban network.
	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.
	7.1.5.6	The system shall be able to command certain classes of vehicle (e.g. heavy vehicles or tourist traffic) to take an alternative route for a period of time.
	7.1.5.7	The system shall be able to recommend re-routing strategies to reduce congestion or atmospheric pollution.
	7.1.5.8	The system shall request confirmation of all exceptional measures before they are executed.
7.1.6 O/D Computations	7.1.6.1	The system shall be able to provide Origin/Destination computations, and route assignment estimations, for the road network.
7.1.7 Speed Management	7.1.7.1	The system shall be able to show the maximum authorised speed of vehicles on selected carriageways to be shown to drivers, and to detect violators.
	7.1.7.2	The system shall be able to set variable speed limits on parts of the road network.
	7.1.7.3	The system shall be able to calculate recommended speed limits for given traffic and weather conditions, and road network characteristics.
	7.1.7.4	The system shall be able to transmit recommended speed limits to equipped vehicles.
	7.1.7.5	The system shall be able to support a database of all speed limits on the road network.
	7.1.7.6	The system shall be able to provide vehicles with information about the road network, e.g. speed limits, road hazards, junctions etc.
7.1.8 Roadside-Vehicle Communications	7.1.8.1	The system shall be able to transmit information to a vehicle to update its on-board database.
7.1.9 Adaptive Traffic Control	7.1.9.1	The system shall be able to provide green wave management for all vehicles.
	7.1.9.2	The system shall be able to minimise delays of all vehicles using adaptive signal control
	7.1.9.3	The system shall be able to override the current method of traffic control to grant priority to selected vehicles, e.g. PT, emergency vehicles.
7.1.12 Vulnerable Road Users	7.1.12.1	The system shall be able to control pedestrian and cycle crossings.
	7.1.12.2	The system shall be able to monitor and control pedestrian and cycle crossings in order to optimise their use.
7.2 Incident Management	7.2.0.1	The system shall detect and respond to various incidents on the road network.
	7.2.0.2	The system shall not do anything to reduce road safety.
	7.2.0.3	The system shall not do anything that might aggravate, or cause, an incident.
	7.2.0.4	The system shall assist the emergency services to provide an effective response to road traffic incidents.

	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.
	7.2.0.6	The system shall minimise the time between the occurrence of an incident and its detection.
	7.2.0.7	The system shall be able to validate that an incident has occurred in order to avoid false alarms.
	7.2.0.8	The system shall be able to suggest one or more responses for dealing with an incident.
	7.2.0.9	The system shall be able to run (pre-)defined incident mitigation strategies automatically.
7.2.1 Emergency Services	7.2.1.1	The system shall be able to locate and identify emergency vehicles on the road network.
	7.2.1.2	The system shall be able to co-ordinate the emergency and rescue services once an incident has been detected, and until the situation has returned to normal.
	7.2.1.3	The system shall provide communications between the emergency services, hospitals and TCCs for the provision of incident information.
7.2.2 Information Management	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.
	7.2.2.2	The system shall be able to identify and classify all incidents on the road network.
	7.2.2.3	The system shall be able to provide information on each incident to TICs for onward transmission to travellers.
7.2.3 Reporting	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.
7.2.4 Post-Incident Management	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.
	7.2.4.2	The system shall be able to monitor the aftermath of an incident.
7.2.5 Pre-Incident Management	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.
	7.2.5.2	The system shall be able to provide local warnings on dangerous sections of the road network.
7.2.6 Hazardous Goods	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.
7.3 Demand Management	7.3.0.1	The system shall provide information that will influence travellers' decisions regarding aspects of their journey, e.g. destinations, time, mode of travel, route etc.
	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, PT usage, fares, tolls, etc.
	7.3.0.3	The system shall be able to recommend a strategy to reduce demand.
	7.3.0.4	The system shall be able to simulate a demand management strategy on the road network.
	7.3.0.5	The system shall be able to simulate potential capacity reduction, e.g. due to road works..
7.3.1 Zoning	7.3.1.1	The system shall be able to create a "traffic collar" and limit the entry of all vehicles into a defined area according to (a set of) criteria.
	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 required.
	7.3.1.3	The system shall be able to control the access of vehicles into a zone using a form of identification, e.g. electronic tags,

		number plate readers, etc.
7.4 Safety Enhancements for Vulnerable Road Users		These are covered in Group 7.1 (ISO Service 7)
7.5 Intelligent Junctions and Links		No EU User Need identified
8 Intelligent Vehicle Systems		This group contains the functions found within a vehicle, including vision enhancement, longitudinal and lateral collision avoidance, lane keeping, platooning, speed control, driver alertness, 'May Day' initiation, etc.
8.1 Vision Enhancement	8.1.0.1	The system shall be able to measure the visibility distance and detect reductions caused by adverse weather and pollution conditions (but not darkness) of the view seen by the driver.
8.2 Automated Vehicle Operation		
8.2.1 Collision Avoidance	8.2.1.1	The system shall be able to detect when the host vehicle is too close to the vehicle in front.
8.2.4 Short Range Communications	8.2.4.1	The system shall be able to communicate with other equipped vehicles, and/or the infrastructure, to exchange data for automatic vehicle control.
8.2.5 Speed Control	8.2.5.1	The system shall be able to limit the speed of a vehicle automatically to the a given, but variable, maximum (intelligent speed adaptation)
	8.2.5.2	The system shall be able to receive (variable) mandatory speed limits from outside the vehicle.
	8.2.5.3	The system shall be able to provide information about various aspects of the road network, e.g. default speed limits, road hazards, junctions etc.
	8.2.5.4	The system shall be able to display continuously to the driver the current mandatory speed limit.
8.2.6 Supporting Tasks	8.2.6.3	The system shall be able to monitor the road and the vehicles in the immediate vicinity.
	8.2.6.4	The system shall be able to monitor the course of the host vehicle.
	8.2.6.6	The system shall be able to measure the distance to the vehicle in front.
	8.2.6.7	The system shall be able to control the steering of the vehicle automatically.
8.3 Longitudinal Collision Avoidance	8.3.0.2	The system shall be able to monitor the conflict zone and predict the trajectory of other vehicles relative to the host vehicle, or the vehicle's movement relative to adjacent stationary objects.
	8.3.0.3	The system shall be able to support a database of safety margins for distances between the vehicle and all other adjacent objects.
8.3.1 Collision Avoidance		
	8.3.1.2	The system shall be able to warn the driver when the vehicle in front is too close.
	8.3.1.4	The system shall be able to warn the driver of possible critical situations using audible, visual or haptic (physical feedback to the driver) methods.
8.5 Safety Readiness	8.5.0.2	The system shall be able to detect impairment of the driver, e.g. alcohol/drug abuse, drowsiness, sudden health problems, prolonged inattention, etc.
	8.5.0.3	The system shall be able to warn the driver when a lack of alertness is detected.
	8.5.0.4	The system shall be able to warn surrounding drivers that this driver has a problem.
8.5.1 May Day	8.5.1.1	The system shall be able to make a 'May Day' call.
	8.5.1.2	The system shall be able to detect that the vehicle has been involved in an accident, identify its location, and initiate a 'May Day' call automatically.

	8.5.1.3	The system shall be able to identify the vehicle's location, and make a 'May Day' call on the command of a vehicle occupant.
8.5.3 Environmental Monitoring	8.5.3.1	The system shall be able to measure and analyse the road surface (e.g. for black ice) together with the vehicle dynamic characteristics, and alert the driver (and/or control the dynamics of the vehicle automatically when necessary).
	8.5.3.2	The system shall be able to provide information on the current range of visibility, and to recommend an appropriate speed.
8.5.4 Accident Data Recording	8.5.4.1	The system shall be able to record data about an accident and the journey immediately before (black box).
8.6 Pre-crash Restraint Deployment	8.6.0.1	The system shall be able to detect the imminence of a longitudinal collision.
	8.6.0.2	The system shall be able to detect the imminence of a lateral collision.
9 Freight and Fleet Management		This group contains all the activities associated with FFM, including statutory data collection and reporting; orders and document mgt; planning, scheduling, monitoring, reporting & operations mgt; vehicle and cargo safety; mgt of inter-modal interfaces.
9.5.2 Road Fleight Fleet Management	9.5.2.12	The system shall be able to provide a driver with a suitable alternative route, when the original planned route becomes unavailable.
10 Public Transport		
10.1.3 Incident Management	10.1.3.1	The system shall be able to identify an incident and to revise its services so that passengers may complete their journeys.
	10.1.3.2	The system shall be able to schedule PT operations dynamically so that incidents or unexpected events can be handled with the minimum disruption.

3 Summary of results of the ROMANSE questionnaire

The ROMANSE (ROad MANagement System for Europe) project, was part of the EUROSCOPE project and was initially aimed at the Southampton urban area, before being expanded to include the city of Winchester and the intervening rural areas. The user needs for incident management were identified through questionnaire surveys sent to the operators of traffic control centres in the U.K, who were members of the SCOOT user group. The questionnaires were sent to 65 traffic system users within the UK. There were 27 responses. Table 3.1 gives the observations made from the responses to all questions.

Table 3.1 Results of the ROMANSE Questionnaire

Question		Result summary
Q1)	<p>Within your overall traffic management plans, how important (on a scale of 1-5), do you regard the following three applications?</p> <ul style="list-style-type: none"> • 'network monitoring'; • 'integrated management strategies'; • c) 'incident management'. 	<p>Surprisingly, it seems that integrated management strategies are rated the most highly, then incident management and finally network monitoring. BUT you need network monitoring in order to undertake the incident management and strategy activities!</p>
Q2)	<p>On a scale of 1-5, how important would you rate the following items of infrastructure equipment?</p> <ul style="list-style-type: none"> • Additional detectors • Closed Circuit Television (CCTV) Cameras • An incident detection system • Variable Message 	<p>CCTV cameras appear the most important, followed by VMS and an incident detection system, with additional detectors rated the least important. This again confirms the view that network monitoring is the least important activity.</p>
Q3)	<p>Of the items 2a-2d, which already exist in your network region? (list those that apply) Which of the above areas do you already use but would need to be expanded to provide more effective incident detection? (list those that apply)</p>	<p>CCTV cameras are by far the most popular forms of infrastructure equipment, followed by VMS and strategic detectors. The CCTV camera network is also the most likely to be expanded followed more closely by strategic detectors. VMS and incident detection systems come third and fourth respectively.</p>
Q4)	<p>Consider the area of incident management and the methods that could be employed to provide this facility. Please rate the importance of the following on a scale of 1-5. A strategy which has been developed to cope with such an incident scenario and, by using off-line simulation modelling, has already examined the network effects of varying proportions of diverting drivers at the VMS. These strategies provide the operator with some estimate of the optimum number of drivers which should divert. An Incident Monitoring procedure is provided to record when and where incidents occur, what effects they have and what action was taken to</p>	<p>Incident monitoring is rated more important than the strategy. This appears to conflict with the results for Q1. However there may be some confusion between general network monitoring and the detection of incidents. These may not be viewed as the same thing by respondents, although it could be argued that network monitoring is needed as a means of providing incident detection.</p>

	alleviate these effects.	
Q5)	<p>The effectiveness of incident management will depend to some extent on the method(s) used to define strategies and record data about incidents that actually take place. Please indicate which of the following applies to you by answering Y (yes) or N (no).</p> <ul style="list-style-type: none"> • Strategies are available on a computer and can be sent directly to systems for implementation. • Strategies are written down as a sequence of instructions for implementation by the operator. • Strategies are up to the operator to decide on an individual basis when incidents occur. • Data about incidents is recorded automatically by a computer based system. • Data about incidents is recorded manually. • The data in c) or d) includes details of the response. • We do not record data about incidents. 	<p>Only half the respondents recorded data about incidents. Over half of these left the operator to decide strategies. Leaving things to the operator was a common theme in most other responses. Very few respondents have pre-defined strategies, either on computer or written down.</p>
Q6)	<p>Please rate the importance of items 5a) - 5f) on a scale of 1-5.</p>	<p>Including details of the response in any incident data was considered to be the most important, followed by written down strategies. Automatic recording of incident details was the next most important, followed by strategies available on computer and strategies being left up to the operator.</p>
Q7)	<p>Consider the area of network monitoring: For major strategic links, how important do you consider the following aspects (on a scale of 1-5)?</p> <ul style="list-style-type: none"> • Very accurate current traffic flows • Fairly accurate current traffic flows • Very accurate current journey time profiles • Fairly accurate current journey time profiles • Historic traffic flows • Historic journey time profiles • Very accurate current queuing conditions • Fairly accurate current queuing conditions 	<p>Comparing a) with b), c) with d), and g) with h), it can be seen that 'fairly accurate' traffic flows / journey times / queues are seen as being more important than 'very accurate' traffic flows / journey times / queues.</p>
Q8)	<p>Incident detection can be undertaken using detector based techniques (such as INGRID or Trafficmaster) or by using video analysis (such as ARTEMIS).</p> <ul style="list-style-type: none"> • Should incident detection cover just the area of the UTC controlled network, or include areas not under UTC control ? (Y/N) • A comprehensive network coverage of detectors will provide comprehensive current traffic data. Incident detection algorithms compare this data with historic data in order for an 'incident' to be detected. The threshold of the algorithm can be adjusted in order to vary the severity of the incidents detected (and therefore the false alarm rate). What do you consider more 	<p>Most responses said that incident detection should go outside the area of UTC control and that the detection should highlight 'severe' incidents with a low false alarm rate. The response time varied widely, with several in the 3-5 minute band, with others at 10, 25 and 30 minutes. Some gave ranges which again went up to 30 minutes. Most responses did not consider CCTV cameras or the Police as adequate decision bases for incident detection. However in combination, together with detection they were the most popular. Other sources identified in one or two cases were Local Authority Staff, Bus</p>

	<p>important; a 'severe' incident and a low false alarm rate (answer A), or a less severe incident and a greater number of false alarms (answer B) ?</p> <ul style="list-style-type: none"> • Typically, what is the delay (minutes) between the incident occurring and its detection in your experience? • CCTV cameras provide an immediate detection of an incident, but are individual CCTV cameras adequate as a decision base? (Y/N) • Is a Police report only an adequate basis on which to assume an incident? (Y/N) • What combination of sources would give you confidence that a 'genuine' incident had been detected. Please list the sources, e.g. CCTV, Police, traffic detectors, etc. 	Operators, the AA, network operators and contractors.
Q9)	<p>Once an incident has been detected, some action needs to be taken. Would additional staff resources be required to support the incident monitoring and subsequent management? Do you envisage conflicting areas of interest between the emergency services (who want to reach the scene as quickly as possible) and the network operator (who wishes to minimise traffic congestion in the network)? If the process of responding to an incident ever becomes automated, which of the following areas do you see it covering?</p> <ul style="list-style-type: none"> • Providing advice to an operator on possible strategies; • Automatically implementing strategies previously defined by an operator; • Devising and implementing its own strategies based on previous experience and/or parameters provided by the operator. 	Most respondents would require additional staff resources to support incident monitoring and subsequent management and did not see a conflict between getting emergency services to an incident as quickly as possible and minimising congestion. An automated system was clearly seen as providing advice to operators, with a less clear majority seeing it automatically implementing strategies or devising and implementing its own strategies.
Q10)	For each of the three options in 9c), how soon do you think it will be before each option becomes a reality? (Years)	Just under a third of responses could not estimate a timescale. Of the rest the average figures were 2 years for a system that provided advice, three years for a system that automatically implemented strategies and five years for a system that devised and implemented its own strategies. However these figures were obviously coloured by respondents own knowledge of what is available now. A few believed that systems providing advice and automatically implementing strategies were available now.
Q11)	<p>Consider the following methods of disseminating roadworks or accident information to the public: How do you perceive the importance of each (on a scale of 1-5)?</p> <ul style="list-style-type: none"> • Radio/television broadcasts • Teletext • Roadside VMS 	It is clear that tv/radio broadcasts and roadside VMS are the two methods of information dissemination which are rated the most highly. RDS-TMC and Trafficmaster are next, with teletext and the internet ranked the least effective methods. It would be

	<ul style="list-style-type: none"> • Trafficmaster • RDS-TMC • Internet web page 	interesting to know why teletext and the internet are ranked so low. Is this due to ease of information access, perceived accuracy of the information or the 'biased' preferences of the operator ?
Q12)	<p>Consider the area of integrated management strategies: How would you rate the following statements (on a scale of 1-5)?</p> <ul style="list-style-type: none"> • The emergency services should reach the incident as quickly as possible. • Traffic already in the network should be warned of the incident as quickly as possible. • Drivers which have not set off on their trip should be warned of the incident as quickly as possible. • The effects of too many drivers diverting at the roadside VMS may cause more problems than benefits. • If the benefits provided to the 'incident' drivers by VMS outweigh the disbenefits caused to the rest of the drivers in the road network, then the strategy is successful. • If large numbers of drivers divert at the VMS, then some signals (particularly along key diversionary routes) usually controlled by a UTC system may have to be run with special fixed time signal plans or SCOOT parameters. 	Not surprisingly the getting the emergency services to an incident as quickly as possible was rated the most important (highest mean score). This was followed by informing drivers already in the network and using special timings along routes signposted by VMS. The other three strategies followed close behind with the overall mean of all responses being above 3.5.
Q13)	<p>The type of operator interface for incident management may affect the effectiveness of the response to an incident. Please rate, on a scale of 1-5, the importance of the following:</p> <ul style="list-style-type: none"> • Incident notification should suspend all other operator activities until a response is input. • Incident notification should be provided through some type of screen based icon that enables the current operator activities to continue. • Data about an incident should be presented against a digitised map background of the area in which the report says that the incident is located. • On-line access to other traffic and travel management systems e.g. UTC, VMS, CCTV, public transport, etc., should be provided. • It will be part of the operator's job to communicate with the emergency services to inform them of incidents that have been reported to the traffic management centre. 	The most highly rated operator interface feature was having on-line access to other systems, e.g. UTC, VMS, CCTV, public transport, etc. It was also considered to be part of the operators' job to communicate with the emergency services to inform them of incidents. The occurrence of an incident should be highlighted with some form of screen display (icon), which did not have to be against a map display, and should not interrupt other activities.
Q14)	<p>The use of a Geographic Information System (GIS) is becoming increasingly popular both as a tool in its own right and as part of a data presentation system. Please rate on a scale of 1-5 the importance</p>	Most responses said that their departments used a GIS with slightly fewer traffic management organisations using one. Only just over half the responses had a preferred supplier. The

	<p>which you attach to the use of a GIS. Does your traffic management organisation use a GIS? Do other parts of your department use a GIS? Do you have a preferred supplier for a GIS?</p>	<p>importance of using a GIS was rated at 3.5, with some responses rating it as not important (0).</p>
Q15)	<p>Are there any other sources of data over which you have no control, from which you would like to receive input?</p>	<p>There was a very low response to this question, which indicates that most respondents are happy with the data sources that they have. However the following were mentioned once: eye in the sky to co-ordinate output, bus systems, motoring organisations, air quality monitoring, Police and bus drivers.</p>