European ITS Framework Architecture

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Proposed Framework of Required Standards

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Table of Contents

Tables

Figures

Executive Summary

Introduction and objectives

The purposes of this report, which is part of KAREN Workpackage 4 (Recommendations for standardisation and exploitation) are as follows:

- to identify existing standards relating to the European ITS Framework Architecture developed by the KAREN (Keystone Architecture Required for European Networks) project;
- to identify and recommend future standards needs.

ITS standards have been developed by various standardisation organisations, whilst in parallel, a number of de facto standards have emerged, i.e. standards or protocols which have come to dominate the market as a result of the uncoordinated actions of suppliers and consumers, without any formal adoption or enforcement of the standard. In addition, various projects, groups and forums aimed at cross-fertilisation and consensus have an important role in developing “informal” standards, through agreements on best practice, memoranda of understanding (MoUs), etc.

This report links these standards to the appropriate “Example Systems” described in the European ITS Physical Architecture Document (KAREN Deliverable D3.2) and identifies those areas where standards are insufficient or non-existent, proposing priority areas for standardisation or harmonisation measures.

The role of standards

The purpose of standards can be summarised as follows:

- they can facilitate the development of systems and their rapid deployment;
- they can promote competition;
- they are a key tool in fostering interoperability between systems;
- they provide a reassurance to investors that their investment is sound (i.e. that they are not buying a non-standard, non-interoperable system which could soon be obsolete).

The development of standards

In terms of standards to be matched to the “example systems” described in the Physical Architecture, these may emanate from a number of sources, including:

- standardisation bodies (ISO, CEN, ETSI, etc);
- ITS bodies involved in standardisation (ERTICO, ITS America, etc);
- European R&D programmes and projects which have developed standards (TELTEN, EDEN, DRIVE II programme, etc);
- Industrial and service standards/protocols, (DATEX, RDS-TMC, Alert-TMC, etc.)

The road ITS market

The ITS for road (or RTTT - road transport and traffic telematics) market is advancing at a rapid pace throughout the developed world. This is as a result of an increased need for ITS as identified by public sector bodies (and also private sector and semi-public bodies) and of an expanding commercial market as seen by the private sector (system developers, service providers, etc).

The importance of ITS in transport is underlined by the significant national and European investment in research and development (R&D), demonstration and implementation projects, such as in the EU's Fourth Framework Programme for R&D, the Fifth Framework Programme and projects funded under the TEN-T budget-line. The European ITS industry accounts for some 22% of global ITS players.

The development of ITS is propagated not only by the increasing need for technology-based solutions to road traffic and transport problems and by the new opportunities offered by emerging technology, but also by the fact that the public and private sector players share the same general goals. This increases the scope for mutual co-operation.

Priorities and prospects

Strong links currently exist between governments and standardisation organisations, as standards are crucial to many areas of national concern.

The objectives of standards include providing a communication tool (common "language" regarding technical or contractual issues), public protection, enhancing health, hygiene, and environmental aspects, promoting trade and reducing consumers' costs by fostering standard specifications. Since standards have considerable potential benefits in terms of efficiency, safety and improving user "comfort", organised action to foster standardisation in these areas is often needed.

However, standards are not a universal remedy and can in some cases lead to excessive bureaucracy and slow down implementation processes, without providing commensurate benefits. Furthermore, the advancement of technology may provide an argument against standardisation in some areas.

It is therefore necessary to identify areas in which standardisation is desirable and then to prioritise such areas so that the scarce resources available can be deployed most effectively.

This identification requires that we have a comprehensive picture of the road ITS domain and its foreseeable developments. In that, the European ITS Framework Architecture developed by the KAREN project is a useful tool. The KAREN project has developed a Functional Architecture for the RTTT domain and a Physical Architecture for some of the application areas. Starting from these achievements, the present report is the result of a systematic review of the various functional and physical blocks and their interfaces, in order to identify the areas where standardisation is required.

The principal objectives of standardisation in the road ITS domain in Europe can be summarised as follows:

- to provide standards or proposals to facilitate interoperability and compatibility of RTTT services (across applications and between countries);
- to support the use of these standards and evaluate their effects, modifying them where needed;
- to co-ordinate effort with other standardisation bodies and harmonisation activities;
- to promote consensus in global ITS standardisation issues.

Many road ITS standards, whether development through formal standardisation bodies or by consensus groups, have been initiated by the public sector and therefore follow a top-down approach. There is now however an increasing recognition of the importance of including industry, operators, service providers and end users in the process, although industry is often reluctant to involve itself in the formal standardisation process as it represents a resource cost with few direct benefits to the company involved.

Road ITS and the standardisation process in Europe

The three key players in standardisation in Europe are as follows:

- **CEN**, the European Standards Committee, which is responsible for all sectors with the exception of the electrotechnical domain.
- **CENELEC**, the European Committee for Electrotechnical Standardisation.
- **ETSI** (European Telecommunications Standards Institute).

At a world-wide level, the **ISO** (International Standards Organisation) is the key co-ordinating body.

Outside CEN, CENELEC and ETSI, European standardisation takes place through a number of forums, consortia and MoU (Memorandum of Understanding) committees. Furthermore, the Information Society Initiative for Standardisation sponsored by EC DG-Industry aims to complement the formal standardisation process through validation and demonstration projects.

European Framework Architecture elements

The European ITS Physical Architecture Document (D3.2) was scrutinised for each area in order to identify in the examples given what standards are already established or in which areas standardisation work is progressing. The Physical Architecture elements studied included the following systems:

- Urban traffic management and interurban traffic management, including maintenance of the physical road network, maintenance of the traffic management equipment, lane management, vehicle speed control, links to multimodal systems and co-ordination of traffic management across organisational boundaries.
- Integrated traffic management systems, including integration with Public Transport management systems.
- Traffic information systems.

- Electronic fee collection systems, including Direct Short-Range Communications (DSRC) and smart cards.
- Safety and emergency systems, including hazardous goods management and the pan-European emergency call.
- Vehicle systems (Advanced Driving Assistance).
- Traveller assistance/information and route guidance, including RDS-TMC and WAP.
- Law enforcement systems.
- Freight and fleet management systems.

Key priorities for standardisation

Where standards are seen to be insufficient, recommendations have been made as to the priority actions.

In summary, these concern the following areas:

- technical standardisation of communication interfaces, e.g. DSRC, EFC;
- location referencing;
- car bus standardisation;
- integrity of data communication;
- cross-border continuity.
- organisational standardisation of information exchange, e.g. Interchange Agreements;
- communications protocols;
- data exchange between vehicles and control centres or service providers;
- data exchange between authorities and public transport control centres;
- common data models/structures to create a stable basis for new and updated data dictionaries;
- RDS-TMC;
- EDI messages (status reporting, task orders, etc) for freight and fleet management;
- integration of tachographs into the on-board system are needed;
- data exchange between UTC and public transport management systems.
- standard protocols for the Deployment of pan-European Emergency Services,
- consensus building on location referencing and HMI;
- floating car data;
- digital tachograph.

It is important however to note that a standard does not make a workable system. In addition to standards, procedures are often needed,. Many of the areas discussed in this report (enforcement, EFC, emergency call, etc) not only need technical specifications, but also require agreement among all the actors in the chain on the application of the standard. Failure to approve and implement standards in the appropriate time delay will make it more difficult to provide interoperable services in Europe and could hinder the development of the ITS market.

The European Commission should give its active support to formal standards only if there is a clear pan-European benefit. Otherwise, it should promote the setting up of industry consensus groups, which can often achieve a result more easily than the formal standardisation process. The EC also has a role, not only in R&D activities relating to standardisation, but also in supporting concerted actions aimed at offering interoperable solutions.

The continuous development of technologies, changes in user needs and expectations, and changes in transport policy means that standardisation work, like ITS architectures, must be dynamic and that the links between them need to be regularly reviewed.

It is therefore recommended that a process of maintaining the European ITS Architecture developed by KAREN is organised and that periodic reviews of the standardisation activities are checked against the Architecture.

1. Introduction and Overview of ITS Related Standardisation Activities

1.1 Introduction

The European ITS Physical Architecture document (D3.2) provided a description of the Physical Architecture for ITS in Europe, which was developed by the KAREN project team in the form of “example systems”. The purpose of KAREN Workpackage 4 – Recommendations for standardisation and exploitation, for which this deliverable is the final output, is to identify existing standards relating to the Physical Architecture elements described in D3.2 and to make recommendations for future standardisation work.

ITS standards have been developed by various organisations, including the ISO and the CEN. In parallel, a number of de facto standards have emerged, i.e. standards or protocols which have come to dominate the market as a result of the uncoordinated actions of suppliers and consumers, without any formal adoption or enforcement of the standard. Examples of de facto standards include VHS video cassettes/recorders and Microsoft’s DOS and Windows systems.

This report links these standards to the appropriate Physical Architecture applications and functions and to identify those areas where standards are insufficient or non-existent, proposing priority areas for standardisation, or at least harmonisation measures.

The purpose of standards can summarised as follows:

- they can facilitate the development of systems and their rapid deployment;
- they can promote competition;
- they are a key tool in fostering interoperability between systems;
- they provide a reassurance to investors (whether public authorities/private operators investing in systems or companies/individuals purchasing personal or in-vehicle devices) that their investment is sound (i.e. that they are not buying a non-standard, non-interoperable system which could soon be obsolete).

However, the adoption (or imposition) of standards on a large scale can sometimes be viewed in a less positive light, in terms of delaying development and deployment in some cases rather than speeding it up. They can sometimes create additional administration and incur costs which outweigh any additional benefits. The promotion of standards can therefore be something of a political issue, and as a result, the scope and objectives of this report need to be set out. These are as follows:

- to illustrate the current situation by matching existing standards with architecture;
- to identify standardisation requirements in the short, medium and long terms;
- to identify weaknesses or gaps in existing standards, including standards organisations;

- to identify key areas where new or improved standards are likely to bring real benefits rather than to simply propose standards for their own sake;
- to recommend action plans where appropriate.

In addition to the standards adopted by means of a proper, inclusive standardisation process and the de facto standards developed by commercial companies in isolation of their competitors, there is also a "middle way" towards standardisation – that of harmonisation measures through consensus groups. This involves a common commitment to consensus, harmonisation, common practises, etc. by competing firms by means of forums, declarations such as Memoranda of Understanding (MoUs) and industry consortia. These measures can lead to directives, guidelines, etc. endorsed by authorities at national or European levels.

This report looks at harmonisation or consensus activities following this route in addition to formal and de facto standards.

1.2 Reference documents

This report makes use a number of other documents, including those produced under Workpackage 3 of KAREN, which are as follows:

- D3.1 European ITS Functional Architecture;
- D3.2 European ITS Physical Architecture;
- D3.3 European ITS Communications Architecture;
- D3.4 European ITS Cost Benefits Report;
- D3.5 European ITS Deployment Study Report (internal report, providing a base for D4.2: Deployment Approach and Scenarios);
- D3.6 European ITS Framework Architecture Overview.

Of these, the D3.2 Physical Architecture document is the key document in terms of detailing the architecture elements for which standards are or may be required. D3.2 defines and describes how the functionality created in the D3.1 Functional Architecture document can be grouped to form systems which can be physically produced (using hardware, software, etc) and implemented. These systems are grouped into areas such as urban traffic control and Public Transport priority, electronic fee collection and in-vehicle systems.

Another source is KAREN deliverable D2.02 – European ITS User Needs.

In terms of standards to be matched to the Physical Architecture elements, these may emanate from a number of sources, including:

- standardisation bodies (ISO, CEN, ETSI, etc);
- ITS bodies involved in standardisation (ERTICO, ITS America, etc);
- European R&D programmes and projects which have developed standards (TELTEN, EDEN, DRIVE II programme, etc);
- industrial and service standards/protocols, (DATEX, RDS-TMC, Alert-TMC, etc.)

The key reference document used with respect to standards is "Standards for Road Transport and Traffic Telematics", the Phase 1 report of Mandate 270 produced by EUROLUM in co-operation with ISIS, for the Comité Européen de Normalisation, Technical Committee 278 (CEN TC278). This document provides an evaluation following a survey for Mandate 270 Phase 1, covering the following topics:

- the state-of-the-art of road ITS technology and deployment in Europe;
- the implications of standardisation in this domain on the European ITS industry;
- the European and world-wide situation regarding standards and specifications in this field;
- industry participation in the standardisation process; and
- recommendations on standardisation requirements and research needs.

1.3 Structure of this report

Following this introduction, Chapter 2 of this report summarises the key results of Mandate 270 of CEN TC278 in terms of:

- identifying stakeholders and trends in the ITS for road (or RTTT - road transport and traffic telematics) market;
- existing standards; and
- the standardisation processes in Europe and in the USA.

A database of standardisation items (in the form of tables) is then provided in Chapter 3.

The heart of this document is Chapter 4, which provides an analysis of the European ITS Framework Architecture developed by the KAREN project in terms of relevant standards, by matching standards with elements of the FA.

Chapter 5 identifies key priority areas for the formulation and adoption of standards, while recommendations and conclusions are provided in Chapter 6.

1.4 Abbreviations and acronyms

ACVO	Advanced Commercial Vehicle Operation
AEI	Automatic Equipment Identification
ANEC	European Association for the Co-ordination of Consumer Representation in Standardisation
ATIS	Advanced Travel Information Systems
AVCS	Advanced Vehicle Control Systems
AVI	Automatic Vehicle Identification
CEN	Comité Européen de Normalisation (European Standardisation Committee)

CENELEC	Comité Européen de Normalisation pour l'Electrotechnique (European Committee for Electrotechnical Standardisation)
DAB	Digital Audio Broadcasting
DMB	Digital Multimedia Broadcasting
DVB	Digital Video Broadcasting
EDI	Electronic Data Interchange
EFC	Electronic Fee Collection
ETSI	European Telecommunications Standards Institute
EU	European Union
FA	Framework Architecture
FAP	Fleet Application Protocol
GSM	Global System for Mobile telecommunications
HMI	Human-Machine Interface
ICTSB	Information and Communication Technologies Standard Board
IDB	ITS Data Bus
IEEE	Institute of Electrical and Electronics Engineers
IRTE	Integrated Road Transport Environment
ISO	International Standards Organisation
ITS	Intelligent Transport Systems
KAREN	Keystone Architecture Required for European Networks
MOST	Media Oriented Systems Transport
NTCIP	National Transportation Communications for ITS Protocol (USA)
RAID	Risk Analysis of ITS Deployment
RDS-TMC	Radio Data System - Traffic Message Channel
RTTT	Road Transport and Traffic Telematics
SA	System Architecture
SAE	Society of Automotive Engineers
TC	Technical Committee
TRAVIN	Traffic/Travel Situation Information Message
TSC	Transit Standards Consortium
UTMC	Urban Traffic Management and Control
VAS	Value Added Service
VERTIS	Vehicle, Road and Traffic Intelligence Society (Japanese ITS consortium)
VMS	Variable Message Sign
WAP	Wireless Application Protocol
WI	Work Item

2 Key Results of Mandate 270

This chapter gives a synopsis of the issues researched and the key findings of the survey for the phase 1 of Mandate 270. This was produced in May 1999 by Eurolum and ISIS as part of the work of CEN Technical Committee 278 (see reference [a]).

The survey itself involved interviews and questionnaires with all 13 CEN Working Group (WG) leaders and with 46 other actors in the Road Transport and Traffic Telematics (RTTT) field, representing national and European administrations, Ertico, motorway operators, research bodies, the car industry, service operators, transport operators, telecom companies, the electronics industry and standards bodies. In addition, input was received from five national standardisation bodies in Europe.

2.1 The ITS for road market: stakeholders and trends

The RTTT (or ITS for road) market is advancing at a rapid pace throughout the developed world as a result of:

- an increased need for ITS as identified by public sector bodies (and also private sector and semi-public operators of transport and infrastructure); and
- an expanding commercial market as seen by the private sector (system developers, service providers, etc).

The importance of ITS in transport is underlined by the significant national and European investment in research and development (R&D), demonstration and implementation projects. These include the EU's Fourth Framework Programme for R&D (77m euro for road and multimodal transport from 1995 to 1999), the Fifth Framework Programme and projects funded under the TEN-T budget-line.

In Japan over 400bn yen (4bn euro) has been spent on ITS deployment from 1991 to 1995 and in the US, $1bn was spent by the Department of Transport on ITS R&D from 1992 to 1997. Some $42bn (46bn euro) of public money is projected to be invested in ITS in the USA over the period 1999-2011, plus expected private sector investment of about four times this figure.

The European ITS industry accounts for some 22% of global ITS players, against 15% for US industry and 63% for Japanese players. One reason for the high figure for Japan is the considerable public sector investment in ITS in that country.

The development of ITS is propagated not only by the increasing need for technology-based solutions to road traffic and transport problems and by the new opportunities offered by emerging technology, but also by the fact that the public and private sector players share the same general goals. This increases the scope for mutual co-operation.

This is furthered by umbrella organisations such as Ertico (in Europe), Vertis (in Japan), ITS America and ITS Australia. Total membership of these organisations numbers around 1000, with some 25% of members being in the electronics, audio, video and telecommunications industries, 21% services, consultants and marketing, 10% research bodies and 9% public authorities.

These membership profiles however differ substantially between these three major organisations, as do their size, as can be seen from the following figures[1]:

- ITS America: 565 members (26% consultants and services, 12% DoTs, 12% universities);
- Vertis (Japan): 346 members (49% electronics industry, 16% consultants and services, 7% universities);
- Ertico (Europe): 80 members (30% DoTs, 11% car manufacturers, 33% other industry, 18% infrastructure operators, 2% users, 6% others).

Some 42 organisations are members of more than one of the above bodies and five major electronics companies are members of all three. In addition, several European countries are establishing national ITS organisations (e.g. the UK, France and Sweden).

Various forecasts have been made concerning the size of various parts of the ITS for road market over the next ten to fifteen years, as shown in Table 1.

Table 1: ITS/RTTT market forecasts

Technology	Market	Billion US $	Year	Source
Intelligent transportation systems	Japan	385.0	2010	Japan News
	USA	425.0	2015	FT[2] Automotive
	USA	452.0	2015	Hagler/Bailley
Telematics	Europe	62.3	2015	FT Automotive
Advanced traveller information systems	Europe	28.6	2015	FT Automotive
Automotive electronics	World-wide	75.0	2015	FT Automotive
Car navigation systems using satellite technology	World-wide	7.5	2015	FT Automotive
Collision Avoidance Systems	World-wide	10.0	2003	Allied Business
Electronic toll collection systems	Europe	3.5	2015	FT Automotive
	USA	5.7	2015	FT Automotive
	World-wide	13.2	2007	FT Automotive
		15.0	2015	FT Automotive
In-vehicle products	USA	17.0	2015	FT Automotive
	World-wide	18.0	2005	Allied Business
Mobile Location Services	Europe	4.3	2005	Ovum
	Japan	0.9	2005	Ovum
	USA	3.0	2005	Ovum
Obstacle warning & driver safety systems	USA	11.9	2015	FT Automotive

[1] November 1998 figures for ITS America and Vertis, Spring 2000 for Ertico

[2] Financial Times

Electronic fee collection (EFC) is a key area being developed in Europe, the USA and in Japan. Other key priorities in the USA are safety systems, traffic management (also a priority in Europe), real-time automatic location and freight and fleet (CVO: commercial vehicle operations). In Japan, key areas include public transport, CVO, emergency vehicles, automated highway systems.

The following examples highlight the main differences between Japan, the US and Europe as regards road ITS. In many areas, Europe stands somewhere in between the US and Japan.

Japan:

- The development of ITS is promoted by a liaison committee made up of the Ministry of Construction, the National Police Agency, the Ministry of International Trade and Industry, the Ministry of Transport and the Ministry of Post and Telecommunications.
- Wide scale use of Vehicle Information and Communication Systems (VICS), with some 20% of vehicles fitted, partly as a result of huge public expenditure in this field. The Japanese market for VICS is by far the world’s largest.
- RTTT developments are principally led by the electronics industry, although car manufacturers are also involved in the telecommunication business.
- Major areas for further development are:
  - navigation systems;
  - EFC;
  - assistance for safe driving;
  - traffic management;
  - automated highway systems (a major project with an annual budget of 115m euro and involving the Department of Roads and Construction as well as several major car manufacturers and electronics companies aims to test a fully automated highway in 2010);
  - increased automation in public transport;
  - increased efficiency in CVO;
  - pedestrian assistance (e.g. route guidance, especially for disabled persons, and evacuation instructions in case of earthquakes, etc);
  - emergency vehicle operations; and
  - expansion of fibre-optics infrastructure.

United States:

- A key market winner in the US is Mayday and related mobility services, with the leading service provider being Protection One, with its National Response Center near Dallas. This uses a very extensive database, voice/data integration and a complete off-site back-up facility to provide seamless services in case of system failure.
- Unlike Japan (and much of Europe), public data collection is low and information is often collected and disseminated by the private sector, financed by advertising/sponsorship.
- Major areas of development in the US are:

- increased efficiency and safety in CVO;
- safety systems and specialised traffic operations;
- real time automatic vehicle location for public transport;
- traffic management and control.

Europe:

- There is a general tradition of public initiative regarding ITS in Europe (e.g. publicly operated Traffic Information Centres), and many demonstrations in cities and regions are funded jointly by the local authorities and the European Commission.
- The European market for in-vehicle navigation is around one million people, which is far less than Japan but more than in the US.
- Cellular network operators are now embracing the new market for transportation and mobility services through mobile phones and call centres.
- The existence of major toll motorway networks in some countries has led to a strong market for EFC systems.
- Many European cities are embracing the concept of integrated travel management systems, enabling transport policy to be considered as a whole. The 5T system in Turin, described in Chapter 4 of this report, is an example of this.
- Major areas of development in Europe are:
  - advanced universal mobile telecommunications systems;
  - advanced public transport systems;
  - integrated traffic management;
  - advanced vehicle control;
  - EFC;
  - traveller information, safety and tracking services;
  - advanced CVO.

In terms of traffic information, the current trend in Europe is towards private sector involvement, particularly where public traffic data collection is low. This increase in PPPs has standardisation implications, with strategies often being of a proprietary or de facto nature. This lack of a top down approach to standardisation, coupled with the large number of organisations involved and the different organisational structures, regulations, languages, etc across Europe, has caused difficulties in setting up pan-European information services. Additionally, in countries where public sector bodies provide a wide range of free traffic information services, commercial “value-added” service providers can find it difficult to attract business.

There is a clear trend towards RTTT market becoming embedded in the telecommunications market, and in particular, in the cellular telephone market, due to a large extent to the exponential growth in mobile phone ownership in recent years. Mobile telecommunications providers are now embracing the ITS market, providing product differentiation in order to succeed in a competitive market. A recent development in this field is Wireless Application Protocol (WAP).

2.2 Standards in the RTTT domain: scope, priorities and prospects

Strong links currently exist between governments and standardisation organisations, as standards are crucial to many areas of national concern.

The objectives of standards include providing a communication tool (common “language” regarding technical or contractual issues), public protection, enhancing health, hygiene, and environmental aspects, promoting trade and reducing consumers’ costs by fostering standard specifications. Since standards have considerable potential benefits in terms of efficiency, safety and improving user “comfort”, organised action to foster standardisation in these areas is often needed.

However, standards are not a universal remedy and can in some cases lead to excessive bureaucracy and slow down implementation processes, without providing commensurate benefits. Furthermore, the advancement of technology may provide an argument against standardisation in some areas.

It is therefore necessary to identify areas in which standardisation is desirable and then to prioritise such areas so that the scarce resources available can be deployed most effectively.

In the road ITS domain, Mandate 270 identified the following areas which should be supported by standardisation:

- communication between vehicles;
- vehicle - road infrastructure communication;
- human - machine (vehicle) interfaces;
- vehicle, container, swap body and goods wagon identification;
- traffic and parking management;
- user fee collection;
- public transport management; and
- user information.

Standards are often seen as a panacea for the consumer, by both the consumer and industry alike, with products not conforming to certain standards sometimes being at a disadvantage in terms of marketability even when the product is as performant as its standardised competitors. As a result, many commercial companies are devoting resources to supporting the progress, development and promotion of various tools, protocols, methods, procedures and services with market potential. In the ITS for road domain, this is perhaps even more the case due to the rapid development of technology in this field, leading to many products and services becoming obsolete after a relatively short time.

On the other hand, some suppliers see standards in a less positive light, as a way of destroying their “protected” market. An example of this is in traffic management, where purchasing a UTC system from one supplier makes it difficult to multi-source the traffic signal controllers.

From the public sector point of view, standards are seen as important in promoting the safety and quality of products, and can also be seen as a key to stimulating industrial production.

Governments also use standards as a tool to help and inform consumers, and also to promote the image of nationally produced goods.

The principal objectives of standardisation in the RTTT domain in Europe can be summarised as follows:

- to provide standards or proposals to facilitate interoperability and compatibility of RTTT services (across applications and between countries);
- to support the use of these standards and evaluate their effects, modifying them where needed;
- to co-ordinate effort with other standardisation bodies and harmonisation activities;
- to promote consensus in global RTTT standardisation issues.

The adoption of formal standards can either be as a result of a formal standardisation process through standards development organisations, or the adoption by governments of laws (e.g. on vehicle emissions) which result in a mandatory standard. Besides being involved in the standardisation process, which in some cases can be considered by industry as being too slow, bureaucratic and costly due to formal and administrative factors, companies can adopt other parallel ways to reach their target:

- the actor can develop a separate policy without any connection with its competitors, trying to impose a “de facto” standard;
- the actor works together with competitors for their mutual benefit by building a consortium or consensus group.

De facto standards, which are normally associated with a single manufacturer, may be “open” (i.e. may be used by any competing company), subject to licensing, or proprietary (i.e. by keeping certain technical information as trade secrets). Examples are the Microsoft DOS and Windows software and VHS video systems.

The two principal concerns regarding de facto standards are:

- the dominant market position likely to be held by the owner of the standard, possibly resulting in anti-competitive practices, and;
- a de facto standard does not necessarily imply the best technical solution, with the possibility that a poorer product could become a de facto standard simply through good marketing.

The use of consortia and consensus groups in standardisation is widespread. Such consortia exist in the mobile telecommunications domain, such as the GSM Association and the WAP Forum (Wireless Application Protocol), which include competing operators and have been successful in terms of the enormous growth in mobile phone ownership in recent years. This has some relevance to ITS insofar as on-trip traveller information is concerned.

Specific ITS developments in Europe making use of forums to reach standardisation objectives include RDS-TMC and DATEX (although the DATEX standard has now been adopted by CEN).

Many ITS standards, whether development through formal standardisation bodies or by consensus groups, have been initiated by the public sector and therefore follow a top-down approach. There is now however an increasing recognition of the importance of including industry, operators, service providers and end users in the process. This is partly due to the increasing number of actors in many of the more recent telematics developments, e.g. services such as emergency assistance, which involve not only road operators and motorists, but also the police, service providers, telecom operators, device manufacturers, the car industry and medical services. Furthermore, standards need to address the increasing number of multi-functional services.

While numerous evaluations have measured or estimated the benefits of individual ITS applications in terms of productivity, efficiency, safety and environmental benefits, there are few concrete figures regarding the benefits of standardisation itself. One estimate by the EU action on telecommunications is that the adoption of common European standards could save 5 to 10% in the telecommunications equipment market, equating to some 1bn euro per year.

Regarding the costs of standardisation, Mandate 270 estimated the cost of a standard of medium difficulty, needing the efforts of 10 persons over 3 years for 5% of their working time, as 0.5m euro. If there are, say, five or six RTTT standards a year, total annual standardisation costs would come to around 3m euro

2.3 Road ITS and the standardisation process in Europe

2.3.1 Key players in ITS standardisation in Europe

The three key players in standardisation in Europe are as follows:

- **CEN**, the European Standards Committee, which is responsible for all sectors with the exception of the electrotechnical domain. CEN was set up in 1985 as a legal body and comprises the national standards bodies of 19 European countries and six associate organisations. The CEN has established Technical Committees (TCs) to co-ordinate and endorse the activities of their Working Groups (WGs), which write the standards. The TCs relevant to RTTT are:
  - TC278: RTTT standardisation – this was established in 1991 and is the principal TC in the road ITS field;
  - TC224: Machine readable card, related device interfaces and operations;
  - TC287: Geographic information;
  - TC226: Road equipment; and
  - TC320: Transportation services.
- **CENELEC**, the European Committee for Electrotechnical Standardisation, which was set up in 1973 as a non-profit making organisation, including 18 European countries. Its two main Technical Committees in relation with CEN/TC278 are:
  - TC9X: Electrical and electronic applications for railways; and
  - TC214: Electrotechnical equipment for surface transport systems (this TC is currently dormant).

- **ETSI** (European Telecommunications Standards Institute) is also a non-profit making organisation, created in 1988. It is an open forum of 647 members from 49 countries with the objective of determining and producing telecommunications standards. ETSI produces voluntary standards, some of which may go on to be adopted by the EU as a technical base for directives or regulations. One ETSI Technical Committee is relevant to RTTT:
  - TC ERM: Radio and electromagnetic compatibility – this TC collaborates with CEN/TC278 WG9 (DSRC) concerning Direct Short Range Communications and Autonomous Intelligent Cruise Control.

At a world-wide level, the **ISO** (International Standards Organisation) is the key co-ordinating body, with ISO/TC204 dealing with transport information and control systems. Other ISO TCs deal with road vehicles (TC22), freight containers (TC104) and geographic information (TC211). Formal exchange of information and common work exists between the ISO and the CEN.

Other relevant bodies are:

- **ANEC** (European Association for the Co-ordination of Consumer Representation in Standardisation), which represents consumers' interests in standardisation. The ANEC is a member of CEN, CENELEC and ETSI.
- **ICTSB** (Information and Communication Technologies Standard Board) – this was set up by CEN, CENELEC and ETSI and is concerned with standards for information superhighways.

2.3.2 CEN Technical Committee 278

CEN/TC 278 (RTTT standardisation) is organised as follows:

- A **TC Plenary**, responsible for the creation of Work Items (WIs) and Working Groups, to guide, to follow up and to approve their work.
- A **Strategy Group**, responsible for advising the TC on future work and liaising with external bodies;
- 14 **Working Groups** (WGs), responsible for writing the standards for the approved WIs. The WGs are as follows:
  - WG1: Electronic Fee Collection (EFC)
  - WG2: Freight and Fleet Management Systems
  - WG3: Public Transport
  - WG4: Traffic and Traveller Information Systems
  - WG5: Traffic Control *(currently dormant)*
  - WG6: Parking Management *(currently dormant)*
  - WG7: Geographic Road Data
  - WG8: Road Traffic Data Elaboration, Storage and Distribution
  - WG9: Dedicated Short Range Communications (DSRC)
  - WG10: Man-Machine Interface
  - WG11: Subsystem and Intersystem Interfaces *(currently dormant)*

- WG12: Automatic Vehicle and Equipment Identification
- WG13: Architecture and Terminology *(WIs in this WG are all led by ISO)*
- WG14: After Theft Systems for the recovery of stolen vehicles.

WGs 1-6 and 12-14 are application oriented and WGs 7-11 are technically oriented. The application WGs provide requirements to the technical ones, whilst the technical WGs prepare technology standards as tools for the building of applications. The application WGs then prepare standards for application based on these tools.

Links exist between CEN/TC278 and ISO/TC204 concerning co-operation by correspondence and mutual representation at meetings, the adoption of existing international standards as European standards and co-operation by the transfer of work and parallel approval of standards. In addition, some WGs of CEN/TC278 and ISO/TC204 are linked.

In addition, the Vienna Agreement aims at preventing duplication of effort between CEN and ISO by allocating responsibilities to ISO204 in various domains.

To summarise the actions of TC278, there has been a huge amount of experience but with very limited financial support. Key successes include the development of standards in DSRC, RDS-TMC, GDF and data exchange, which have proved to be beneficial to users. Concerns are that the process is often slow in comparison with the evolution of technology and the political environment and that the standardisation process relies on a limited number of volunteers. Lack of funding has been identified by Mandate 270 as a key problem.

Mandate 270 identified a need to improve the image of the standardisation world, to make the process more efficient, to maintain the motivation of the WGs and to foster co-operation with the outside world (e.g. research projects). It proposed new Work Items (WIs) as a result of the wishes of the WG members and as a response to evolving technology, and also some changes to the structure and mission of CEN/TC278 to create a more transparent and centre-stage organisation.

2.3.3 CEN Technical Committee 287

Standardisation in the field of geographic information[1]

Objectives: Geographic information concerns objects and phenomena directly or indirectly associated with a location relative to the surface of the Earth. The basic objective of standardisation in this field is to enable geographic information to be accessed by different users, applications and systems, and from different locations. This requires a standard way of defining and describing this information, a standard method for structuring and encoding it, and a standard way of accessing, transferring and updating it via geographic information processing and communication functions, independent of any particular computer system. Standardisation enables consistent implementations across multiple applications and systems, but permits different implementation technologies to be used for storing data in computer systems.

[1] See reference (f)

Principles: The Geographic Information European Pre-standards are intended for use by suppliers of data and developers of systems and applications as well as users. They are based on existing information system standards and methodologies, especially those relating to the interconnection of open systems. To enable databases and applications that are different in structure, form and content to interconnect and inter-operate, a distinction is made between internal and external applicability of this standard, with the major emphasis placed on the external aspects. Additional benefits may be gained from application of this standard internally to databases and applications.

Work programme: The work programme of TC 287 is divided into four main parts: fundamentals, data description, referencing and processing.

- Under the main heading of fundamentals, there are three work items:
  - WI 287001: Fundamentals - Reference Model
  - WI 287002: Fundamentals - Overview
  - WI 287003: Fundamentals - Definitions
- Under the main heading of data description, there are five work items describing and defining geographic data:
  - WI 287006: Data description - Rules for application schemas
  - WI 287007: Data description - Geometry
  - WI 287008: Data description - Quality
  - WI 287009: Data description - Metadata
  - WI 287010: Data description - Transfer
- Under the main heading of referencing, there are three work items:
  - WI 287011: Referencing - Position
  - WI 287012: Referencing - Time
  - WI 287014: Referencing - Indirect positioning systems
- Under the main heading of processing there is one work item:
  - WI 287013: Processing - Query and Update

At the international level, the standardisation work is addressed by ISO TC/211. A list of ENV standards is included in Table 4.Other European standardisation activities

Outside CEN, CENELEC and ETSI, European standardisation takes place through a number of forums, consortia and MoU (Memorandum of Understanding) committees. The principal ones concerned with RTTT are as follows (non-exhaustive list):

- **RDS-TMC** MoU and Forum – to co-ordinate RDS-TMC activities in Europe, to encourage its use, to foster evolution of TMC and to provide a central point of contact and distribution of information and products.
- **DATEX-Net** MoU and Forum – focuses on the use of interoperable mechanism for international data exchange of traffic and travel data/information between road traffic centres. It refers to DATEX-Net specifications whose key elements are a data dictionary, a data model, location referencing rules and message exchange format. The DATEX Net Forum gathers DATEX users from traffic centres. In March 2000, the DATEX data

dictionary (version 3.1a) and the DATEX specifications for data exchange between traffic and travel information centres (version 1.2a) were adopted by CEN.

- **Telematics Forum** (formerly GATS Forum: Global Automotive Telematics Standard) – to push for a quick opening of the ITS market to services which can be provided over cellular networks (GATS, WAP type applications, etc) via cost reduction and decreasing investment risks. GATS focuses on services disseminated via a cellular radio network such as GSM.
- **EFC** (Electronic Fee Collection) MoU (proposed) – in order to promote interoperable EFC systems in Europe, the EC is supporting the signing of an MoU, based on an EU framework agreement, leading presumably to an EFC Forum later. Currently, projects such as CARDME, CESARE and MÅNS deal with interoperable EFC and cross-fertilisation/convergence activities are carried out by the ASSISTEN-T project. In addition, the activities of DELTA project and the DELTA forum are worthy of mention. Their objective is to integrate the in-vehicle EFC tag in order to facilitate the deployment of interoperable EFC systems and value added services based on the short range communication medium. One of the difficulties with the current tag is its operation in cars with metallic windscreens.
- **HMI** (Human-Machine Interface) MoU – to enlarge the number of actors willing to comply with an HMI "code of practice", proposing principles for good practice, guidelines for in-vehicle systems installation, presentation, interaction, behaviour and information.
- **GNSS** (Global Navigation Satellite System) Forum (proposed) – the Galileo project focuses on safeguarding Europe's major strategic, political and commercial interests. To ensure that the resulting GNSS-2 system will meet the requirements of ITS suppliers, operators and users, the EC is pushing the creation of a GNSS Forum.
- Standardisation in the area of **GSM** (cellular phones), including **WAP** (wireless application protocol) and **DAB** (Digital Audio Broadcasting). This includes the GSM Consortium, the WAP Forum and a number of projects, for example DIAMOND (using DAB to deliver ITS through multimedia), ITSWAP (technical and commercial feasibility of delivering ITS via WAP) and LOCUS (location of cellular users for Emergency Services).
- **AMIC** (Automotive Multimedia Interface Collaboration) – created by some of the leading car manufacturers to endorse the ITS Data Bus (IDB) standard developed by the Society of Automotive Engineers (SAE).
- **TSC** (Telematics Suppliers Consortium) – established by set manufacturers to balance their point of view with that of the car industry.
- **VXML** (Voice eXtensible Markup Language) Forum – set up by AT&T, Lucent Technologies and Motorola to create voice access to the World Wide Web over telephones. This will provide a crucial mobile component to Internet access, of much interest regarding in particular HMI.
- **WWW: MMM** (Mobile Media Model) – established by Nokia, Ericsson, and Motorola to speed the introduction and recognition of mobile internet services with the launch of a common symbol for mobile internet access. The right to use the WWW MMM icon will be granted to licensees solely in conjunction with wireless applications protocol compliant products, content and services.

- **CARDME** (Concerted Action for Research on Demand Management in Europe) – this project for ECDG INFSO (CARDME 1-4, 1997-2001) is concerned with the identification and removal of obstacles to cross-border interoperability of electronic tolling systems for road transport in Europe.
- **TEN-T Cross-fertilisation** – the EC ASSISTEN-T project involves cross-fertilisation and consensus activities in the DATEX and EFC domains (see above) and also in traffic management, road and traffic monitoring, and traveller information services, through expert groups comprising representatives from the Euro-Regional TEN-T projects.

In addition to the above, the **Information Society Initiative for Standardisation** sponsored by EC DG-Industry aims to complement the formal standardisation process through validation and demonstration projects. The project aims to:

- accelerate the formal standardisation process and validate the resulting standards so that industry may, with confidence, develop interoperable products based on novel technologies;
- stimulate convergence of standards to facilitate the timely developments and take-up of new products and improve access to the internal market for suppliers;
- lower the risk and cost of entry for industry into novel, standardised technologies; and
- promote and build awareness of available standards-based products and the use of standards to develop novel products.

2.4 Other road ITS standardisation activities

There are two other principal architecture activities from which information is readily available, namely the US National ITS Architecture and the work being done by ISO/TC204/WG1, which are described here. Work is however also being undertaken elsewhere, e.g. Japan, South Korea, and Australia.

2.4.1 The US National ITS Architecture

A central concept as regards ITS standardisation in the United States is the US National ITS Architecture – an open framework architecture conceived by the Department of Transport (DOT). The key aim of this Architecture is national interoperability.

Following on from this architecture is a multi-annual programme of standards development to facilitate ITS deployment, covering “critical standards” identified in the National ITS Architecture. These standards are not market-driven, but have been developed at a national level in order to meet identified needs concerning national interoperability. The requirements for standards cover areas such as interfaces, message sets, protocols and specific technology required for implementation. The starting point for their development was the National ITS Architecture, which identified thirteen areas in which standards should be produced.

The National ITS Architecture is effectively a reference architecture which spans these standardisation activities, with the work itself being carried out by national standardisation bodies. Considerable resources have been devoted to this standardisation process, and consensus has in some cases been difficult to reach because of the Federal structure and the variety of standardisation organisations in the US. The process has however been effective, although the fact that views and developments from outside the US were not taken into consideration could be viewed as protectionism. Furthermore, since the US User Service Requirements essentially address national problems and aims, they not necessarily applicable outside the USA.

More than one hundred consensus private-sector standards will be developed for ITS applications. These standards will enable the use of new technologies to provide ITS services for improvements in surface transportation systems in such areas as traffic management, transit operations, traveller information, emergency vehicle priority and commercial vehicle operations. Based upon the National ITS Architecture, the standards aim to provide improved safety, greater efficiency, and reduced costs to users of the highway systems.

There are six Standard Development Organisations (SDOs) dealing with the development of standards in the United States and sponsored under the US DoT Joint Program Office (JPO) for ITS Standards Development Effort. These are:

- The Society of Automotive Engineers (SAE)
- The Institute of Transportation Engineers (ITE)
- The Institute of Electrical and Electronic Engineers (IEEE)
- The American Association of State and Highway Transportation Officials (AASHTO)
- The National Electrical and Manufacturers Association (NEMA)
- The American Society of Testing and Materials (ASTM).

Some umbrella standards for ITS are developing on different stages:

- IEEE Data Dictionary Standards for ITS
- IEEE Data Registry catalogue
- IEEE Massage set template for ITS
- ASTM/IEEE DSRC protocols
- NTCIP (National Transportation Communications for Interface Protocols), centre to centre communication profiles.

A list of “critical” road ITS standards, i.e. those defined by the Transportation Equity Act for the 21st Century (TEA-21) as being necessary for national interoperability, is as follows:

- Advanced Traveler Information System (ATIS) Data Dictionary
- Advanced Traveler Information System Message Set
- ATMS Data Dictionary
- Commercial Vehicle Credentials
- Vehicle Safety and Credentials Information Exchange
- Commercial Vehicle Safety Reports
- High Speed FM Sub-carrier Waveform Standard

- Information Service Provider-Vehicle Location Referencing Standard
- Message Sets for DSRC, ETTM and CVO
- On-Board Land Vehicle Mayday Reporting Interface
- Standard for Common Incident Management Message Sets for Use by Emergency Management Centers
- Standard for Data Dictionaries for Intelligent Transportation Systems
- Standard for Message Set Template for ITS
- Standard Specification on DSRC – Data Link Layer
- Standard Specification on DSRC – Physical Layer
- Standard Specification on DSRC at 5.89 GHz
- Standards for ATIS Message Sets Delivered Over Bandwidth Restricted Media.

There has also been a certain level of success in the US from the consortium/forum approach, such as the WAP Forum with Unwired Planet, AMIC and TSC (Transit Standards Consortium). Such co-operation is leading to consensus-driven standards in areas such as electronic devices and in-vehicle services.

2.4.2 ISO Technical Committee 204

Like the US National Architecture, the ISO/TC204/WG1 Reference Architecture begin with a blank slate (a “green field” approach, i.e. without considering any existing systems or equipment).

The 32 Transport Information and Control System (TICS) Fundamental Services produced by ISO/TC204/WG1 have been based mainly on the US User Service Requirements (which are now recognised as not being totally applicable outside the USA) and thus tend to be oriented towards US problems and desires.

ISO/TC204/WG1 took the US National ITS Architecture, which uses a Function Oriented (or Process Oriented) approach, and has rewritten it using an Object Oriented approach with UML to produce a proposal for a Reference Architecture for TICS [ISO/TC204/WG1 Pt2].

During 1998 it was recognised by the US, European and Japanese representatives that the work needed to be improved with regard to its consistency and readability. These and other comments were submitted to WG1 in November 1998, the European ones being submitted through ISO/TC204/WG1/SG7 which is responsible for representing European interests in this area. The comments have resulted in the production of a revised and improved version.

A new work item was also proposed, the “bridge building function”, which would also describe the TICS architecture using a Function Oriented approach.

3 Database of Standardisation Items

This chapter provides a series of reference tables of adopted and ongoing standardisation measures relevant to road ITS/RTTT.

The key players in European standardisation were described in Section 2.3.1. The table below provides a summary of the committees which are the most relevant to road ITS within these organisations.

Table 2: List of main European committees relevant to Transport Telematics

Reference	Title
CEN/TC278	Road transport and traffic telematics
ISO/TC204	Transport information and control system
CENELEC/TC214	Electrotechnical aspects of surface transport systems
CEN/TC224	Machine readable cards, related devices and operations
ISO/TC22	Road vehicles
CENELEC/TC9X	Electrical and Electronic Applications for Railways

3.1 Industrial and de-facto standards

The following table provides a list of CEN road ITS standards which have been adopted.

Table 3: List of adopted CEN standards for road transport telematics (TC278)

Reference	Year	Title
ENV 12253	1997	Dedicated Short-Range Communication - Physical layer using microwave at 5.8 GHz
ENV 12313-1	1998	Traffic and traveller Information (TTI) - TTI Messages via traffic message coding - Part 1: Coding protocol for Radio Data System - Traffic Message Channel (RDS-TMC) using ALERT- C
ENV 12313-2	1997	Traffic and traveller Information (TTI) - TTI Messages via traffic message coding - Part 2: Event and information codes for Traffic Message Channel (RDS-TMC)
ENV 12313-4	1999	Traffic and traveller Information (TTI) - TTI Messages via traffic message coding - Part 4: Coding protocol for Radio Data System - Traffic Message Channel (RDS-TMC) - RDS-TMC using ALERT-Plus with ALERT-C
ENV 12314-1	1996	Automatic vehicle and equipment identification - Part 1: Reference architectures and terminology
ENV 12315-1	1996	Traffic and traveller Information (TTI) - TTI Messages via Dedicated Short-Range Communication - Part 1: Data specification - Downlink (roadside to vehicle)
ENV 12315-2	1996	Traffic and traveller Information (TTI) - TTI Messages via Dedicated Short-Range Communication - Part 2: Data specification - Uplink (vehicle to roadside)
ENV 12694	1997	Public transport - Road vehicles - Dimensional requirements for variable electronic external signs

Reference	Year	Title
ENV 12795	1997	Dedicated Short-Range Communication (DSRC) - DSRC Data link layer: Medium Access and Logical Link Control
ENV 12796	1997	Public transport - Road vehicles – Validators
ENV 12834	1997	Dedicated Short-Range Communication - Application layer
ENV 12896	1997	Public transport - Reference data model
ENV 13093	1998	Public transport - Road vehicles - Driver's console mechanical interface requirements - Minimum display and keypad parameters
ENV 13106	2000	Traffic and travel data dictionary - Part 1: General definitions, entities, attributes (version 3.1a)
ENV 13149-1	1998	Public transport - Road vehicle scheduling and control systems - Part 1: WORLDFIP definition and application rules for onboard data transmission
ENV 13372	1999	Road Transport and Traffic Telematics (RTTT) - Dedicated Short-Range Communication (DSRC) - DSRC profiles for RTTT applications
ENV 13777	2000	DATEX specifications for TRAVIN (Traffic/Travel Situation Information Message), version 1.2a
ENV 14815	1999	Automatic vehicle and equipment identification - System specification
ENV 14816	1999	Automatic vehicle and equipment identification - Numbering and data structures
ENV ISO 14812	1999	Glossary of Standard Terminologies for the Transport Information and Control Sector
ENV ISO 14825	1996	Geographic Data Files
ENV ISO 14904	1997	Electronic Fee Collection (EFC) - Interface specification for clearing between operators
ENV ISO 14906	1998	Electronic Fee Collection - Application interface definition for Dedicated Short-Range Communication
ENV ISO 14907-1	1999	Electronic Fee Collection – Test procedures for user and fixed equipment - Part 1: Description of test procedures

Concerning standardisation in the field of geographic information (CEN/TC287), a structured set of standards have been produced which specifies a methodology to define, describe and transfer representations of the real world. This will allow understanding and usage of digital information related to any location. The objective is to facilitate the use of digital information related to real world location through information technology as a whole. This standardisation work will influence and be influenced by developments in the field of information technology. Note that a location in the real world may be represented by co-ordinates, textual description or a codified name.

Table 4: List of adopted CEN standards for Geographic Information Systems (TC287)

Reference	Year	Title	Summary (scope)
ENV 12009	1997	Geographic Information - Reference Model	Describes the basis of the whole area of standardisation for geographic information, stating the main items of interest and how they interrelate
ENV 12160	1997	Geographic Information - Data description - Spatial schema	Establishes the principles for defining spatial schemas. The spatial schema specifies the primitives and their constructs for representing geometry and topology of geographic objects.
ENV 12656	1998	Geographic Information - Data description - Quality	Establishes the general principles for describing the quality of geographic information. It is concerned with presenting information appropriate for judging the quality of geographic information
ENV 12657	1998	Geographic Information - Data description - Metadata	Defines a conceptual schema for metadata for geographic data sets. Metadata is data about datasets. It includes information about the content, representation, extent (both geometric and temporal), spatial reference system, quality and administration of the dataset
ENV 12658	1998	Geographic Information - Data description - Transfer	Defines the transfer schemas, implementation mechanisms and encoding rules for the transfer of geographic data. It allows users to transfer spatial and non-spatial components of geographic information, together with their data dictionary and metadata.
ENV 12661	1998	Geographic Information - Referencing systems - Geographic identifiers	Describes methods of documenting and disseminating systems for spatial referencing using geographic identifiers.
ENV 12762	1998	Geographic Information - Referencing systems - Direct Position	Defines the basic concepts related to position information based on co-ordinates and defines how that position information may be described and identified.
prENV 13376		Geographic Information - Rules for application schema	Defines the rules about the use of the data description techniques for developing application schemas for geographic information

The standards in the following table (Table 5) are in the process of being developed or are awaiting adoption .

Table 5: Programme of on-going standardisation activities undertaken by CEN

WG	Work item	Title	Document
1	278005	Electronic Fee Collection (EFC) - Interface specification for clearing between operators	ENV ISO 14904:1997
1	278009	Electronic Fee Collection - Application interface definition for Dedicated Short-Range Communication	ENV ISO 14906:1998

WG	Work item	Title	Document
1	278076	Electronic Fee Collection - Application interface definition for Dedicated Short-Range Communication	ENV ISO 14906:1998
1	278010	Electronic Fee Collection - Test procedures for user and fixed equipment - Part 1: Description of test procedures	ENV ISO 14907-1:1999
1	278103	Electronic Fee Collection (EFC) - Test procedures for user and fixed equipment - Part 2: EFC application interface conformance tests specification	
1	278114	Electronic Fee Collection - System architecture for vehicle related transport services	
1	278105	Electronic Fee Collection - Security framework	
1	278104	Electronic Fee Collection (EFC) - Application interface definition for CN/GNSS based EFC	
2	278094	Freight and Fleet Management Systems - Reference architecture and terminology - Part 1: high level architecture and terms	N739
3	278080	Public Transport - Road vehicles - AVMS on board equipment - Environmental and electrical conditions and limits	
3	278019	Public transport - Road vehicle scheduling and control systems - Part 1: WORLDFIP definition and application rules for onboard data transmission	ENV 13149-1:1998
3	278121	Public transport - Road vehicle scheduling and control systems - Part 2: WORLDFIP cabling specifications	N835
3	278122	Public transport - Road vehicle scheduling and control systems - Part 3: WORLDFIP message content	
3	278123	Public transport - Road vehicle scheduling and control systems - Part 4: CAN definition and application rules for onboard data transmission	
3	278124	Public transport - Road vehicle scheduling and control systems - Part 5: CAN cabling specifications	
3	278125	Public transport - Road vehicle scheduling and control systems - Part 6: CAN message content	
3	278021	Public transport - Reference data model	ENV 12896:1997
3	278077	Public transport - Road vehicles - Dimensional requirements for variable electronic external signs	ENV 12694:1997
3	278078	Public transport - Road vehicles - Driver's console mechanical interface requirements - Minimum display and keypad parameters	ENV 13093:1998
3	278079	Public transport - Road vehicles - Validators	ENV 12796:1997
3	278081	Public transport - Road vehicles - Visible variable passenger information devices inside the vehicle	
3	278082	Public transport - Road vehicles - AVMS - Test methods for the measurement of the result of the system	
3	278083	Public transport - Passenger information systems at stops	
4	278118	Road Transport and Traffic Telematics - Traffic and Travel Information (TTI) - TTI information over high data-rate broadcast digital bearers	

WG	Work item	Title	Document
4	278098	Traffic and traveller Information (TTI) - TTI Messages via traffic message coding - Part 1: Coding protocol for Radio Data System - Traffic Message Channel (RDS-TMC) using ALERT- C	ENV 12313-1:1998
4	278112	Traffic and traveller Information (TTI) - TTI Messages via traffic message coding - Part 1: Coding protocol for Radio Data System - Traffic Message Channel (RDS-TMC) - RDS-TMC using ALERT-C	prENV ISO 14819-1
4	278113	Traffic and traveller Information (TTI) - TTI Messages via traffic message coding - Part 2: Event and information codes for Radio Data System - Traffic Message Channel (RDS-TMC)	ENV 12313-2:1997
4	278071	Traffic and traveller Information (TTI) - TTI Messages via traffic message coding - Part 2: Event and information codes for Traffic Message Channel (RDS-TMC)	ENV 12313-2:1997
4	278115	Traffic and traveller Information (TTI) - TTI Messages via traffic message coding - Part 3: Location Referencing for ALERT- C	N783
4	278116	Traffic and traveller Information (TTI) - TTI Messages via traffic message coding - Part 4: Coding protocol for Radio Data System - Traffic Message Channel (RDS-TMC) - RDS-TMC using ALERT-Plus with ALERT-C	ENV 12313-4:1999
4	278117	Traffic and traveller Information (TTI) - TTI Messages via traffic message coding - Part 5: Location referencing for ALERT-Plus	N783
4	278060	Traffic and traveller Information (TTI) - TTI Messages via Dedicated Short-Range Communication - Part 1: Data specification - Downlink (roadside to vehicle)	ENV 12315-1:1996
4	278026	Traffic and traveller Information (TTI) - TTI Messages via Dedicated Short-Range Communication - Part 2: Data specification - Uplink (vehicle to roadside)	ENV 12315-2:1996
4	278025	Traffic and Traveller Information (TTI) - TTI messages via cellular networks	N949
4	278084	Traffic and traveller Information - Messages via stationary dissemination systems	
4	278027	Traffic and traveller Information - Medium-range pre-information	
7	278039	Geographic Data Files	ENV ISO 14825:1996
7	278041	Geographic road data - Location catalogues	
7	278044	Geographic road data - Maintenance rules	
8	278072	DATEX specifications for data exchange between traffic and travel information centres (version 1.2.a)	N752
8	278073	Road traffic data - Elaboration, storage, distribution - Exchange procedures (low level)	
8	278074	Road traffic data - Elaboration, storage, distribution - Exchange formats (low level)	
8	278085	Road traffic data - Elaboration, storage, distribution - Exchange protocol	
8	278075	Road traffic data - Elaboration, storage, distribution - Physical interfaces	
9	278051	Dedicated Short-Range Communication - Application layer	ENV 12834:1997

WG	Work item	Title	Document
9	278092	Dedicated Short-Range Communication - Physical layer using microwave at 5.8 GHz	ENV 12253:1997
9	278053	Dedicated Short-Range Communication (DSRC) - DSRC Data link layer: Medium Access and Logical Link Control	ENV 12795:1997
9	278106	Road Transport and Traffic Telematics (RTTT) - Dedicated Short-Range Communication (DSRC) - DSRC profiles for RTTT applications	ENV 13372:1999
9	278119	Dedicated Short Range Communication - Physical integration with the vehicle of On Board Units (OBU) for Electronic Fee Collection (EFC)	
10	278062	Road vehicles - Traffic information and control systems - Ergonomic aspects of in-vehicle visual presentation of information - Part 1: Specifications	prEN ISO 15008-1
10	278099	Road vehicles - Traffic information and control systems - Ergonomic aspects of in-vehicle visual presentation of information - Part 2: Evaluation	prEN ISO 15008-2
10	278063	Road vehicles - Man-machine interfaces - Comprehensible presentation of visual messages	
10	278065	Road vehicles -Transport information and control systems - Man-machine interface - Auditory information presentation - Part 1: Requirements	prEN ISO 15006-1
10	278100	Road vehicles - Man Machine Interfaces - Auditory information presentation - Evaluation procedure	
10	278068	Road vehicles - Ergonomic aspects of in-vehicle presentation of traffic information and control systems - Part 1: Dialogue management principles	N736
10	278101	Road vehicles - Ergonomic aspects of in-vehicle presentation of traffic information and control systems - Part 2: Dialogue management compliance testing	prEN ISO 15005-2
10	278070	Road vehicles - Man Machine Interfaces - Measurement of driver visual behaviour - Definitions and metrics	N738
10	278102	Road vehicles - Man Machine Interfaces - Measurement of driver visual behaviour - Equipment and procedure	
12	278054	Automatic vehicle and equipment identification - Part 1: Reference architectures and terminology	ENV 12314-1:1996
12	278056	Automatic vehicle and equipment identification - System specification	ENV 14815:1999
12	278057	Automatic vehicle and equipment identification - Numbering and data structures	ENV 14816:1999
12	278126	Automatic Vehicle and Equipment Identification (AVI/AEI) - AVI/AEI Interfaces	
12	278090	Automatic vehicle and equipment identification - Intermodal goods transport - Architecture and terminology	
12	278089	Automatic vehicle and equipment identification - Intermodal goods transport - System parameters	
12	278088	Automatic vehicle and equipment identification - Intermodal goods transport - Numbering and data structures	
13	278002	Transport Information and Control Systems - Reference Model Architecture(s) for the TICS Sector - Part 1: TICS Fundamental Services	prENV ISO 14813-1

WG	Work item	Title	Document
13	278107	Transport Information and Control Systems - Reference Model Architecture(s) for the TICS Sector - Part 2: Core TICS reference architecture	prENV ISO 14813-2
13	278108	Transport Information and Control Systems - Reference Model Architecture(s) for the TICS Sector - Part 3: Example Elaboration	prENV ISO 14813-3
13	278109	Transport Information and Control Systems - Reference Model Architecture(s) for the TICS Sector - Part 4: Reference model tutorial	prENV ISO 14813-4
13	278110	Transport Information and Control Systems - Reference Model Architecture(s) for the TICS Sector - Part 5: Requirements for Architecture Description in TICS standards	prENV ISO 14813-5
13	278111	Transport Information and Control Systems - Reference Model Architecture(s) for the TICS Sector - Part 6: Data presentation in ASN.1	prENV ISO 14813-6
13	278001	Glossary of Standard Terminologies for the Transport Information and Control Sector	ENV ISO 14812:1999
14	278095	After-theft systems for the recovery of stolen vehicles - Common status message set	
14	278096	After-theft systems for the recovery of stolen vehicles - Interface and system requirements in terms of short range communication system	
14	278097	After-theft systems for the recovery of stolen vehicles - Interface and system requirements in terms of long range communication system	

A key area of road ITS with respect to standardisation is that of vehicle to roadside communications. These are relevant to a wide range of services, including EFC, emergency systems, public transport priority systems, etc. The types of media available for this, the transmission modes involved, the technical specifications and standardisation in terms of protocols adopted are set out in Table 6.

Table 6: Main features of vehicle to roadside communications standards

Media	Data rate	Frequency band	Transmission Mode	Protocol
Analogue FM radio	Analogue stereo channel	87.5 à 108 MHz	Broadcast	
RDS – TMC (Radio Data System - Traffic Message Channel)	Raw: 1187.5 bps Efficient: 300 bps	Sub-carrier at 57 kHz combined with FM analogue carrier	Broadcast Traffic information.	ALERT-C for events ALERT + for status
DARC (Data Radio Channel)	Raw: 16 kbps Efficient: 6.8 kbps	Sub-carrier at 76 kHz combined with FM analogue carrier	Broadcast	ALERT C & ALERT +
RF 433 MHz	2 - 10 kbps	433.055 to 434.785 MHz 69 channels by step of 25 kHz	Point to point or multicast. Subject to interference from other users.	Non standardised
DVB-T (Digital Video Broadcast - Terrestrial)	5-31 Mbps	240 to 870 MHz	Broadcast – on-going experiments.	

Media	Data rate	Frequency band	Transmission Mode	Protocol
DAB (Digital Audio Broadcast)	Raw: 2.3 Mbps Efficient: 0.6-1.7 Mbps	L-Band 1.5 GHz	Digital broadcast Currently, deployment limited to several major cities.	TPEG (Transport Protocol Expert Group) and MOT (Multimedia Object Transfer)
DECT (Digital European Cordless Telephone)	Domestic cordless telephone		Not suited to high speed mobile communications.	
GSM data **DCS 1800** **GSM-SMS (Short Message Service)**	9.6 kbps 100 bit/s (length of 140 bytes)	900 MHz 1800 MHz	Point to point – agreement between operators for roaming services GSM Phase 2+: group calls, pre-emption, etc	WAP ACP - GATS - ViaSat
GPRS (Global Packet Radio Service) **EDGE**	14.4 - 170 kbps 384 kbps	900 MHz, 1800 MHz (EU bandwidth) or 1900MHz (North America)	Point to point	WAP + IP (full internet)
UMTS or IMP-2000 **(Universal Mobile Telecommunication System)**	144 kbps in rural areas V<500km/h 384 kbps in suburban areas V<120km/h 2 Mbps in urban areas V<10 km/h	2 GHz (1.92-2.025)	Point to point + multicast Roaming between European and global operators	IP (full internet)
DSRC (Dedicated Short Range Communication)	512 kbps beacon to vehicle. 256 kbps vehicle to beacon.	5.8 GHz	Point to multipoint Electronic tolling, multi-applications	DSRC + ISO 14906
TETRA	SMS at 9.6kbps Packet switching mode up to 28.8kbps	380-400 MHz	Point to point + multicast	New ETSI standard
Bluetooth	Global 700 kbps if range < 4m, 75 kbps up to <10m Lanes: 64 kbps in synchronous mode and up to	2.4 GHz	Local dynamic network for office computing and in-vehicle networking.	Special Interest Group of industrial and telecom companies (1883 members to date)

Media	Data rate	Frequency band	Transmission Mode	Protocol
	721 kbps in asynchronous mode			

Concerning standardisation in the field of GIS, it appears that TC 287 is currently quite dormant. Most of the work has been transferred to ISO level (TC 211)

3.2 Ongoing European projects relating to standardisation

Section 2.3.3 outlined the principal standardisation activities for a range of applications (RDS-TMC, EFC, WAP, etc). In some of these areas, standardisation is taking place by means of an industry forum, but in others specific European Commission supported projects are contributing to the standardisation effort.

The EC projects which include standardisation activities, or which influence standardisation in ITS for road, include the following:

- **ASSISTEN-T Cross-Fertilisation** (DG-TREN 1999-2001) - this project includes cross-fertilisation activities in traffic monitoring, traveller information, DATEX and EFC. The latter two are particularly relevant in terms of standardisation and interoperability issues, e.g. through a DATEX MoU.
- **CARDME 1 to 4** (DG-INFSO, 1997-2001) - projects supporting the Concerted Action for Research on Demand Management in Europe) concerned with the identification and removal of obstacles to cross-border interoperability of electronic tolling systems for road transport in Europe.
- **CESARE 1 and 2** (DG-TREN, 1998-2001) - Projects developed by ASECAP (association of European till motorway operators) members, aiming at an operational and technical definition of a common “tele-tolling” (EFC) system, able to co-exist with systems already in operation and compliant with CEN standards. CESARE 2 includes non ASECAP members and is focusing on the MoU for EFC.
- **DELTA** (DG-INFSO, 2000-2002) - DSRC Electronics implementation for Transportation and Automotive applications. This project will establish a common interface between CEN compliant DSRC units and in-vehicle electronics, allowing the integration of the DSRC communication link as standard equipment in the vehicle. DELTA will fully comply with current DSRC ENVs as well as with future ENs.
- **DIAMOND** (DG-INFSO, 2000-2002) - concerns the delivery of ITS systems through multimedia over networks using DAB, either as stand-alone or combined with GSM and/or positioning..
- **ITSWAP** (DG-INFSO, 2000-2002) - Intelligent Transport Services over Wireless Application Protocol - this project will establish the technical and commercial feasibility of ITS over WAP. It will formulate recommendations to relevant bodies such as the GATS Forum and the WAP Forum.
- **LOCUS** (DG-INFSO, 2000-2001) - Location of Cellular Users for Emergency Services: a project involving an overview of existing services, user and institutional requirements,

market analysis, service options (one/two-way, voice/data, etc), implementation issues and dissemination activities.

- **MCP** (DG-INFSO, 2000-2002) - Multimedia Car Platform: a project aimed at providing transparent access to multimedia services on the basis of GSM/GPRS, DAB, DVB-T and UTMS, taking into account the specific needs of the automotive environment..
- **NEXTMAP** (DG-INFSO, 2000-2002) - a research project to define, prototype and evaluate the content of digital map databases required for Advanced Driver Assistance Services (ADAS). The project will develop and propose an extension to the Geographic Data Files (GDF) standard, providing input to ISO standardisation work.
- **SMARTCITIES** (DG-INFSO, 2000-2002) - Multi-application Smart cards in Cities. This project will design a smart card and multi-application management architecture to allow the technical and commercial exploitation of smart cards without the need for cities to tie themselves to a single proprietary application. The resultant architecture will be forwarded to standardisation bodies.
- The **TEN-T Euro-Regional Projects** (DG-TREN) - these five projects - ARTS (started 1997), CENTRICO (started 1995) and CORVETTE, SERTI and VIKING (all started 1996) are concerned with the co-ordinated implementation of telematics applications on the Trans-European Road Network in five cross-border “Euro-regions”.
- **TPEG** (DG-INFSO, project to be confirmed) - achieving technical consensus and supporting standardisation of TPEG applications, targeted at rapid implementation of enhanced multi-modal information services and navigation systems for European travellers.
- **TRIDENT** (DG-INFSO, 2000-2002) - Transport Intermodality Data Sharing and Exchange Networks - project aimed at enabling data exchange for multimodal transport and the investigation of the use of new technologies. It will lead to common mechanisms and new standards for the sharing of information between transport operators. Throughout the project, interim results will be made available to CEN to seek feedback from standardisation bodies as well as from the operators concerned.

Furthermore, the DERD (Deputy European Road Directors) has subgroups on standardisation, telematics and a VMS platform, which are likely to produce user requirements for standards.

4 Analysis of Framework Architecture versus Standards

In this section, the “example Systems” in the European ITS Physical Architecture document (D3.2) are scrutinised in order to identify for each area what standards are already established or in which areas standardisation work is progressing. Areas where no standardisation work is undertaken are thus highlighted and a short analysis is presented detailing whether this absence is crucial for the deployment of ITS in Europe.

Deliverable 3.2 in particular underlined the Physical Architecture link to the “outside world”, i.e. actors and systems outside the scope of the KAREN project. These links have to be examined in detail due to the crucial importance of standards relating to the interface between ITS and the non ITS world, and the particular difficulty of developing them if they appear necessary.

4.1 Traffic management systems

The European ITS Physical Architecture document describes traffic management systems in terms of two “example Systems”: urban traffic management and interurban traffic management systems. The key functions of these systems are management of traffic using urban/interurban road networks, including:

- maintenance of the physical road network;
- maintenance of the traffic management equipment;
- lane management (primarily an urban consideration);
- vehicle speed control;
- links to multimodal systems;
- co-ordination of traffic management across organisational boundaries (primarily an interurban consideration).

Although vehicle speed control is a traffic management function, it has yet to be implemented on a wide scale in European traffic management systems. So far, it has been implemented on the part of M25 London Orbital motorway, where variable speed limits (VMS and speed control cameras) have increased road capacity.

The context of traffic management systems in terms of its external links (terminators) and links with other systems is summarised in Table 7.

Table 7: Traffic management systems: context

Terminator	**Interface**	
	From terminator to traffic management system	From traffic management system to terminator
Traveller *(only pedestrians and cyclists considered)*	✔	✔
Driver		✔
Weather system	✔	
Law enforcement agency	✔	✔
Multi-modal system *(multi-modal crossing and multi-modal management system only)*	✔	✔
Related road systems *(exchange of data between traffic management systems)*	✔	✔
Operator (*road network operators only)*	✔	✔
Bridge/tunnel infrastructure *(not considered in the urban TM example system)*	✔	
Vehicle *(not considered in the interurban TM example system and only considered for Public Transport and Emergency vehicles for the urban example)*	✔	
Transport planner	✔	✔
Maintenance organisation	✔	✔
Road pavement	✔	
External service provider		✔
Traffic	✔	

In the following sub-sections, we will review the following application areas:

- urban traffic management systems;
- interurban traffic management systems;
- integrated traffic management systems, including integration with Public Transport management systems;
- traffic information systems.

4.1.1 Urban traffic management system

The urban traffic management system comprises three sub-systems. These are

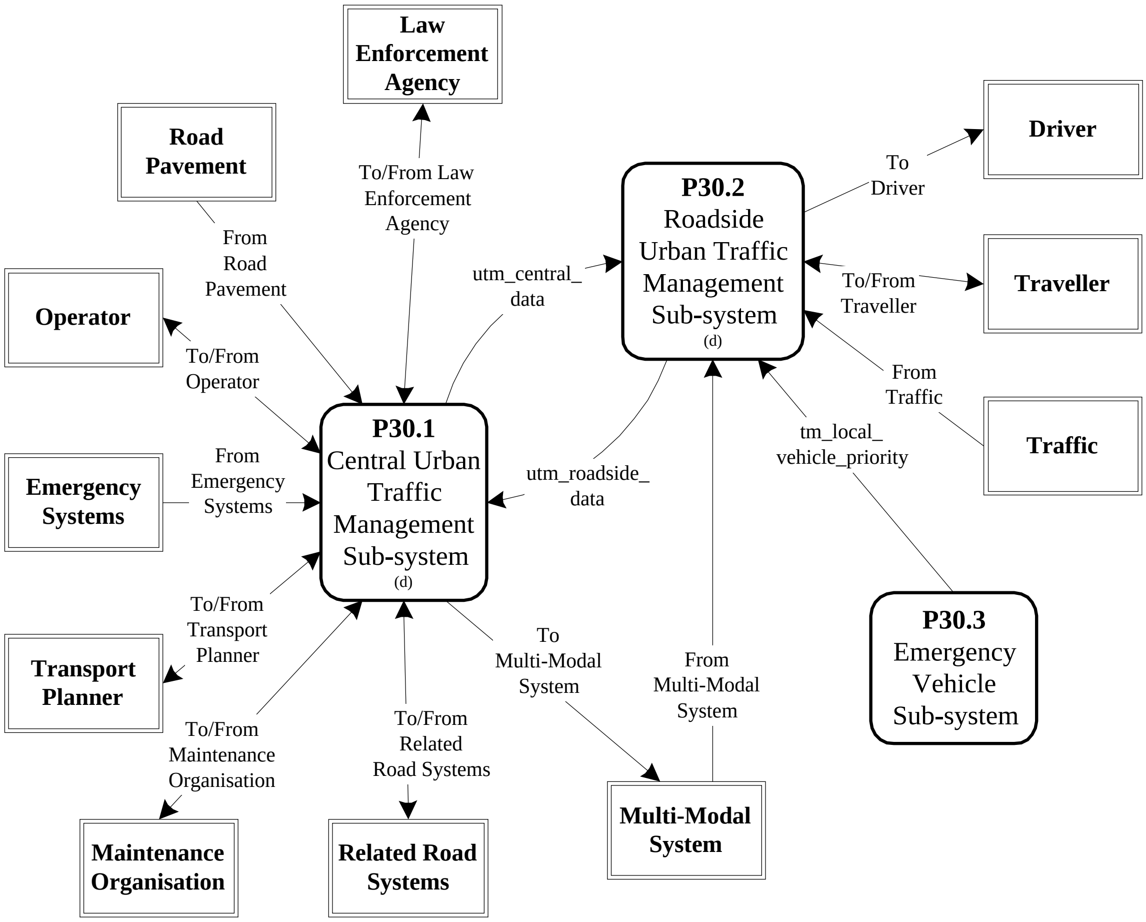
P30.1 *Central Urban Traffic Management Sub-system*;

P30.2 *Roadside Urban Traffic Management Sub-system*;

P30.3 *Emergency Vehicle Sub-system*.

These interact as shown in Figure 1.

Figure 1: Urban traffic management system - sub-systems context diagram



The aim of the an urban traffic management system is to improve the efficiency of the road network in two ways:

- improve general efficiency – reducing delays can be done by traffic monitoring and optimisation of traffic signals – the latter can involve localised optimisation, with adjacent traffic signals communicating with each other, or by central co-ordination, which requires a lower level of functionality of the individual traffic signals;
- improve safety, e.g. through speed control, traffic signal enforcement and reduction in conflicts between opposing vehicle flows and between vehicles and cyclists/pedestrians;

- improvements for certain vehicles (e.g. Emergency Services and Public Transport), e.g. by priority at traffic signals – this can be by means of in-vehicle equipment which sends a priority request to the traffic signal, or by a request to a central traffic management system.

The Central Urban TM Sub-system consists of three modules, as follows:

- *Central Urban Traffic Management Module* – includes storage of data collected at the roadside and the creation and output of traffic management strategies to be disseminated to users at the roadside.
- *Central Urban Traffic Maintenance Module* – road network monitoring function (including weather conditions, faults in equipment).
- *Central Urban Offenders Prosecution Module* – receives data from the roadside sub-system about violations of traffic rules and passes the data on to the law enforcement agency.

The Roadside Urban TM Sub-system consists of three modules, as follows:

- *Roadside Urban Traffic Data Collection Module* – involves roadside data collection and possibly car park use data collection.
- *Roadside Urban Traffic Management Actuation Module* – enables instructions (provided by the Central Urban TM Sub-system) to be provided to users of the road network, including pedestrians.
- *Roadside Urban Law Enforcement Module* – monitors the activities of road vehicles to detect violations of laws.

In addition, the Emergency Vehicle Sub-system is responsible for generating local requests for priority from emergency vehicles, which are then used to give priority to these vehicles as they approach the control module in the Roadside Urban TM Sub-system. This sub-system is only for use when a priority route cannot be (or has not been) selected by the Emergency System. Although not included in this “example System”, a similar Sub-system could be created for public transport vehicles to request local priority.

Issues

One issue concerning urban traffic management systems is related to the exchanges required between neighbouring systems, where different authorities are responsible for neighbouring networks. While this may be an issue within the same urban or peri-urban area, it is certainly a bigger one when considering the interface between urban and interurban systems. Another issue concerns the exchange of information between urban traffic management systems and traffic information systems.

Location referencing is an issue in the development of traffic management systems in urban areas. Current standards deal with interurban location referencing (e.g. in DATEX), which are not sufficiently detailed for use in an urban environment, for example, they do not take account of travel time, traffic flow and density for each link, turning movements, traffic signal timings, or public transport needs.

Concerning emergency vehicle management, roadside systems should be able to respond directly to a request without having to receive additional (e.g. verification) data from a central control unit. Thus there is a need for a rigorous authentication system to ensure that unauthorised vehicles do not obtain priority.

Central to roadside communications are a key issue in urban areas. For example there is a need for vehicles requesting priority (e.g. Emergency Services and Public Transport) to have a certain level of standardisation in terms of their communication systems, to ensure interoperability with the roadside systems. In order that priority is not given to vehicles that do not require it, there should be no possibility for a vehicle sending a request for priority to turn before the junction for which priority is requested. This implies the use of a close range radio system. There is no dedicated standard system for such a radio system, although a frequency range has been reserved for DSRC, which is the subject of standardisation activities in the field of EFC.

Standardisation of message content could be difficult as much of Europe uses distributed processing systems. Therefore a possible solution is standardisation of the message protocol to allow communications infrastructure to be shared with other services, e.g. video and other forms of digital communications.

Standardisation work carried out

CEN 278 Working Group 5 is concerned with Traffic Control Systems. This WG is currently dormant but two actions in the urban field of urban traffic management are relevant.

Firstly, the UDC (Urban Drive Control) Project, in the frame of the EUCAR masterplan, and particularly the action “New technology for control systems and traffic management”, was initiated. This aimed to meet the joint demand from authorities and drivers by combining traffic management and information systems (green wave) and adaptive cruise control (ACC) sets, integrating in the same vehicle ACC monitoring and recommended speeds, computed by traffic management centres and broadcast through 5.8 GHz beacons. This could lead to a new WI interfacing ACC and traffic control information.

Secondly, the UTMC (Urban Traffic Management and Control) research programme was piloted by the UK DETR (Department of the Environment, Transport and the Regions). This was a response to the need for more powerful and more integrated traffic management tools and aiming to support the R&D and implementation of open standards, modular urban traffic management and control systems. Among its results are issues on selected vehicle priorities and improved data exchange among all parties involved in traffic management, from local authorities to service providers. Besides, UTMC is involved in an evaluation of NTCIP and Internet protocols. This could lead to:

- a new WI dealing with priority for some vehicles (Public Transport, Emergency Vehicles, etc) in connection with WG3 for Public Transport; and
- another WI dealing on the exchanges between Traffic Control Centres and operators such as Public Transport network operators or service providers.

Automatic Vehicle Identification (AVI) and Automatic Equipment Identification (AEI) are two areas in which CEN/TC278 Working Group 12 and ISO/TC204 Working Group 4 have a common programme. These applications are relevant for the detection of vehicles requiring priority at junctions.

WG12 (Automatic vehicle and equipment identification) spans several applications and several interfaces to define a technique, and addresses architecture, system specification, numbering, data structure and interfaces. It concentrates on the basic data which have to be at each level of the automatic identification chain but does not deal with the internal functionality of the equipment.

The work items and standards relating to AVI/AEI are covered in Chapter 4.4: Vehicle systems.

In addition, CEN/TC278/WG8 deals with road traffic data elaboration, storage and distribution, which is relevant to all types of traffic management system. Standards are currently under development in this area, with relevant Work Items (WIs) within WG8 being as follows:

- WI 278073: Exchange procedures (low level)
- WI 278074: Exchange formats (low level)
- WI 278085: Exchange protocol
- WI 278075: Physical interfaces

The TRIDENT project is concerned with data sharing on a multimodal level, in particular by means of object oriented exchange (Java/Corba) and database access techniques. Solutions emanating from this project may be more suited to urban traffic management applications than DATEX, which requires more maintenance and the use of complex dictionaries.

Recommendations

One priority is to extend the traffic data dictionary, which currently only concerns interurban situations, to cover urban road networks as well. This extension should pay particular attention to the needs in urban areas and also the urban/interurban interface, to allow the exchange of basic data between different systems. ISO204 WG1 has produced a “Glossary of Terms” which should be used as a starting point.

There is a need for addressing location referencing in urban areas for meeting the requirements of data exchange between UTC and other TCCs, Public Transport management (vehicle tracking), and data exchange between vehicles and UTC (link between ACC and traffic light control, etc).

Standardisation is needed in the area of central to roadside communications, e.g. vehicles requesting priority need to have a certain level of standardisation in terms of their communication systems, to ensure interoperability with the roadside systems. The requirement implies the use of a close range radio system possibly DSRC, which is the subject of standardisation activities in the field of EFC.

4.1.2 Inter-urban traffic management system

The interurban traffic management system comprises three sub-systems. These are

P31.1 *Centralised Interurban Traffic Management Sub-system*;

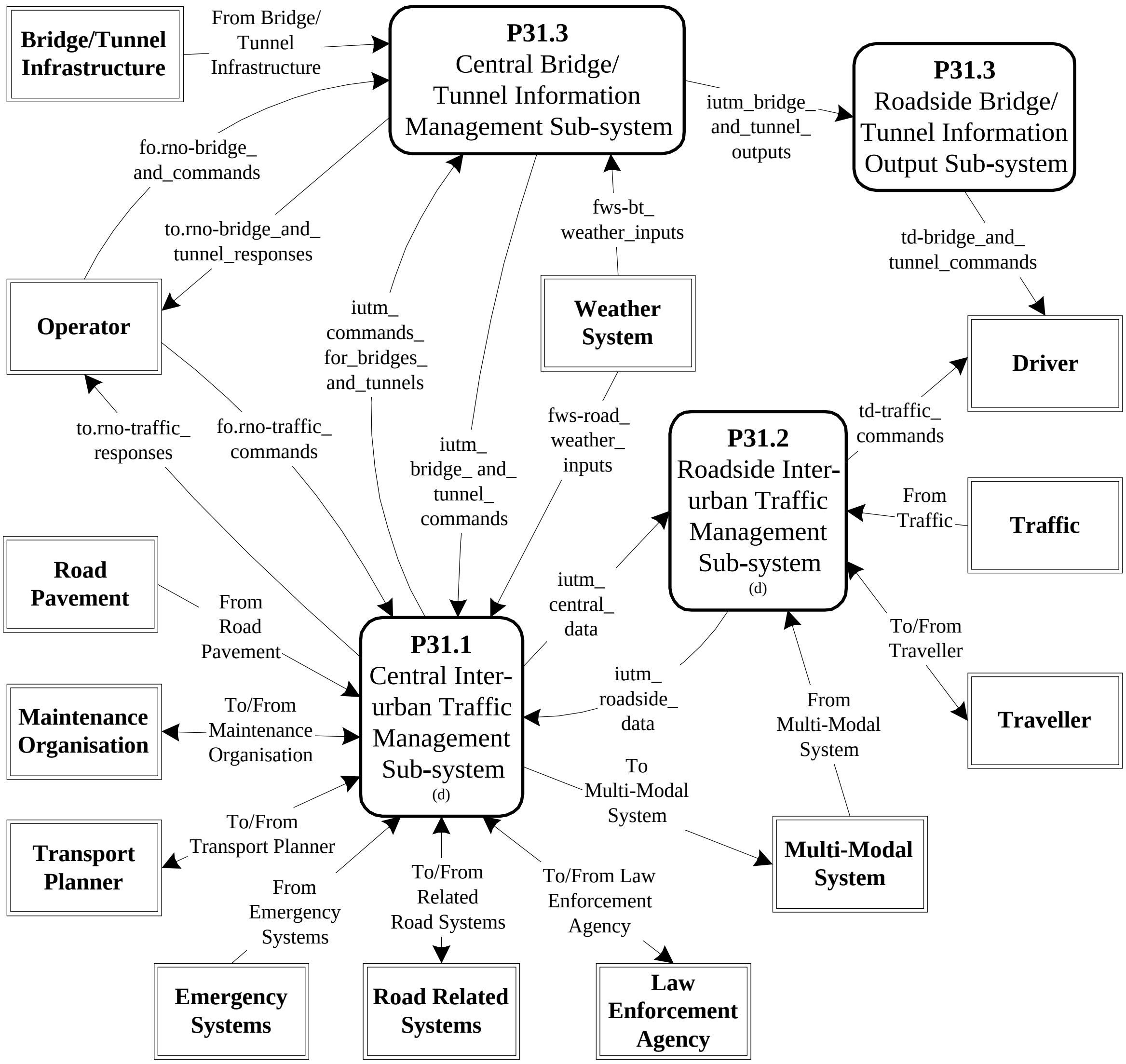
P31.2 *Roadside Interurban Traffic Management Sub-system*;

P31.3 *Central Bridge/Tunnel Information Management Sub-system*;

P31.4 *Roadside Bridge/Tunnel Information Output Sub-system.*

These sub-systems are linked as shown in Figure 2.

Figure 2: Inter-urban traffic management system - sub-systems context diagram



The aim of an inter-urban traffic management system is to improve the efficiency of the road network, including:

- provision of road condition information and instructions to drivers;
- provision of specific information relating to local conditions for any bridges or tunnels on the network.

This involves the use of traffic congestion prediction and incident identification. Driver information is usually given in the form of advance warnings of incidents and congestion, possibly also giving advice on likely delay times and alternative routes. Advice may be targeted at specific vehicle types, e.g. by recommending different alternative routes for cars and HGVs.

Information relating to bridges concerns weather conditions which could affect various types of traffic, e.g. high winds which could lead to the bridge being closed to high-sided HGVs. Other information may relate to temporary weight limits or closures (e.g. due to engineering work) or the opening of swing or lifting bridges to allow vessels to pass.

Information relating to tunnels concerns traffic conditions within the tunnel, e.g. incidents, restrictions on lanes or on certain types of vehicles, poor atmospheric conditions in the tunnel, etc.

Consideration can also be given to Public Transport priority (covered in Chapter 4.3 Integrated TM systems) and priority for emergency vehicles. However this is more difficult on interurban routes as traffic signals are less common and bus traffic is not normally sufficient on such routes to justify dedicated lanes. However, where lane control signals exist, these can be used to clear a lane for specific use, such as by Emergency Services.

The Central Interurban TM Sub-system consists of three modules – one for traffic management, one for traffic maintenance and a third for offender prosecution. These correspond to the three modules within the Central Urban TM Sub-system. Similarly, the Roadside Urban TM Sub-system consists of three modules, the Roadside Interurban Traffic Data Collection Module, the Roadside Interurban Traffic Management Actuation Module and the Roadside Interurban Law Enforcement Module.

Issues

Key issues to address in the field of interurban traffic management are data exchange, traffic monitoring, the development of traffic management plans and the provision of information and instructions to users.

This means that links both with urban traffic management systems and with other inter-urban traffic management systems in neighbouring areas are required, otherwise the system would act in isolation. In terms of traffic data exchange, agreements between parties (e.g. neighbouring road authorities, police, etc) are necessary regarding the type of data to be exchanged, its quality, the means of exchange and its proposed use. DATEX is a useful tool in this respect, particularly for cross-border data exchange, as the protocol provides a language-independent media. Similarly, these bodies need to agree on measures such as traffic management plans, covering traffic re-routing in response to incidents, congestion or weather conditions.

Traffic management involves the provision of instructions and advice to drivers and other transport users, by means of signage (permanent or temporary fixed signs or VMSs) or by in-vehicle systems (radio, RDS-TMC, GSM, visual display, etc). Given that in-vehicle systems also provide route guidance, standards related to these media are covered in Section 4.5 “Traveller assistance and route guidance systems”.

Standardisation work carried out

The standardisation work carried out with regard to Automatic Vehicle Location (mentioned in 4.1.1 above and described more fully in Chapter 4.5 Vehicle systems) is also relevant to interurban traffic management. The same is true for road traffic data issues, considered in CEN/TC278/WG8 (see again Section 4.1.1).

Other work in traffic management issues has taken place through consensus groups rather than by a formal standardisation procedure.

One such group has been the Euro-Regional TEN-T Expert Group on Traffic Management Plans, co-ordinated by the ASSISTEN-T project. Traffic management plans have been adopted in several countries to cope with incidents, heavy holiday traffic, HGVs and winter conditions, with an increasing number of cross-border plans being implemented by the five Euro-Regional projects (EC DG-TREN). The Expert Group brought together key actors in this field and reached some consensus on the elaboration of these plans, the need for evaluation and modelling, and on the adoption of a common re-routing sign. A recent sixth Euro-Regional project, INSTANT (not involved in this group as the project only started in 2000) may also feature cross-border traffic management measures between Northern Ireland and the Irish Republic.

This cross-fertilisation action identified differences in approach to the development of traffic management plans between European regions. However, it was not considered necessary to impose a standard approach as each region and country has different road and traffic characteristics and also a different “culture” insofar as traffic management approaches are concerned. What was important was to be aware of other approaches and also to ensure that plans were evaluated rigorously to test their effectiveness, and altered where necessary.

Further work concerning the use of variable message signs (VMSs) in traffic management to give information or instructions to motorists was carried out by the TROPIC project (EC DG-TREN, 1996-99). This project looked at a wide range of issues relating to best practice and recommendations for harmonisation, including the needs of authorities and operators, legal and institutional issues, development of pictograms and text strategies and their comprehension by users, cross-boundary VMS issues and system architecture.

In addition, the action FIVE (Framework for harmonised Implementation of VMS in Europe) by the West European and Deputy European Road Directors (WERD/DERD) in 1997 produced basic rules for presentation methods on VMSs for use on the Trans-European Road Network (TERN) and on other motorways/principal roads. FIVE does not impose a single standard for VMS design and presentation, but indicates a direction in which to migrate, taking into account existing facilities and differences in traffic management approaches/culture between countries.

The availability of accurate and up to date data is essential for effective interurban traffic management and the development of electronic data exchange between traffic centres using DATEX-Net specifications is a key tool in this respect. There is a strong DATEX community in Europe, comprising an MoU Management Committee which is responsible for technical and operational development of the common specification (now adopted by CEN), under the auspices of the DATEX MoU Steering Committee, which represents many national interests. In addition, a DATEX User Forum is being established in order to involve the user in the DATEX community through an appropriately focused group. This implies the need to review the users' real motivations, priorities and plans. In this way, the take-up of DATEX will be enhanced, the development of a user community would be encouraged and co-operative strategies would be promoted.

Recommendations

Besides the technical standardisation regarding DATEX (covered by the MoU), there is also a need for organisational standardisation, concerning who should send data to whom (TCCs, police, local authorities, motorway operators, etc), what sort of data, by what means and on what terms (further dissemination/use of data, cost, etc). This does not imply the adoption of rigid standards, but does involve relevant organisations agreeing to such terms. This is commonly achieved by means of a formal bilateral data interchange agreement. Consensus activities could work to produce a "model" interchange agreement for use by all affected bodies, which would streamline and simplify the procedure, and could be modified to suit local circumstances where necessary.

Regarding traffic management plans and information provision issues (e.g. VMSs), it is inappropriate to impose rigid standards and the optimal solution is to continue with the consensus approach. This should involve cross-fertilisation activities between projects, traffic operators and national/regional road authorities to learn from each others successes and failures and to establish and disseminate best practice(s).

4.1.3 Integrated traffic management systems

There is a European trend towards considering the transportation policy as a whole, through the co-ordination of different systems such as centralised traffic control systems, motorway management systems, incident management systems, automatic traveller information systems and advanced Public Transport management/priority systems.

These are examples of integrated traffic management systems, which aim to make best use of the available traffic and transport management tools and to react to incidents in a co-ordinated manner considering all transport modes.

Three examples of integrated systems were developed under the auspices of the QUARTET+ and EUROSCOPE projects:

- Turin's '5T' system (Telematics Technologies for Transport and Traffic in Torino);
- the installation in Toulouse of various traffic management systems in the same building with the aim of exchanging traffic information between the different bodies involved in traffic management;

- the installations in Southampton and Winchester (ROMANSE) which link various traffic and Public Transport management systems together.

These efforts are more often transportation policy oriented than business oriented and may limit the growth of market share by private investors. This philosophy of public initiative in Europe led at an early stage to the conception and implementation of integrated traffic management systems and public authority operated services such as traffic information centres. This is in contrast to the US situation, where there are more private sector initiatives and a lesser role for Public Transport.

This section on integrated traffic management systems covers three “example systems”, as follows:

- TITOS: an integrated open system for traffic and travel information services, to be demonstrated at the ITS World Congress in Turin;
- SPOT/UTOPIA: an urban traffic control and Public Transport priority system;
- 5T: Telematics Technologies for Transport and Traffic in Torino system

Integrated open system for traffic and urban traffic and travel information services (TITOS open environment, Turin)

This system offers comprehensive real-time traffic and travel data at different levels of detail and complexity and provides communication channels to deliver services to users.

The example system described in the European ITS Physical Architecture document (D3.2) is based on the TITOS open environment (Torino ITS 2000 Open Showcase). This will be tested at the 7th ITS World Congress in Turin, providing a ‘real-life’ open platform for ITS, i.e. a ‘plug and play’ concept in which to demonstrate the most recent developments. It favours the European ITS Framework Architecture.

Participants will be able to plug into this architecture to demonstrate their products or services on three different levels:

- by making use of free real time data at city, national and international levels, such as vehicle flows and speeds, travel times, queues, pollution predictions, Public Transport data and car park availability;
- by benefiting from processing engines which can provide processed data on incidents, congestion, etc on specified routes, and itinerary calculation;
- by means of free access to communication channels such as RDS-TMC, GSM, DAB/DMB, Internet and teletext.

The context of the TITOS system is summarised in Table 8. The terminators (or external links) are only potential ones – in an open platform, there may be many additional external players.

Table 8: Integrated urban traffic and Public Transport systems: context

Terminator	Interface	
	From terminator to traffic management system	From traffic management system to terminator
Vehicle	✔	✔
External service provider	✔	✔
Traveller	✔	✔
Weather system	✔	
Multi-modal system *(multi-modal management system only)*	✔	✔
Related road systems	✔	✔
Consignor/Consignee	✔	✔
Operator *(traveller information operators only)*	✔	
Emergency systems	✔	✔
Bridge/Tunnel infrastructure	✔	✔
Ambient environment	✔	

This system comprises six sub-systems, as follows:

P1.1 *Interface platform Sub-system*, comprising:

- a *data exchange module*, enabling traffic data to be shared and exchanged using different European standardised and/or emerging solutions; and
- an *interface module*, providing the required interfaces with the different shared transmission channels.

P1.2 *National and international data provider Sub-system*.

P1.3 *Local data provider Sub-system*, comprising:

- a *basic data module*, providing observed real-time traffic data; and
- an *elaborated data module*, providing traffic information derived from the basic data.

P1.4 *Local service provider Sub-system*.

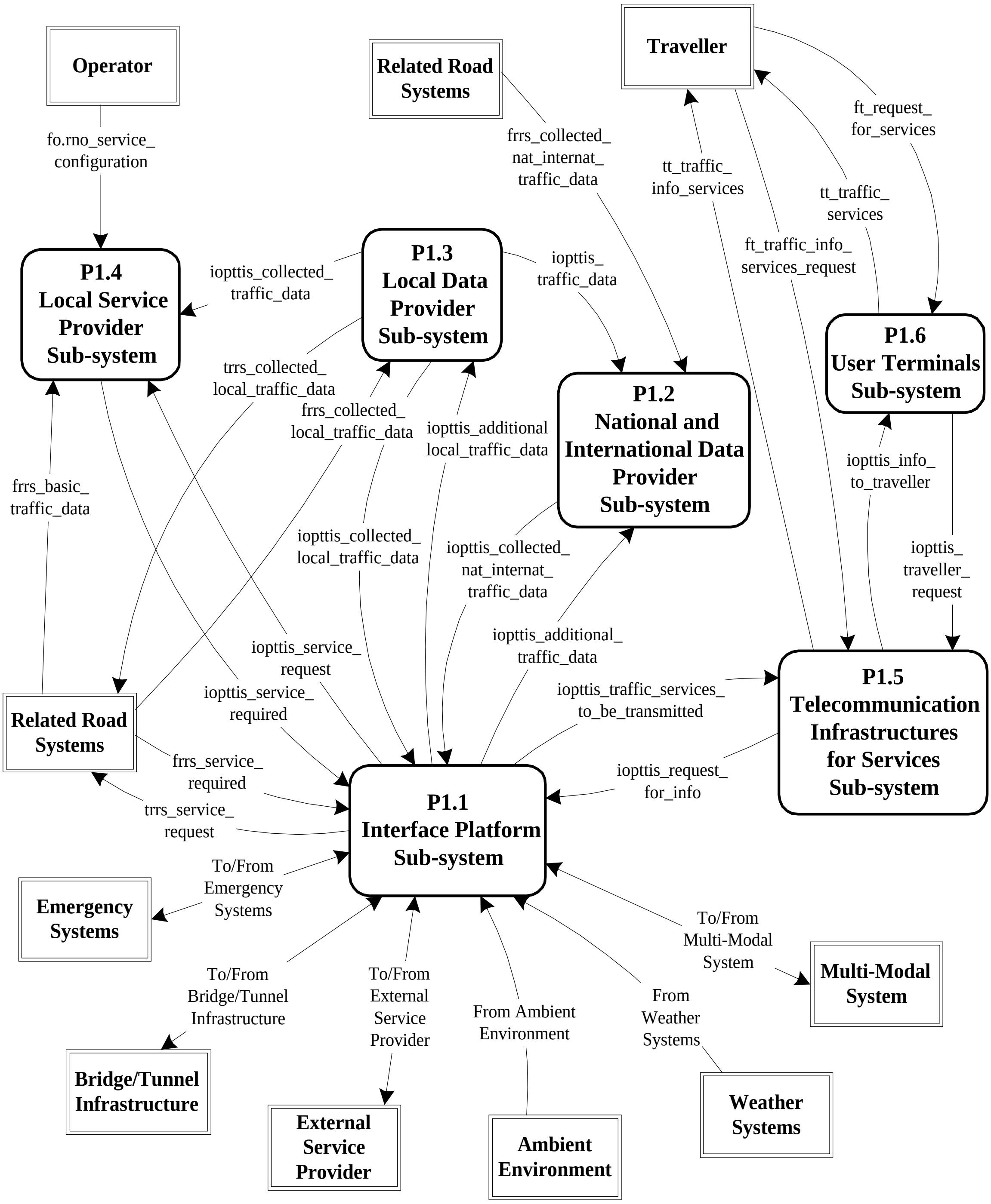
P1.5 *Telecommunications infrastructure for services Sub-system*.

P1.6 *User terminals Sub-system*, comprising:

- a *kiosks terminals module*, which is an interactive module with local browsing facilities to provide information to users at stations, airports, service areas, etc; and
- a *multimedia bus stop display terminals module*, which displays travel information on a large screen.

These sub-systems are related as shown in the following figure.

Figure 3: Integrated open system for traffic and travel information services - sub-systems



Urban traffic control and Public Transport priority system (SPOT/UTOPIA)

The example system described in the European ITS Physical Architecture is based on the SPOT/UTOPIA (Urban Traffic Optimisation by Integrated Automation) system.

It aims to improve urban travel conditions by the application of fully automated hierarchic control principles which dynamically optimise traffic signal stages in urban areas.

Optimisation is based on continuously measured real time data plus historical data and knowledge of special events.

This system's relationships with other systems and its links to the outside world (by "terminators") are shown in the table below:

Table 9: Urban traffic control and Public Transport priority system - context

Terminator	**Interface**	
	From terminator to traffic management system	From traffic management system to terminator
Related road systems	✔	✔
Operator	✔	✔
Driver		✔
Traveller	✔	✔
Traffic	✔	

Like TITOS, this system has an open architecture in order to facilitate its integration with other external systems. It comprises three main sub-systems, as follows:

P3.1 *Central Traffic Control Sub-system*, which provides the centralised functionality for traffic control at an "area" level. It interfaces with the Town Supervisor in order to receive a control strategy from a higher level and also to provide information, e.g. travel times, flows, densities, incidence of congestion, etc, analysed by the P3.1 sub-system.

P3.2 *Multifunctional Outstation Sub-system*, which provides the peripheral functionality for traffic control at the intersection level, including dealing with Public Transport priority requests and displaying information at bus stops, on VMSs, etc.

P3.3 *Roadside Local Infrastructures Sub-system*, which includes sensors, traffic signal controllers, bus stop displays, VMSs, car park panels, beacons, etc.

Telematics Technologies for Transport and Traffic in Torino (5T) System

This is an example of an integrated system developed under the auspices of the QUARTET Plus project. This system aimed to integrate a number of main sub-systems to provide co-ordinated traffic and transport management in the Turin conurbation.

The open, modular Physical Architecture of 5T enables several proprietary systems to coexist and co-operate using their own language, protocols and databases within their individual domains. Translator interfaces convert this information from the exchange facility to the format of the proprietary systems.

The system's links are described in Table 10.

Table 10: 5T system - context

Terminator	**Interface**	
	From terminator to traffic management system	From traffic management system to terminator
Multimodal system	✔	✔
External service provider	✔	✔
Related road systems	✔	✔
Maintenance organisation		✔
Financial clearinghouse	✔	✔
Vehicle	✔	✔
Transport planner		✔
Operator	✔	✔
Traffic	✔	
Traveller		✔
Ambient environment	✔	
Driver	✔	✔

The 13 sub-systems in 5T are as follows:

P4.1 *Town Supervisor Sub-system* – the highest level of the system architecture, which is basically a suite of software modules capable of integrating the actions of the other sub-systems and co-ordinating their operations to achieve common goals, as determined by public policy.

P4.2 *Urban Traffic Control Sub-system*, such as in the SPOT/UTOPIA example above.

P4.3 *Collective Route Guidance Sub-system*, which provides guidance and general information to private vehicle users by means of VMS.

P4.4 *Public Transport Management Sub-system*, which controls and monitors the transport system's capacity as a function of demand and ensuring its regular and timely performance. It is based on a two-way connection between a central operating centre and vehicles on the network and exchanges both data and voice communications are exchanged.

P4.5 *Parking Control Sub-system*, monitoring the use of car parks, calculating occupancy forecasts and, through close integration with the P4.7 Sub-system, provides an advance booking service.

P4.6 *Individual Route Guidance Sub-system*, which is able to implement a multi-routing strategy that is consistent with the traffic control actions taken by the other sub-systems.

P4.7 *Informative Media Control Sub-system*, which is composed of a centre equipped with a set of databases for managing the storage and dissemination of user information and offering specific trip-planning functions via teletext, Internet, user information terminals, etc.

P4.8 *Emergency Vehicle Priority Sub-system*, to improve the management performance of the fleet of ambulances currently in service by permitting vehicles involved in an emergency call to request priority use of the road network. Integration with the P4.2 sub-system should ensure that the emergency vehicle finds a clear path on its route and receives green lights at intersections.

P4.9 *Fare Integration and Debiting Sub-system*, aiming at integrating Public Transport and parking payment facilities.

P4.10 *Environmental Monitoring Sub-system*.

P4.11 *Backbone Network Sub-system,* representing the high level network thanks to which sub-systems P4.1 to P4.10 can exchange information and data. It consists of four LANs (Local Area Networks) connected by high-speed data links (i.e. 2 Mbps). The data, exchanged over the whole network (over the WAN and the LANs), is defined by a data dictionary. This and a single reference description of the urban network ensures dialogue between the sub-systems using the TCP/IP protocol. Consequently, within the System architecture several proprietary systems can thus coexist and co-operate using their own language, database and protocols.

P4.12 *Roadside Network Sub-system*, providing all of the peripheral functionality for the interaction at the intersection level.

P4.13 *Roadside Infrastructure Sub-system*, providing all of the roadside functionality for traffic control, data collection and information dissemination, including sensors, traffic signal controllers, bus-stop displays, VMS panels, car park panels, beacon controllers, etc.

The above sub-systems therefore perform their individual functions independently but also co-operate as part of a hierarchically distributed structure under the co-ordination of the Town Supervisor (P4.1).

Issues

The key issue is to ensure the integration and interoperability of ITS technologies and products, which in integrated traffic management systems translates into implementing and guaranteeing links between Traffic Control systems and Public Transport Management systems. Today, various proprietary solutions are under development or specific solutions are necessary to be developed for answering local requirements.

Though it has been proven that Public Transport priority systems are beneficial for improving transport efficiency, the lack of harmonised solutions impedes rapid deployment. There must also of course be a willingness for road and Public Transport authorities and operators to co-operate and to adopt a common approach.

As mentioned in Section 4.1.1, location referencing is an area which requires development in urban areas as interurban standards do not take account of travel time, traffic flow and density for each link, turning movements, traffic signal timings, etc, nor does it take account of Public Transport needs.

For the TITOS system, interoperability is particularly important given the requirement to ensure a neutral demonstration environment for a wide range of ITS operators. For example, within this system, the data exchange module in sub-system P1.1 (interface platform sub-system) requires that the media used for data exchange is standardised in each case so as to allow data reception from various sources. Examples are DATEX-Net and Internet Protocol.

Standards may be needed in TITOS Sub-System P1.6 (kiosk terminals and multimedia bus stop display terminals) relating to HMI issues (comprehensibility, ease of use, access by people with disabilities, etc).

Roadside systems (described in Chapter 4.1.1) are equally relevant to integrated traffic management systems, where the smooth flow of Public Transport is a key aim. This requires some level of standardisation in the vehicle/roadside communication architecture.

For 5T, relatively few common standards need to be defined as the individual sub-systems can operate largely independently. However, the crucial issue is that of communications architecture, to enable these systems to interact with one another.

Multi-modal on-line modelling is also important, with systems such as “Town Supervisor” providing a link between the various urban traffic management applications. This is related to organisational structures (between authorities/companies with different responsibilities and those with similar functions but covering a neighbouring geographical area) which are an issue for all traffic management systems. They are more complex in an integrated urban environment as there is a wider diversity of actors, e.g. Public Transport authorities and operators.

One issue raised by modelling is the need for a standard way of specifying the strategies developed by all on-line and off-line modelling applications. This would enable them to be more easily connected to both urban and interurban traffic management systems.

Standardisation work carried out

In addition to the work described in Chapter 4.1.1 of this document, standards relating to Public Transport have been developed in the Public Transport working group (CEN/TC278/ WG3). However, most items in this WG are not concerned with integrated traffic management but are focused on interoperability and interchangeability of in-vehicle systems (mainly buses – displays, communications, etc).

Two standards of relevance in this area are:

ENV 12896	1997	Public Transport. Reference data model (TRANSMODEL)
ENV 13149-1	1998	Public Transport. Road vehicle scheduling and control systems. Part 1: WORDFIP definition and application rules for onboard data transmission.

The standardisation work concerning automatic vehicle identification (AVI) described in Section 4.4 “Vehicle systems” is relevant to integrated traffic control, as are the standards relating to DSRC described in Section 4.5 “Traveller assistance/information and route guidance”.

In addition WG3 has the following on-going activities:

- Public transport - Road vehicle scheduling and control systems:
  - Part 1: WORDFIP definition and application rules for onboard data transmission;
  - Part 2: WORDFIP cabling specifications;
  - Part 3: WORDFIP message content;
  - Part 4: CAN definition and application rules for onboard data transmission;
  - Part 5: CAN cabling specifications;
  - Part 6: CAN message content.
- Public transport - Road vehicles:
  - Validators;
  - Visible variable passenger information devices inside the vehicle.
- Public transport - Passenger information systems at stops.

CEN/TC278 Working Group 4 (Traffic and Traveller Information Systems) is active in developing standards for information messages not only via RDS-TMC but also via cellular networks and stationary dissemination systems.

The working group on traffic control (WG5) is dormant, as its last deliverable (Traffic Control messages specification format) in 1995 raised no reaction.

CEN/TC278 Working Group 13 (Architecture and Terminology) has on-going work in the area of transport information and control systems which are relevant to integrated traffic management. This has developed ISO pre-standards relating to reference model architectures for the TICS (transport information and control systems) sector (prENV ISO 14813-1 to prENV ISO 14813-6) plus a glossary of standard terminology for the transport information and control sector (ENV ISO 14812).

The TCPIP protocol covers the exchange of messages between centres (e.g. TTI, UTC, freight and fleet management, emergency and toll).

Recommendations

In the USA, the NTCIP (National Transportation Communications for ITS Protocol) is becoming a solution which could be adopted in Europe. This protocol deals with key links such as between control centres and roadside units. The UK piloted UTMC project (see Chapter 4.1.1) is involved in an evaluation of this protocol.

However, many implementations are using the TCP IP protocol (a de facto standard) and a proprietary data dictionary. Using this solution therefore implies a need for further work on the data dictionary, message format, and most importantly, location referencing.

Mandate 270 has identified some priorities for standardisation in CEN/TC278/WG3, of which those relevant to integrated urban traffic and Public Transport management are:

- data exchange between vehicles and control centres or service providers, by means of DAB, TETRA and GSM;
- data exchange between authorities and Public Transport control centres;

- video surveillance and real time transmission of images – a safety matter, in order to protect both drivers and travellers, to allow for immediate assistance and to identify attackers;
- Public Transport priority at junctions – standardisation of exchanges between traffic servers and vehicles based on the concept of “smart” intersections, a topic which could lead to co-ordination with WG5 (Traffic Control) and WG9 (DSRC);
- demand responsive systems and car-pooling (information, reservation and payment).

In addition, due to increasing of environmental concerns in cities, links need to be established with external systems in charge of monitoring ambient conditions. These links should consider the exchange of data in both directions, e.g. data on current and projected emissions are necessary for devising traffic management strategies aiming at alleviating the problem. Data on current and forecasted traffic are in the same way useful for predicting the level of pollution.

These types of data exchange have traditionally been considered as internal to the traffic management system. The European ITS Framework Architecture developed by the KAREN project has clearly identified different functions in different areas, taking into account that the responsibility for traffic and environment can rest within different authorities.

Standardisation of data between UTC and the “ambient conditions” terminator (external link) are to be proposed.

WG5 should be reactivated with a focus on data exchange between UTC and Public Transport management systems.

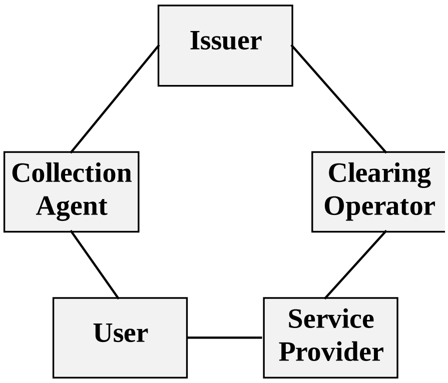
4.2 Electronic fee collection systems

Electronic Fee Collection covers the processes of collecting money electronically for using specific services linked to transport, where these can be the use of the infrastructure itself or other services. In order to maintain the structure identified in the European ITS Physical Architecture document (D3.2), we follow the two example systems: Electronic Cash Transaction System and Automatic Road Tolling System. However, we will cover both cases under the same conceptual model for electronic payment.

In order to identify the standardisation aspects within those two fields, we will take the context diagrams as they appear in D3.2 and will map interfaces with protocols. The process will result firstly in an overview of the issues related to this area and of the standards according to interfaces, and secondly it will identify further work that may be done.

Figure 4 represents the conceptual model for electronic payment. The five entities shown in the figure can be combined in a variety of ways in order to reflect the contractual and technical arrangements between the organisations involved in a given payment system.

Figure 4: Conceptual model for electronic payment



Issues

Interoperability

For seamless travel throughout the EU:

- The On Board Unit Sub-System (P11.2) will have to function in the same way at all locations. It is therefore essential to define a set of minimum functionality for OBUs to support a common transaction.

Concerning other issues involving operational and contractual aspects, there is a need to work towards an MoU between the actors involved in the fee collection process by electronic means, as:

- there may be many Contract Management sub-systems;
- there may be many Toll Management sub-systems; and
- it will probably be necessary to have many co-operating Toll Clearing sub-systems.

Whilst the test procedures of RSE (roadside equipment) and OBE (on-board equipment) with regard to the conformance to EFC related standard, are defined in pr ENV ISO 14907-1, the parameter values to test against are not provided. Hence the standard is not sufficient to rely on for type approvals or (field or laboratory) acceptance test. Currently, WG1 is drafting a proposal.

- Definition of a Common Application which would be implemented, e.g. CARDME Transaction.

Security

ENV ISO 14906 provides security specific functionality to enable the implementation of secure EFC transactions. Yet the specification of the security policy (including specific security algorithms and key management) remains at the discretion and under the control of the payment system operator. The working group is working on a draft under development.

Two new WIs are undertaken in relation with PT11 (CEN/TC 278/N893: Programme for electronic toll systems - Assessment of future standardisation requirements), both of them related to enforcement:

- Classification of Vehicles - finalisation of the vehicle characteristics which can be used;
- Video Enforcement - to set up relevant authentication and security features to allow video images to be accepted as proof.

If we consider a Vehicle Positioning System (VPS) style of tolling to be used, several aspects need to be taken on board:

- all vehicles will have to be fitted with an appropriate on-board unit;
- there must be a mechanism for updating the charging algorithms within each on board unit;
- enforcement for VPS is still under investigation, and has not been developed in this system - the technique that is finally chosen will have to operate in a consistent manner throughout the EU;
- a document similar to 14906 is to be developed for VPS based tolling

GNSS/CN for tolling purposes

The aim of this action is to ensure that the feasibility of these new techniques is demonstrated under related RTD projects. This is done through the co-ordination between CEN and ISO improved on this WI (1.5.2: EFC Application Interface Definition for CN/GNSS based EFC) by transferring it to ISO (PWI 5.3).

Miscellaneous

- The correct functioning of ETC equipment installed behind metallic windscreens raises some difficulties and short term and long term solutions (full integration in the dashboard) in connection with WG9 are required. A new work item (WI) has been implemented in CEN/TC279/WG9 to deal with this issue.
- Regarding the OBU-ICC (On-Board Unit-Integrated Circuit Card) needs, procedures for identification and selection of an (EFC) application residing on the ICC are required, in order to allow for a generic autonomous selection by the OBU (autonomously performed without road side equipment interaction). It is equally desirable to define a procedure for loading of ICC/purse instructions from the ICC to the OBU, providing the OBU with the necessary resources to support an ICC/purse not known by the OBU at the time of factory delivery.

Standardisation work carried out

The following list provides the standards in use and in preparation regarding the interfaces of the model above:

User - Service Provider

ENV 12253	1998	Dedicated Short-Range Communication (DSRC) - Physical layer using microwave at 5.8 GHz
ENV ISO 14814	1999	Automatic vehicle and equipment identification - Part 1: Reference architectures and terminology

ENV 12795	1998	Dedicated Short-Range Communication (DSRC) - DSRC Data link layer: Medium access and Logical Link Control
ENV 12834	1998	Dedicated Short Range Communication - Application Layer
ENV ISO 14906	1998	Road Transport and Traffic Telematics - Electronic Fee Collection - Application interface for dedicated short range communication
EN 300 674	1999	Radio Equipment and Systems (RES) - Road Transport and Traffic Telematic - Technical characteristics and test methods for data transmission equipment operating in the 5,8 GHz Industrial, Scientific and Medical (ISM) band.
ENV ISO 14816	1999	Automatic vehicle and equipment identification - Part 2: Numbering and Data structures
ENV ISO 14815	1999	Automatic vehicle and equipment identification - System Parameters
ENV 13372	1999	Road Transport and Traffic Telematics - Dedicated Short Range Communication (DSRC) - DSRC Profiles for RTTT applications
ENV ISO 14907-1	1999	Road Transport and Traffic Telematics - Electronic Fee Collection - Test procedures for user and fixed equipment -Part 1: Description of test procedures
prENV ISO 14907-2	2000	Road Transport and Traffic Telematics - Electronic Fee Collection - Test procedures for user and fixed equipment -Part 2: Application interface conformance test specification
prENV ISO 15008-	1999	Road vehicles - Man Machine Interfaces - Visual presentation of information

All interfaces

ENV ISO 14904	1997	Road Transport and Traffic Telematics - Automatic Fee Collection - Interface specification for Clearing Between Operators
prENV 1545-1	1997	Identification card systems - Surface transport applications - General data elements
prENV 1545-2	1997	Identification card systems - Surface transport applications - Transport payment related data elements
ENV 13106	2000	Traffic and travel data dictionary (version 3.1a).

ISO TC204 WG5

Committee of Japan 1999 An Architecture for Electronic Toll Collection (ETC) Payment System in Japan Using Object Oriented (OO) Method

General

ISO 7498-1	1994	Information Processing Systems - Open Systems Interconnection - Basic Reference model
ISO/IEC 8824-1	1995	Information processing systems - Open Systems Interconnection - Specification of abstract syntax notation one (ASN.1)
ISO/IEC 8825-2	1996	Information processing systems - Open Systems Interconnection - ASN.1 encoding rules: Specification of Packed encoding rules
prENV ISO 14813-2	1997	Road Transport and Traffic Telematics - Architecture and Terminology - Requirements for Architecture Description in TICS standards
prENV ISO 14813-3	1997	Road Transport and Traffic Telematics - RTTT Reference Architecture - Data Presentation in ASN.1.

Smart cards

Smart card technology is closely linked to EFC and the evolution of payment means has a significant influence on the development of EFC systems. For that reason, it is particularly important to examine the work concerning smart cards.

Two European and international bodies are working on smart card standardisation:

CEN/TC 224 (Machine-readable cards, related device interfaces and operations) created in 1989 in accordance with a mandate from the European Union and EFTA, is responsible for the development of standards in this field, its exact scope being as follows:

"Organisation, co-ordination and monitoring of the developments of standards (including testing standards) for cards, related device interfaces and operations with special emphasis on inter-industry standardisation and on integrated circuit cards, and without restriction to payment cards or banking cards".

The following list provides some specific European application standards which are important for road ITS:

prEN/CEN 1546, parts 1-4	Inter-sector electronic purse (in preparation in CEN/TC 224/WG 10)
ENVCEN 1545-1	Identification card systems - surface transport systems - Part 1: general data elements (adopted in CEN)
ENV/CEN 1545-2	Identification card systems - surface transport systems - Part 2: transport payment related data elements (adopted in CEN)

ENV/CEN 1545-3	Identification card systems - surface transport systems - Part 3: tachograph related data elements (proposal)
ENV/CEN 1545-4	Identification card systems - surface transport systems - Part 4: driving licence related data elements (proposal)
ENV/CEN 1545-5	Identification card systems - surface transport systems - Part 5: freight related data elements (proposal)
ENV/CEN 1545-6	Identification card systems - surface transport systems - Part 6: vehicle related data elements (proposal)

An international standardisation of inter-industry specifications of cards is performed in **ISO/ IEC/JTC1/SC17** “Identification cards and related devices” in the following main areas:

“Physical, electrical, logical protocol specifications and test methods applying to different recording techniques (embossing, magnetic stripe, integrated circuit cards with contacts, contactless circuit cards, optical memory cards)”.

The generic smart card standards existing or under development in ISO/IEC/JTC 1/SC 17 are:

ISO/IEC 7810	Identification cards - Physical characteristics
ISO/IEC 7816	Integrated circuit cards without contact
ISO/IEC 10373	Identification cards - Test methods
ISO/IEC 10536	Contactless integrated circuit card - close coupled cards
ISO/IEC 14443	Contactless integrated circuit card - proximity cards
ISO/IEC 15693	Contactless integrated circuit card - vicinity cards

In addition, the EC DG-INFSO project SMARTCITIES is currently focusing on a management architecture for a plug and play smart card platform for urban applications.

Recommendations

Dedicated Short Range Communications

- Windscreen attenuation and other technical issues:

Scope: to address the problem raised by metallic windscreens for the operation of on-board units (OBU) which rely on DSRC for ITS and especially ETC. This is of high priority.

Reason for the creation: European car manufacturers are introducing metallised windscreens on a wide scale throughout Europe. These windscreens have attractive thermal qualities but risk compromising the correct functioning of OBU for EFC communicating with the roadside. In connection with WG1, and beyond the work already performed and the temporary solution found, conception and development of long term solutions by full integration in the dashboard of the OBU.

Action taken: close relations with the ERTICO Committee created on “Physical Integration of OBU for ETC”, that issued in October 1998 a report on the topic suggesting some solutions. ERTICO proposed a new WI in TC278/WG9 and this item, WI 00278119: DSCR physical integration with the vehicle of OBUs for EFC has now been implemented.

- International DSRC standardisation:

In connection with ISO/TC 204/WG 15, harmonisation of ISO DSRC layer 7 “application layer” is needed to solve all problems from requirements of Europe, North America and Japan. A further Project Team will be necessary to carry out this work.

4.3 Safety and emergency systems

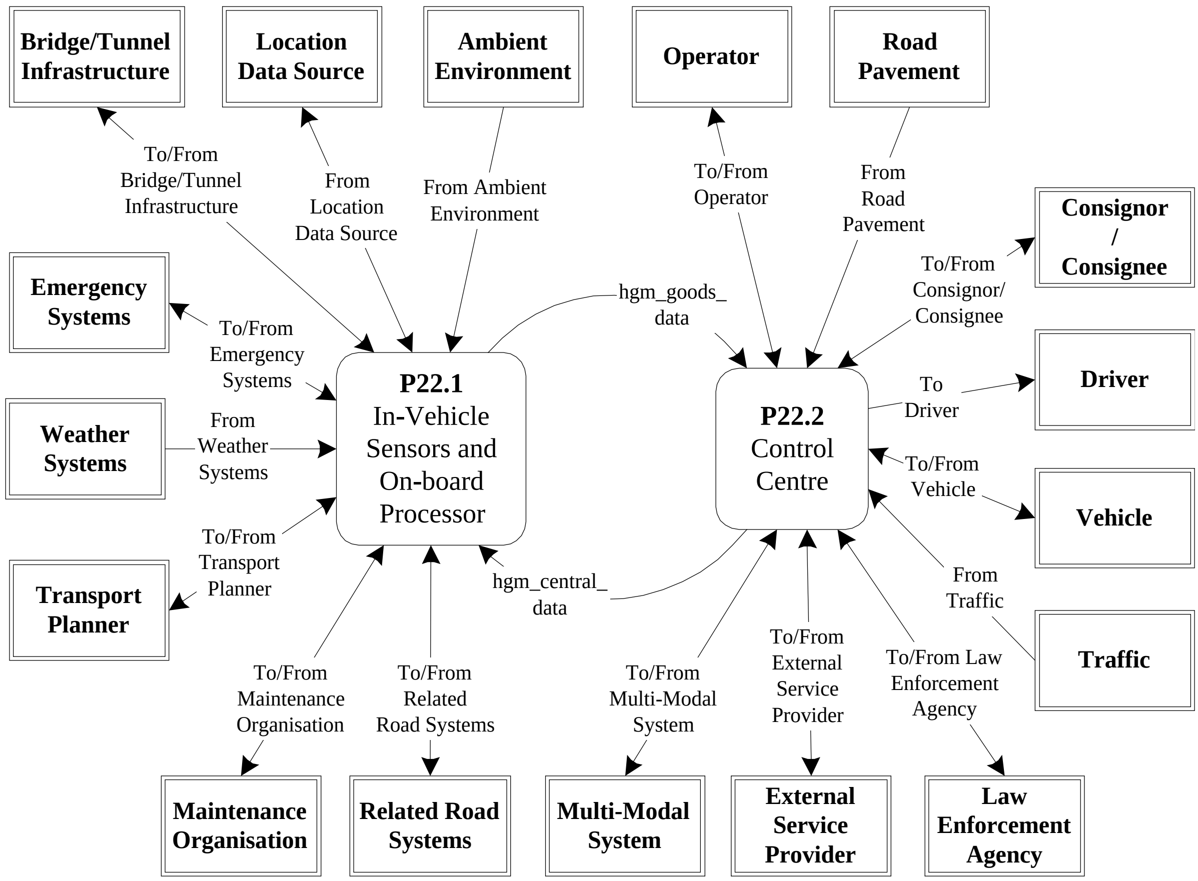
This section focuses on Incident Management Systems that provide an early response in critical situations and systems that cover the transport of hazardous goods.

The **Hazardous Goods Management System** consists of two main sub-systems:

- in-vehicle sensors and on-board processor;
- control centre.

The sub-system diagram in Figure 5 provides a view on the interfaces to take on board in the mapping with standardisation activities in this area. The in-vehicle sensors and other necessary equipment are discussed Section 4.4 “Vehicle systems”.

Figure 5: Interfaces relating to safety and emergency systems



Issues

The transportation of hazardous substances by road is not necessarily hazard in itself, provided the vehicle is properly maintained and the goods are suitably packed. In order to minimise the effect of an accident involving hazardous materials, this type of traffic should be routed away from areas of high accident risk and there should be informed and effective available assistance in the event of spillage. The vehicles should be clearly marked so that the people dealing with an emergency know exactly what to do.

Procedures that indicate the actions to take in case of an accident involve:

- a hazard information system, that provides information on the dangers of a particular hazard and describes the immediate actions needed; and
- clearly marked labels with emergency numbers, nature of the materials, etc.

Operators carrying hazardous substances across national borders in Europe are required to carry a similar label giving the unique code number, another number indicating the nature and degree of the hazard and the diamond warning sign. There is also a need for advance warning of the movements of some types of load.

It is interesting to point out that no real definition as to what a hazardous load constitutes. It could be related to the goods or substance carried (although some goods not normally considered hazardous have led to serious incidents, such as the fire in the Mont-Blanc tunnel in 1999 which was caused by a lorry carrying margarine and flour), or alternatively to a very large and slow-moving load which can cause a hazard to other vehicles on the road if there are insufficient warnings, police escorts, etc. This issue raises a possible need to look at standards for load classification and provision of information relating to such loads to the relevant traffic management systems.

Monitoring the movement of hazardous freight by road has been investigated. Technologically feasible methods of monitoring the movements of vehicles carrying hazardous freight have been identified with the aid of various electronics companies. The methods include radio-location techniques, proximity to fixed objects techniques and the Dead-Reckoning technique.

On a national level, we can find some computerised operational assistance systems to manage the accident risk and to maintain a level of service. This is the case of MIGRAZUR on the A8 motorway along the French Riviera, which uses a network that gathers information and data comprising tele-surveillance, emergency call points, traffic stations and automatic incident detection.

Some other national examples provide us with procedures and measures to deal with hazardous goods with respect to fire protection. This is the case in the Netherlands, where the protection of tunnels against fire is required for those tunnels that allow the transport of “Category I substances” (flammable substances and certain explosives).

Other issues that are covered by Safety and Emergency Systems are the following:

- Node/Link incident detection: this may be roadside equipment, including automatic incident detection (AID) which can detect static vehicles, and possibly other effects such as smoke or the sound of a crash. Other systems are vehicle-mounted, such as systems triggering black box data recorders or airbags.

- Assistance: location confirmation, roadside emergency telephones, mobile phone services/call centres, Emergency Services, vehicle recovery and response/access time.
- Incident investigation: scene protection and investigation protocol.
- Cordon evacuation/traffic control: manning issues and diversions/re-routing (including provision of information to motorists upstream).

Standardisation work carried out

Currently there are no specific standards under development in this area in Europe (in contrast to the US where this topic is particularly addressed).

Various areas where standardisation is required are:

- In-vehicle "black box" collision detection/notification systems (perhaps from airbag deployment data) - so that onwards communication with Emergency Services is consistent.
- Hardware/communication links between rollover/crash sensor devices on hazardous freight vehicles which will automatically communicate with the fleet/goods management systems and then inform the police/fire services on the possible nature of the spill incident to which they are going.
- Incident monitoring technology on the highway (measuring flow disruptions/models) - but it will enable cross-boundary monitoring and reappraisal of incidents and appropriate diversionary routes.
- Command and control systems for the Emergency Services so that cross-agency/boundary incident logs can be transferred intact without having to retype in details of whole incident.
- Emergency procedure manuals so that there is a consistent approach to scene protection, emergency service notification and callout, investigation, recovery/clear-up etc (this may not be crucial if each country is self-sufficient but it will aid inter-agency co-ordination).
- Driver/highways/public transport information systems during an incident to advise of delays/alternative actions to benefit users.
- Location monitoring of emergency type vehicles (GPS, etc) and intelligent routing to hospitals, incidents along clear routes, etc.
- Automatic nomination of relevant commanders of agencies to take charge of incremental roles from respective agencies (duty rosters/skills lists).
- Automatic printing out of relevant sections/action chapters of major incident protocols relevant to data/information coming from on-site intelligent systems (to aid commanders).
- Automatic media notification/handling and press releases after deployment of a safety/ emergency system.

Key questions to be addressed are:

- what constitutes a safety system?

- what constitutes a hazardous load?
- what constitutes a major incident/emergency?
- what minimum response is needed for a major incident/emergency?

Recommendations

With regard to the implementation of Pan-European Emergency Call:

ERTICO partners have identified the requirements and issues that need attention from both the emergency authorities and the network operators. There is no obvious need for regulation regarding the provision of emergency call on the market side; any need for regulation should only be through the licensing of the network operators.

Requirements and issues to be addressed by emergency authorities:

- Responsibilities of actors in the value chain need to be clear so that liability can be established.
- Single entry point(s) to emergency call centres are essential in each country or region.
- The hand-over from the VAS provider to the emergency authority should be subject to common operational procedures.
- Agreements are necessary on how to filter false calls.
- Investigation is necessary on the need and means to harmonise feedback procedures with VAS providers.
- Emergency authorities should adopt common protocols to minimise equipment requirements.
- Common location referencing systems should be adopted between emergency authorities and VAS providers.
- The routing for both voice and data calls should be transparent to the whole value chain.

Requirements and issues to be addressed by network operators:

- Priority should be established in the network for data-assisted emergency call.
- Attention is required on the issue of SMS roaming and multilingual services in the context of data-assisted emergency calls, to provide continuity of service.
- The fallback voice call should be the common 112 number.
- Network operators should be aware that localisation through the network would be appreciated.
- Caller line identification needs to be transferred between networks.

With regard to the Deployment of pan-European Emergency Services:

A discussion is urgently needed on which standard protocols to be used.

In addition, some car manufacturers would like to automate the generation of emergency calls in case of accidents, whereby information from different sensors could be incorporated in the distress message so that the Emergency Services could get a better picture of the type of accident.

Other important topics for consensus building are location referencing and HMI.

4.4 Vehicle systems

This section reviews the “example system” described in the Physical Architecture that provides Advanced Driving Assistance in the vehicle (ADAS).

This system provides a range of facilities for Advanced Driving Assistance. It is based on similar systems that exist or are under development in different countries and particularly as part of the European Commission 4th Telematics Application Programme.

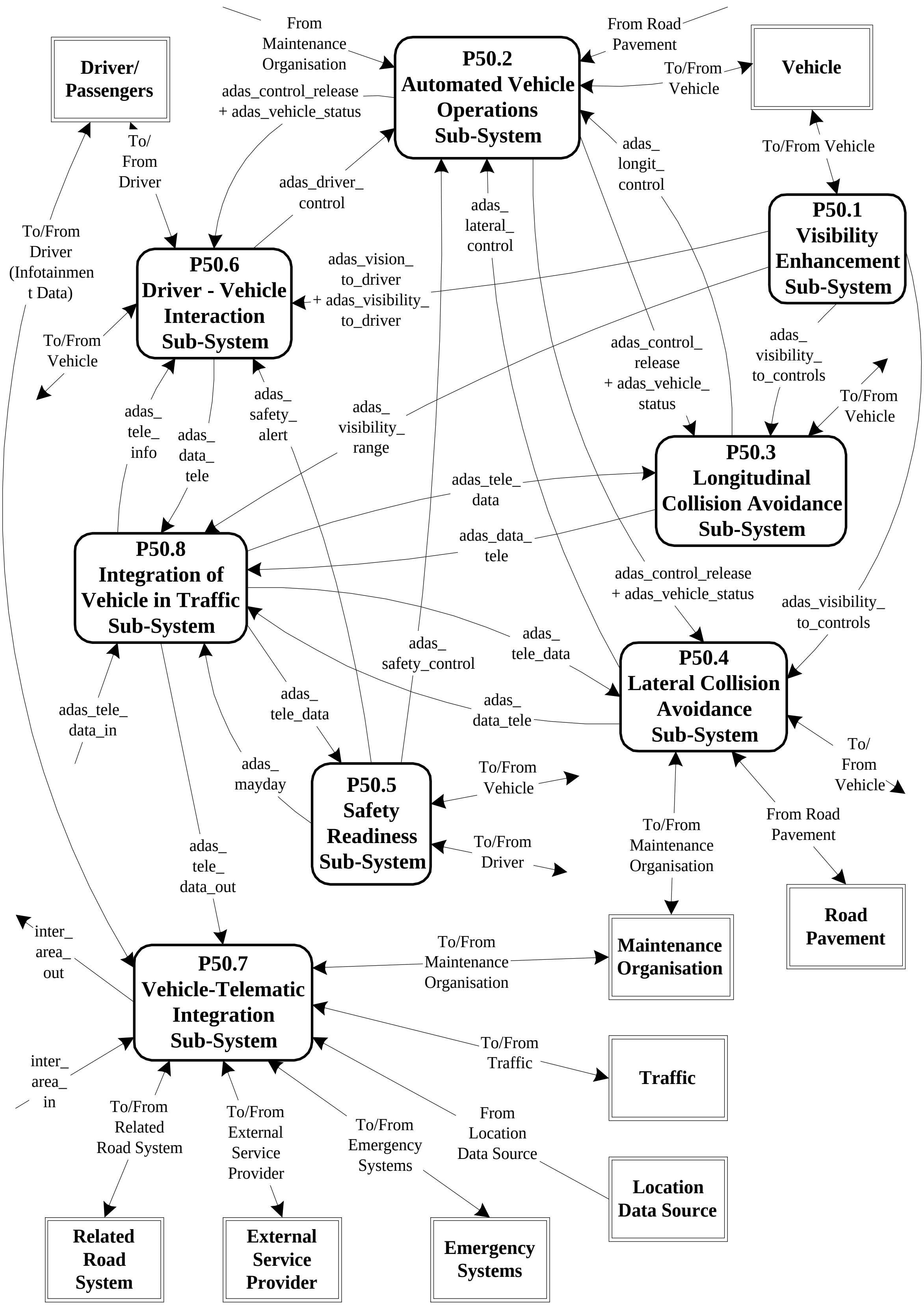
In this System both the standard components (engine, brakes, dashboard, sensors etc.) and the ADAS equipment (radar, cameras, automatic controls, telematic equipment etc.) are considered as part of the vehicle.

The Driver-Vehicle Interaction Sub-system includes interactions both with the standard in-car equipment and the ADAS related equipment. As well as the driver, the passengers are also (implicitly) considered.

There are two on-board networks for the interconnection of the different functionality. The first network is related to the ITS functions (i.e. it is a kind of multimedia bus) and its main aim is to circulate to all the on-board modules, the information coming from (or going to) outside the vehicle (via communication media such as RDS, GSM, DAB, DSRC, etc.). This bus has provisions to check the integrity of the data and to avoid misuse. The second network is a kind of vehicle control bus that, depending on the required function, guarantees a suitable level of dependability. In real applications it can be split in two or more lines to assure safety critical operations.

The context is shown in Figure 6.

Figure 6: Context diagram for vehicle systems



The different sub-systems are as follows:

P 50.1 *Visibility Enhancement Sub-system*: In adverse visibility conditions this sub-system shall provide a direct view of the area of interest to the driver, enhanced by instrumental means.

P 50.2 *Automated Vehicle Operation Sub-system*: This sub-system shall provide a range of vehicle automatic controls and procedures to allow a fully automated vehicle operation.

P 50.3 *Longitudinal Collision Avoidance Sub-system*: This sub-system shall provide a range of facilities to detect impending collisions on the longitudinal (principal axis of motion of the vehicle) direction and provides data for warnings and/or automatic controls the longitudinal vehicle dynamics to avoid the collision.

P 50.4 *Lateral Collision Avoidance Sub-system*: This sub-system shall provide a range of facilities to detect impending collisions on the transversal directions (with respect to the principal axis of motion of the vehicle) and provides data for warnings to the driver and automatic vehicle lateral control to avoid the collision.

P 50.5 *Safety Readiness Sub-system*: This sub-system shall provide all necessary facilities to avoid accidents due to impaired drivers. It detects driver impairment, warns the surrounding traffic and provides data for automatic vehicle control to a safe stop.

P 50.6 *Driver - Vehicle Interaction Sub-system*: This sub-system shall provide a range of Driver-Vehicle interaction facilities both for current functionality and for ADAS. It includes visual, acoustic and haptic information together with the capability to manage all the inputs from the driver (manual, acoustic etc.). It also includes the management of virtual reality driving supports.

P 50.7 *Vehicle - Telematics Integration Sub-system*: This sub-system shall provide the on-board availability and use telematic supports for a better use of the vehicle in the ITS world.

P 50.8 *Integration of Vehicle in Traffic Sub-system*: This sub-system shall provide the integration of the vehicle, equipped with telematic systems, in the whole traffic systems providing all the services for the efficient exploitation of transport telematics.

Issues

Integrity of data communications

The integrity of data messages needs to be examined. Some of the standards and regulations given in Section 4.3 cover this subject area but we need to ensure that any specific requirements are examined.

Future vehicles are like to have dual power supply systems, for example passenger cars will have a 42 volt supply as well as the traditional 12 volt system. The current test methods need to be reviewed to include these new systems.

Concerning the individual blocks and interfaces, we consider the following:

Visibility enhancement

Regulations already exist covering the light output and pattern for conventional vehicle lighting systems. However, vision enhancements systems are not covered in these regulations or standards. We will need to consider the following aspects of performance:

- Contrast – the ability to define objects against a background.
- Level of illumination.
- Method of display including position (e.g. head-up system) and type.
- Level of illumination over a range of lighting conditions.
- Performance in adverse weather (e.g. fog, rain, snow).

Automated vehicle operation

Automated vehicle operation is a highly safety critical area and needs special attention in terms of performance requirements, standards and regulations. Generic standards such as IEC 61508 for safety critical electronic systems should be adapted for this type of system. Reliability is a key issue and suitable techniques for analysing the system reliability such as failure mode analysis and fault trees should be included in regulations.

Fault tolerant systems, for example software techniques, need to be employed to ensure that this type of system can operate safely under fault conditions.

Built-in redundancy is also an important factor in ensuring the high levels of reliability required for these systems.

Longitudinal collision avoidance

Most of the requirements for automated vehicles apply to collision avoidance. However, there are some specific areas that need appropriate performance standards. In particular we need to specify the performance of the different sensing devices used for collision detection. These include:

- radar;
- infra-red;
- ultra-sonic;
- video camera;
- capacitive devices.

It is necessary to establish the operating criteria for each of these types of sensor. For example, radar systems will also need to have requirements for electromagnetic compatibility.

Another important factor is the reliability of correct object detection and the ability to distinguish between different types of impacting object.

Lateral collision avoidance

As for longitudinal collision avoidance.

Safety readiness system

As this is primarily a warning system it could be considered as less safety critical than systems directly controlling the vehicle. However, we will need to establish the levels of correct detection of driver readiness and the requirements for the method of display to other road users.

Driver - vehicle interaction system

The main feature of this type of system will be the ability to provide the driver with accurate information. The ability to do this reliably will need to be addressed. The method of display will also need performance requirements.

Vehicle telematics integration

As for the driver - vehicle interaction, but there are also requirements for harmonised data interchange protocols and associated hardware. We will need to develop systems beyond the scope of the current CAN bus already found in some vehicles. New methods will need to have high levels of reliability, security and data integrity.

Integration of vehicle – traffic

As for vehicle telematics integration. In addition, the integrity of the vehicle - traffic communications system including protocols, hardware and data transmission will need to be considered.

Active safety systems

Active safety systems will provide both occupant and pedestrian protection. These systems will use the sensing systems similar to those used for collision avoidance but will set up the vehicle's safety devices to optimise both internal and external protection. A similar approach to collision avoidance for formulating standards and regulations is needed.

In addition, the operation of the safety devices, e.g. inflatable bags, needs to be considered in terms of rate of inflation, pressure and venting. These parameters may be different for external and internal systems.

Other aspects of performance requiring consideration include:

- Environmental issues, e.g. temperature range, water ingress, humidity and vibration/ shock.
- Electrical issues, e.g. over and under voltage, short/open circuit operation of all inputs and outputs, power supply variation, electromagnetic compatibility, transient disturbances on all inputs and outputs, and electrostatic discharge effects including lightning.
- System reliability.

Standardisation work carried out

Some existing standards and regulations relating to the above are listed below:

95/54/EC	1995	The European Automotive EMC Directive

EN 60068	1994	Environmental testing
ISO 7637	1994	Road vehicles: electrical disturbance by conduction and coupling
ISO TR10605	1994	Road vehicles: electrical disturbances from electrostatic discharges
IEC 61508	1999	Functional safety of electrical/electronic/programmable electronic safety-related systems

EN 60068 covers a wide range of environmental tests including temperature, water ingress, humidity, vibration, shock and electrical performance. The transient electrical disturbance requirements given in ISO 7637 provide a range of transient tests covering the major potential sources found on vehicles.

ISO TR10605 offers proposals for testing for electrostatic discharge. This document does not cover lightning effects which are a special type of electrostatic disturbance.

ISO 61508 is a general document covering a wide range of aspects relating to the safe operation of electronic equipment for all system environments. The proposals include both hardware and software aspects of system performance.

As two specific areas that are addressed by concrete standardisation activities, we include the Human Machine Interface and Automatic Vehicle Identification:

Automatic Vehicle Identification/Automatic Equipment Identification (AVI/AEI)

CEN/TC278/WG12 and ISO/TC204/WG4 have a common programme. Generic AVI/AEI items which are about to be finished are:

- “Reference Architecture and terminology” for AVI/AEI that established a framework which allows standards to be formulated for the individual means and services, without compromising the position of any other means or services.
- “System Specification” which aims at giving AVI/AEI specification with regard to the chain from the Host System (centralised functions) to the Application processes (in-vehicle applications).
- “Numbering and data structure” for AVI/AEI which have to be at each level of the chain, and in the exchange process between each level, that is designed to be independent of carrier medium.

Specific items dealing with intermodal goods transport and which have started are:

- architecture and terminology, systems parameters, numbering and data structure, interfaces.

Three work items have already been completed:

ENV 12314-1	1996	Automatic vehicle and equipment identification - Part 1: Reference architecture and terminology
ENV 14815	1999	Automatic vehicle and equipment identification - System parameters

ENV 14816 1999 Automatic vehicle and equipment identification - Numbering and data structure

Results of this WG are input for the following WGs: CEN TC278 WG1 (Electronic Fee Collection), CEN TC278 WG2 (Freight and fleet management systems), CEN TC278 WG9 (Dedicated Short Range Communication) and CEN TC278 WG 14 (After-theft systems)

Links to other entities:

- ISO/TC204 WG 4: AVI/AEI (same convenor, same field)
- ISO/IEC/JTC1 SC 31: Automatic identification and data capture techniques
- CEN/TC278 WG1 and ISO TC204 WG5: Electronic Fee Collection
- CEN/TC278 WG3: Public Transport
- CEN/TC278 WG2: Freight and fleet management systems
- CEN/TC278 WG9 and ISO/TC204 WG15: Dedicated Short Range Communication
- CEN/TC278 WG 14: After-theft systems

Human Machine Interface (HMI)

The work of CEN/TC278/WG10 is conducted in close liaison with and under the lead of ISO/TC 22/SC 13/WG8: indeed HMI standards for the presentation of information in vehicles reflect the international nature of vehicle production and development.

- HMI issues related to Automatic Cruise Control (ACC) and Forward Vehicle Collision Warning Systems (FVCWS), handled by ISO/TC22/SC13/WG8, deserve attention on a European level, although at present they are far from being in operation on the European road network.
- The support given by the CONVERGE project through a dedicated task force allowed the issue of a European Statement of Principles on HMI for in-vehicle information and communication systems (Expansion of principles, dated November 1998). There is a will to go further towards verification and evaluation procedures for the standards based on the previous publication. More recently, the EC recommendation on safe and efficient in-vehicle information and communication systems[1] states the following:

> *The European motor manufacturing and supply industries which provide and/or fit and/or design in-vehicle information and communication systems, whether original equipment providers or after sales system providers, including importers, should comply with the attached statement of principles. They are invited to enter into a voluntary agreement on this matter. This statement of principles summarises essential safety aspects to be taken into account for the human machine interface (HMI) for in-vehicle information and communication systems. It is concerned with all these systems intended for use by the driver while driving .In this context the principles consider that the driver's*

[1] A European Statement of Principles on Human-Machine Interface [document no. C(1999)4786], 21 December 1999

primary driving task is safely controlling the vehicle through a complex dynamic traffic environment. These principles are valid:

- *whether the system is directly related to the driving task or not*
- *for both portable and permanently installed systems such as telephones*
- *for both original equipment manufacturers and after sales system providers including importers for all road vehicle types provided on the Community market.*

The EC will monitor for two years the progress made in this field to see if voluntary agreements, monitored by Member States, work. Otherwise the EC will consider regulation.

- Two preliminary work items have been approved as new work items dealing with:
  - HMI suitability of TICS for use while driving (responsible: UK);
  - criteria for determining priority of TICS messages presented to the drivers (responsible: Japan).

  Task forces prepare draft versions in additional meetings.

The topic of navigation function accessibility is proposed by the US delegation as a new work item: a separate SAE (Society of Automotive Engineers) standard is under consideration.

Multimedia interfaces

The AMI-C project aims to develop a set of common specifications for a multimedia interface to motor vehicle electronic systems in order to accommodate a wide variety of computer based in-vehicle electronic devices. The AMI-C Release 1 specification (to be released in 2000) will cover:

- plug and play IDB-C open bus (internal communications network), plus MOST (upon resolution of legal issues) and IEEE (Institute of Electrical and Electronics Engineers) standard 1394 (upon resolution of automotive grade capacity);
- hardware interfaces and connectors for the above buses;
- preliminary IDB-C to vehicle bus and MOST to vehicle bus gateways;
- preliminary IDB-C to MOST and IDB-C to IEEE1394 gateways (providing message level translation only in Release 1).

Recommendations

In this area, most of the items are still at the stage of research and evaluation. Some systems are autonomous while other require communications or interaction with infrastructure and/or other vehicles. Depending on the selected solutions, this will give different level of priority for standardisation work.

Today, focus should be given on integrity of data communication as it appears to be a topic common to various systems.

Concerning HMI, the findings of the CONVERGE project need to receive acceptance from the automotive industry and equipment suppliers by signing up to voluntary agreements to adhere to the EC recommendation on HMI of 21 December 1999.

4.5 Traveller assistance/information and route guidance

Traveller Assistance and Route Guidance (TARG) systems cover systems that provide assistance to travellers with their journeys. The purpose of such systems is to enable travellers to undertake their journeys in the most efficient, safe and comfortable way. RDS-TMC is included in this chapter (in 4.5.2) as it is a specific example of a TARG system, although with more limited functionality than the system described in Section 4.5.1.

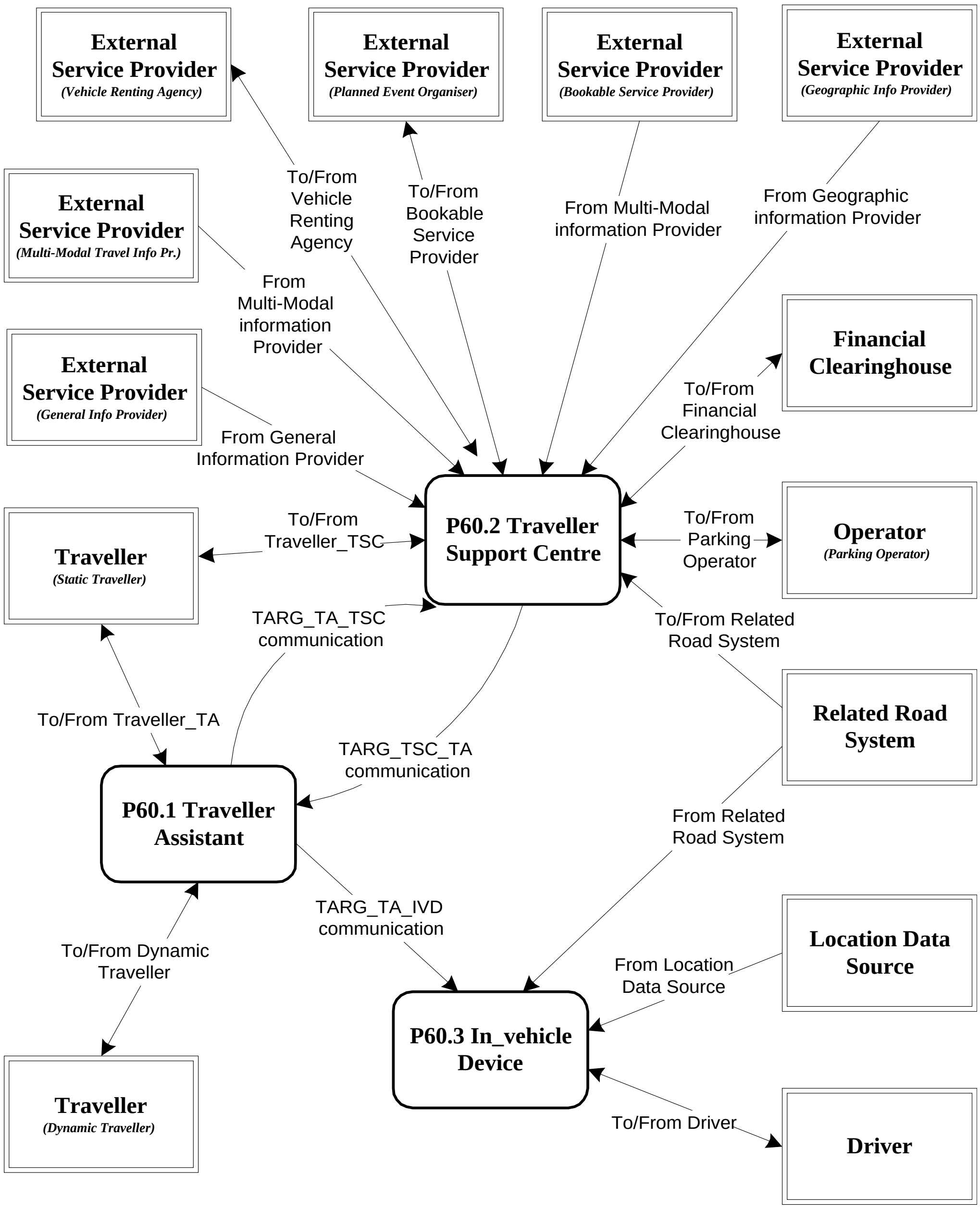
Traveller assistance and route guidance (TARG) system

Traveller Assistance systems can aid the traveller both before (pre-trip) and during their journey (on-trip). Ideally TARG systems should embrace all modes of transport, e.g. Dynamic Route Guidance Systems could suggest that the driver uses park and ride facilities rather than taking a car into a city centre.

Standardisation work in this field tends to concentrate on the delivery mechanisms rather than the applications. All systems claim similar functionality and content, but differ in format of information, protocols used, the location of elements such as digital maps, and the location and degree of processing required (e.g. whether the route guidance calculated centrally or in the vehicle).

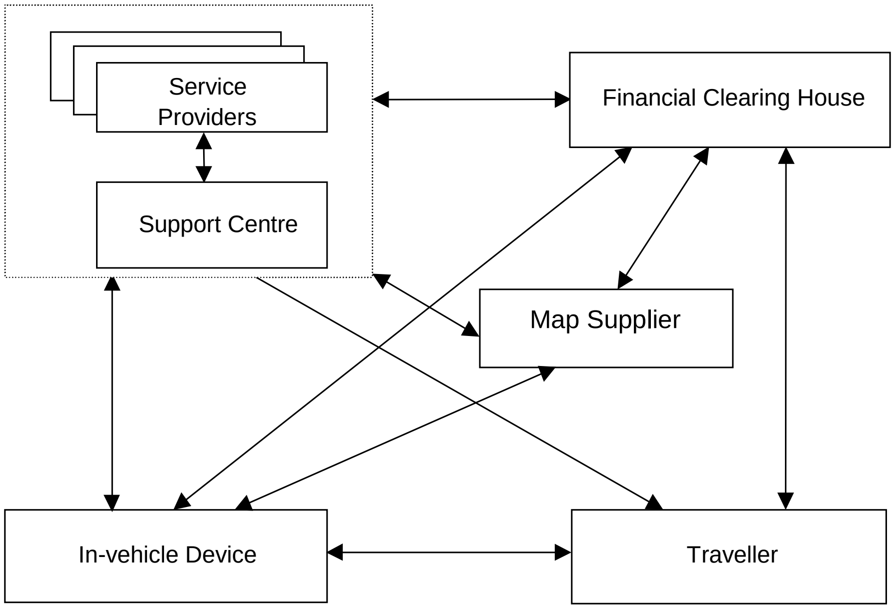
In order to identify and clarify the standardisation work in this field we can use the context diagram as it appears in the European ITS Physical Architecture document (D3.2). In this way the protocols being developed in the standardisation activities can be mapped with the interfaces identified in D3.2, shown in Figure 7.

Figure 7: Context diagram for traveller assistance and route guidance systems



However this diagram is complex as it intends to embrace every combination of possibility of traveller, service provider, device and application. A simplified context diagram (Figure 8) will suffice to explain the linkages and interfaces developed in the standardisation area.

Figure 8: Simplified context diagram for traveller assistance and route guidance systems



The Traveller Assistance and Route Guidance (TARG) system consists of three sub-systems:

P 60.1 *Traveller Assistant (TA) Sub-system*, which is a "personal assistant" comprising a memory box or an intelligent processor for the traveller with the capability to communicate with the Traveller Support Centre (see P60.2 below) for route definition and the gathering of all relevant information. The TA may exist in a number of levels of sophistication and functionality, hence the variation between a memory box and intelligent processor, but the basic functionality is user identification, easy access to the Traveller Support Centre and the support of customised travel planning. More advanced functions will include storage of information such as disruptions and bookings, re-use of information from former trips and route guidance. In the description a distinction is made between the static traveller (preparing their journey) and the dynamic traveller (any traveller en-route, except the IVD driver, using the TA for travel performance).

P 60.2 *Traveller Support Centre (TSC) Sub-system*, which is a kiosk-type system with the ability to have a collection of pertinent data and the facility to communicate with various other types of systems for information retrieval. It functions as an information intermediary, providing the traveller with access to an range of information, without the need to know where the information actually is, how to access it and how to combine it. The TSC is bound to a certain region, and may have information from outside that region, but will rely on its peers elsewhere to supply it with comparable information from other regions. Tourist and even commercial information can also be delivered if desired.

P 60.3 *In-Vehicle Device (IVD) Sub-system*, which is a device in the vehicle that can be coupled with the Traveller Assistant. It enables the collection of information and, for the more advanced types of devices, with external systems such as roadside equipment and radio, for the collection of the most recent information available.

RDS-TMC

RDS-TMC (Radio Data System - Traffic Message Channel) is closely related to traveller assistance and route guidance and its implementation in Europe is an area where a common communication architecture exists, with standards having been consensus-driven.

The EU has focused on the deployment of RDS-TMC services as part of the TEN-T implementation programme and its implementation on an international level with a choice of broadcast languages is being planned. The aim is for a continuous, compatible and interoperable service with a key benefit being that the user can use the same certified receiver in any country in Europe to receive a standard quality in the language of his/her choice. At present, several regional and national services exist and others will start broadcasting shortly.

The system described in the European ITS Physical Architecture is the Italian RDS-TMC service, whose relationships with other systems and the outside world ("terminators") are as shown in the following table:

Table 11: RDS-TMC Italian System - context

Terminator	**Interface**	
	From terminator to traffic management system	From traffic management system to terminator
Related road systems	✔	
Operator	✔	✔
External service provider		✔
Location data source	✔	✔

The driver receives information from external RDS-TMC service providers, and is therefore not included in this system.

The system comprises the following subsystems:

P 2.1 *Data Providers Gateway Sub-system*;

P 2.2 *Standard Data Exchange Sub-system*;

P 2.3 *Data Gathering and Management Sub-system*;

P 2.4 *RDS-TMC Encoder Sub-system*.

Issues

Each bearer technology for TARG systems claims that its protocol is "independent of the communication technology" and there is unwillingness to develop and adopt totally independent protocol which is shared by all the technologies. Thus each camp develops a separate protocol which favours their communication medium. However there has been a willingness to share message sets, with the GATS protocol sharing the RDS-TMC Alert C message set and TPEG developing its message set so it is compatible with the Alert C and DATEX message sets.

There is no common definition of the interface between service providers and support centres and their respective responsibilities. In many cases the data, service and communication providers are encompassed in one organisation. It is not clear whether the architectures consider this.

Mandate 270 has detected new items and suggestions for the way forward for WG4 – Traffic and Traveller Information:

In the short term, a new WI (Traffic and Travel Information over High Data-rate Digital Broadcast Bearers) has started work and is about to release final drafts on TPEG Syntax, Semantics and Framing structure and Road Traffic Messages (RTM). The related group will go on and start developing other applications such as:

- public transport messages; and
- status oriented messages;

checking that there is no overlapping with other WGs.

Traffic data input is a key requirement for RDS-TMC and links therefore exist to monitoring and data exchange applications.

Location referencing is also an issue that should be addressed as RDS-TMC data should be used by navigation systems using more detailed location referencing models.

The arrival of WAP brings further issues, such as the need to be able to send a location in a common format to a centre (e.g. an Internet information provider), which can change according to the country in which the user is located.

A further issues relates to whether and how to charge for route guidance and information services.

Standardisation work carried out

<u>Service provider – In-vehicle device</u>

RDS data bearers:

ISO ENV 12313-1	1998	Traffic and Traveller Information – TTI Messages via traffic message coding – Part 1: Coding protocols (updated to EN status as EN ISO 14819-1)
ISO ENV 12313-2	1997	Traffic and Traveller Information – TTI Messages via traffic message coding – Part2: Message Set (event and information codes) (updated to EN status as EN ISO 14819-2)
ISO ENV 12313-3	1999	Traffic and Traveller Information – TTI Messages via traffic message coding – Part 3: Location Coding (to be updated to EN status as EN ISO 14819-3)
ISO ENV 12313-4	1999	Traffic and Traveller Information – TTI Messages via traffic message coding – Part 4: Protocols for ALERT+

ISO prENV 12313-5	1999	Traffic and Traveller Information – TTI Messages via traffic message coding – Part 5: Location referencing for ALERT+
ISO prEN 14819-1	2000	Traffic and Traveller Information – TTI Messages via traffic message coding – Part 1: Protocols
ISO prEN 14819-2	2000	Traffic and Traveller Information – TTI Messages via traffic message coding – Part 2: Message Set

Dedicated Short Range Communications (beacons) – these standards have since been withdrawn.

ENV 12315 –1	1997	Traffic and Traveller Information – TTI messages via DSRC – Part 1: Data Specification – Uplink (roadside – vehicle)
ENV 12315 –1	1997	Traffic and Traveller Information – TTI messages via DSRC – Part 2: Data Specification – Downlink (vehicle – roadside)

Cellular systems

ISO prENV 14821-1	2000	Traffic and Travel Information (TTI) – TTI messages via cellular networks – Part 1: General specifications
ISO prENV 14821-2	2000	Traffic and Travel Information (TTI) – TTI messages via cellular networks – Part 2: Numbering and ADP message header
ISO prENV 14821-3	2000	Traffic and Travel Information (TTI) – TTI messages via cellular networks – Part 3: Basic information elements
ISO prENV 14821-4	2000	Traffic and Travel Information (TTI) – TTI messages via cellular networks – Part 4: Service-independent protocols
ISO prENV 14821-5	2000	Traffic and Travel Information (TTI) – TTI messages via cellular networks – Part 5: Internal services
ISO prENV 14821-6	2000	Traffic and Travel Information (TTI) – TTI messages via cellular networks – Part 6: External services
ISO prENV 14821-7	2000	Traffic and Travel Information (TTI) – TTI messages via cellular networks – Part 7: Performance requirements for onboard positioning
ISO prENV 14821-8	2000	Traffic and Travel Information (TTI) – TTI messages via cellular networks – Part 8: GSM-specific parameters

High-data-rate digital broadcast bearers (to include internet and Digital Audio Broadcasting (DAB))

ISO prENV 18234-1	2000	Traffic and Travel Information (TTI) over high data-rate digital broadcast bearers – [TTI] via Transport Protocol Expert Group (TPEG) data-streams – Part 1: Introduction, Numbering and Versions

ISO prENV 18234-2	2000	Traffic and Travel Information (TTI) over high data-rate digital broadcast bearers – Transport Protocol Expert Group (TPEG) data-streams – Part 2: Syntax, Semantics and Framing Structure (SSF)
ISO prENV 18234-3	2000	Traffic and Travel Information (TTI) over high data-rate digital broadcast bearers – [TTI] via Transport Protocol Expert Group (TPEG) data-streams – Part 3: Service and Network Information (SNI) Application
ISO prENV 18234-4	2000	Traffic and Travel Information (TTI) over high data-rate digital broadcast bearers – [TTI] via Transport Protocol Expert Group (TPEG) data-streams – Part 4: Road Traffic Message (RTM) Application

Map Supplier – Support Centre – In-vehicle Device

RDS data bearers

ISO ENV 12313-3	1999	Traffic and Traveller Information – TTI Messages via traffic message coding – Part 3: Location Coding
ISO prENV 12313-5	1999	Traffic and Traveller Information – TTI Messages via traffic message coding – Part 5: ALERT+ Location coding

Support Centre – User

ISO prENV 14823	2000	Dictionary of pictograms for use in stationary devices such as variable message signs (VMS).

In WAP, the ITSWAP project is looking at different business models, including how to charge for services.

In addition, there has been work on DATEX-Net by the DATEX Management and Steering Committees (described in Chapter 4.1.2) and the RDS-TMC Forum promotes and supports this particular media.

RDS-TMC is an area where standards exist, but implementation is slow for other reasons, such as the fact that commercial companies have not always been enthusiastic in developing and promoting it.

There has been no standards work undertaken by the CEN and ISO Working Groups in the area of Dynamic Route Guidance systems. Systems are being introduced that have proprietary data interfaces, routing algorithms and Human Machine Interfaces and many of the systems have data interfaces that can accept RDS-TMC and GATS messages. However, standardisation may not be a priority in this area as information is delivered in ASCII format and in the user's own language.

Furthermore, there has not as yet been any standardisation effort on payment issues for Traveller Information Services. There is no implicit charging method for RDS-TMC, GATS relies on the charging mechanisms within GSM, and TPEG has "hooks" to a charging mechanism if required, but this has not yet been developed. Again, it is debatable whether payment issues is a domain where standardisation activities should be concentrated - normally it is the business of each operator to collect their own payment in the case of use of traffic information. However interfaces between the user, payment clearing houses and service providers are important with respect to interoperability.

Recommendations

In the medium term, consideration could be given to the following topics:

- coherence of messages in a door-to-door travel information concept, when several different databases are supplying information (linked to the above suggestion in Public Transport);
- criteria allowing to assess the quality of information; and
- floating car data: collection of information, criteria for good performance of the service;

while in the long term, a major revision could be required to add functionality and the use of another data representation like ASN.1.

Though location referencing rules have been developed within WG7, this is still a key issue for RDS-TMC, in particular for the integration with more elaborated location referencing systems that are use for navigation.

4.6 Law enforcement systems

Law enforcement systems cover the detection of violation and the identification of the affected vehicle and/or driver.

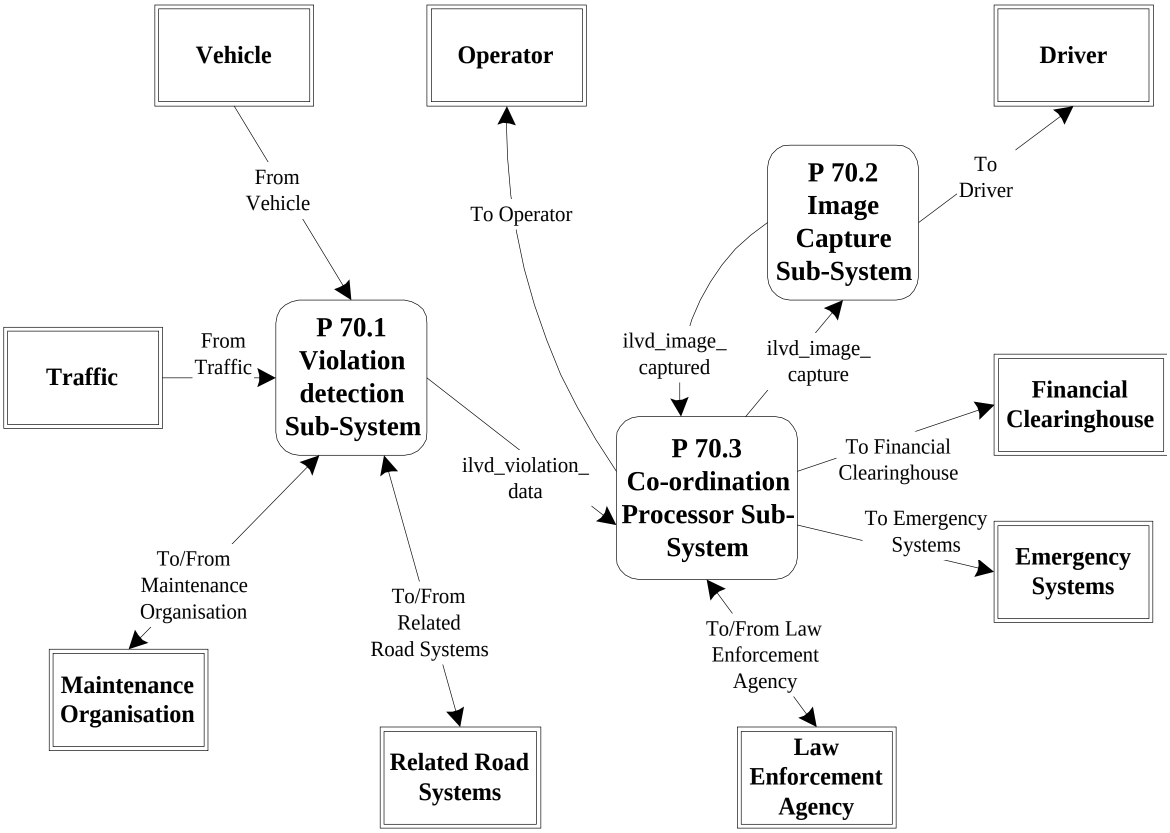
The following subsystems are considered:

P 70.1 *Violation detection Sub-System*: - This sub-system detects the vehicle, classifies it and transmits this data to the Co-ordination Processor Sub-system. In the case of violation it transmits the relevant data caused by the vehicle additionally. The sub-system provides the functionality to have an overview about the traffic-violation selected by different types of vehicles.

P 70.2 *Image Capture Sub-System*. - This sub-system receives images of the passing vehicles and captures images of violating vehicles on the request of the Co-ordination Processor Sub-System.

P 70.3 *Co-ordination Processor Sub-System*: - This sub-system receives data from the Violation Detection Sub-System and initiates the capturing of the passing vehicle by the Image Capturing Sub-System. Every communication with the world outside of the system and with all related terminators will be handled by this sub-system.

Figure 9: Context diagram for law enforcement systems



Traffic law enforcement covers specific areas including alcohol, speed, seatbelts and signalised junctions. There are different types of traffic enforcement methods available to policing authorities to increase efficiency in terms of cost and human resources and the effectiveness of enforcement operations. There is a need to use enforcement in conjunction with educational and environmental/engineering strategies.

Issues

There is no standard procedure in dealing with law enforcement situations. National laws and regulations apply in most cases and there is a lack of international procedure that harmonises approaches to similar situations in different countries.

There are many different situations and scenarios that lead to offences. We could summarise these in terms of the following categories:

- Construction and use regulations (dimensions, vehicle fittings, loads, plates and markings, trailers, weight, safety provisions);
- Lighting regulations (fitting on vehicles, fitting on projecting loads and trailers without front position lamps, etc., fitting additional side marker lamps, maintenance of lamps, use of lamps, restriction on use of lamps);
- Registration and licensing (forgery and fraud, excise licenses, registration marks, registration document, trade licences);
- Driving licences (general, provisional licences, physical fitness);

- Operator licences and permits (goods vehicles, foreign vehicle permits, public service vehicles);
- Test certificates;
- Plating (ministry plates and certificates, other plates);
- Driving offences;
- Driving under the influence of drink or drugs (drink drive offences);
- Road traffic accidents (failing to stop, exceeding speed limit, temporary speed restrictions);
- Traffic regulations (police officers, traffic signs);
- Pedestrian crossing offences (protected (signalised) and unprotected (zebra) crossings, school crossing patrols);
- Highways (obstruction, parking, builders' skips, dangers to road users, damaging the highway);
- Motorways;
- Motorcycles;
- Other cycles (pedal cycles, electrically assisted cycles);
- Inspection of vehicles;
- Conduction of public service vehicles;
- Tachographs and drivers hours (tachograph head, charts, EU regulations, domestic regulations).

There has not been any harmonisation on the prosecution for these offences. There are various reasons behind this, for instance there is no need to "standardise" everything. However, it could be more complex task for a person driving across Europe to be aware of the specific national regulations and respect them if these differ from country to country.

Another difficulty is the lack of mutual acceptance of different types of evidence, which makes it difficult to prosecute an offender who is not resident in the country where the offence was committed. Examples are speeding or traffic light offences captured on camera, or use the of EFC lanes without a valid OBU. ITS applications designed to detect such offences lose their value if the offender returns to his or her own country and the courts of that country do not allow evidence collected in this way.

Other areas that can be considered within the field of law enforcement include the following:

Automatic Number Plate Recognition

- Node / Link systems:
  - stolen vehicle register;
  - speeding;
  - intelligent message notification to officers.

Stolen Vehicle Tracking

- Remotely mapped in control centre;
- Real time orientation in police car;
- Real time mapped in police vehicle;
- Real time guided in police vehicle.

There are links with CEN/TC278 WG1, WG2, WG9, WG12 and ETSI RS9.

Standardisation work carried out

There are EU regulations (EEC Reg. 3820/85) concerning the tachograph and drivers hours, dealing with:

- failing to take a weekly rest;
- failing to take a daily rest;
- exceeding daily driving period of 9 or 10 hours;
- exceeding 4.5. hours of continuos driving (this include failure to take a 45 minute break within 5.25 hours);
- exceeding the fortnightly driving period (90 hours).

EU regulations regarding drivers hours and tachographs are referenced in 3820/85 and 3821/85. EEC 3820/85 deals with drivers hours and lists those vehicles exempted from the requirements. EEC 3821/85 specifically deals with recording equipment.

Concerning cross-border acceptance of evidence collected by ITS, the VERA project (Video Enforcement for Road Authorities - EC 4th Framework Programme) has examined harmonised approaches to the enforcement of traffic laws and promoted the acceptance of video records as evidence in court.

With regard to stolen vehicle tracking or after theft systems for the recovery of stolen vehicles, the following standardisation work has been carried out by CEN/TC 278/WG14.

The CEN/TC 278/WG14 carried out a survey with a large scope in terms of types of systems taken into account:

- Vehicle Recording Systems (VRS);
- Vehicle Identification Systems (VIS);
- Vehicle Remote Immobilisation Systems (VRIS);
- Vehicle Signalling Systems (VSS), with two kinds of such systems:
  - Short range electronic detection;
  - Long range electronic detection;
- Vehicle Location Systems (VLS).

The description of the work progress is given in the CEN document N955.

Two levels of standardisation needs are focused on:

- interface between the vehicle and the detection means;
- interface between detection and operation means.

Already, some delay is mentioned in the schedule because of:

- the lack of technical experts actively involved in the process;
- the debate between two possible approaches: from the existing systems to the standards or from the needs to the standards;
- to what systems to give prevalence: short range or long range?
- the exact extent of the standardisation area: protocols, data, devices, etc;
- the lack of financial support.

Recommendations

Future standardisation work must stress:

- technical constraints due to threats of destruction, perturbation, falsification, identification;
- legal constraints;
- economic constraints;

while much attention must be devoted on cross-border continuity.

Consideration is needed of potential impacts on standardisation requirements induced by the introduction of the digital tachograph. Standards are under development but none are yet ready for use.

The justification of this is the lack of links between the legal provisions for the use of the new digital tachograph (EC regulation n°2135/98) and the technical specifications refined by the CATP (Committee for Adaptation to the Technical Progress) concerning the following:

- print-outs;
- warnings;
- display;
- pictograms;
- data organisation in the vehicle unit and in the driver card;
- modes of operation of the vehicle unit;
- external and downloading interface;
- card issuing; and
- security principles.

At the current stage reached in the process, there is a strong requirement to adapt the membership and to select experts. The problem of funding is of crucial importance.

4.7 Freight and fleet management systems

The example system described in the European ITS Physical Architecture document is that of a distributed freight management system for a large haulage company. This is a physically distributed system comprising a Fleet Management Subsystem and several Fleet Management Services Subsystems.

Its links with the outside world are as detailed in Table 12.

Table 12: Distributed freight management system - context

Terminator	**Interface**	
	From terminator to traffic management system	From traffic management system to terminator
Driver	✔	✔
Vehicle	✔	✔
Law enforcement agency	✔	✔
Location data source	✔	
Multi-modal system	✔	✔
Operator	✔	✔
Consignor/Consignee	✔	✔

The system comprises the following sub-systems:

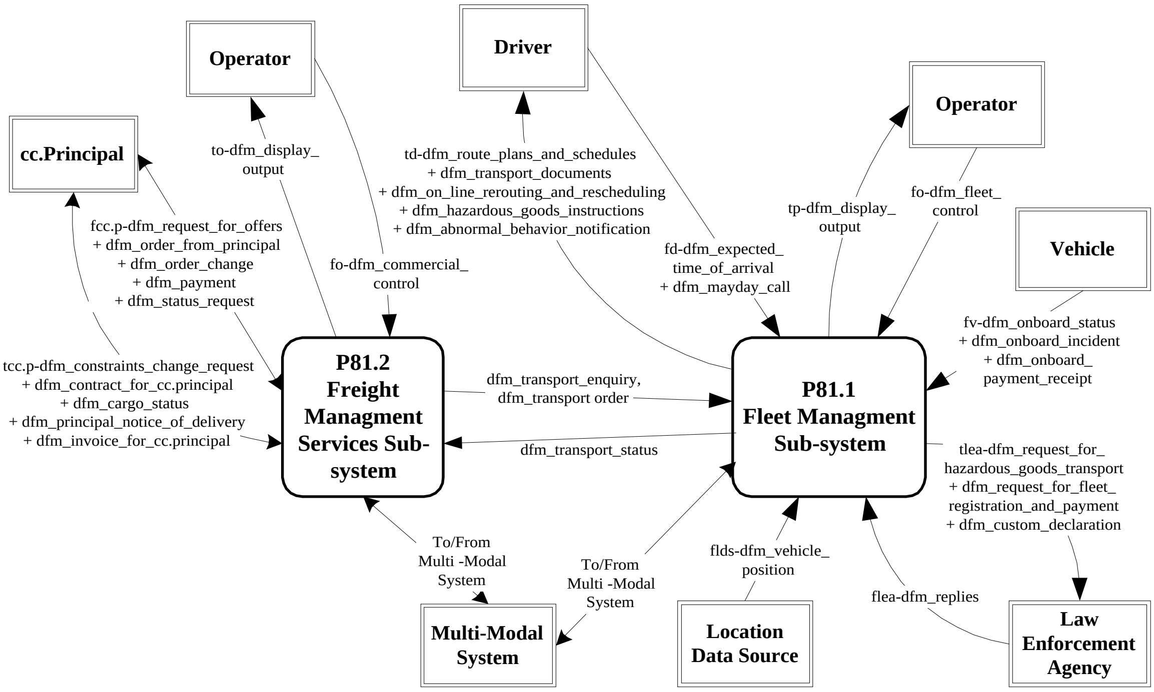
P81.1 *Fleet Management Sub-system*, which provides the centralised functionality. It is split into modules responsible for:

- centralised preparation, planning and control of fleet operations (with multimodal interfaces in the case of intermodal freight transport); and
- fleet maintenance.

P81.2 *Fleet Management Services Sub-system*, which is responsible for the business functions (customer relations, negotiation, etc).

These are linked as shown in Figure 10.

Figure 10: Distributed freight management system - sub-system diagram



Issues

There exists a growing number of on-board systems for commercial vehicles, produced by a number of manufacturers, either to fulfil legal requirements or market demand. This proliferation of systems creates problems related to interoperability and ergonomics, and there is a need for some standardisation of architecture.

Standards in the freight and fleet domain may be regional (e.g. on a national or Europe-wide basis, such as fleet standards, regulations, etc) or global (e.g. for containers, swap-bodies, etc which can be transported world-wide).

A resolution in the European Parliament in February 1999 included a call for the Commission to “initiate the harmonisation or co-ordination of national and/or modal technical, operational and administrative standards in order to ensure interoperability and the free flow of goods and loading units, and of the data and communications required in the intermodal transport chain”. This therefore underlines the link between freight and fleet management and multimodal freight issues, and the need for the development of standards in order to increase intermodality and interoperability in freight.

Key items for standardisation include:

- integration of the electronic tachograph within a physical and communications architecture for freight and fleet management;
- tachograph information structure;
- messages by mobile electronic data interchange (EDI) to/from vehicles concerning transport orders, task management, status reporting, etc;

- human-machine interface (HMI) issues;
- emergency systems and in-vehicle safety systems (covered in sections 4.3 and 4.4);
- automatic identification (see AVI in section 4.4: Vehicle systems) and tracking and tracing;
- positioning, navigation and route optimisation (standards are already largely addressed, e.g. GIS and geo-referencing);
- cargo management, e.g. cargo/vehicle weighing and planning/optimisation of loading bays at terminals.

Standardisation work carried out

No real standards exist in the freight and fleet management domain. CEN TC278 Working Group 2, which deals with Freight and Fleet Management Systems, published a reference architecture and terminology[1] in 1997, but there was no reaction from the actors in this field. The WG has been largely dormant since then.

Smart card applications and bar coding are relevant to the freight and fleet domain, and are dealt with by CEN Technical Committees 224 and 225.

Several activities have been developed in this area by a range of projects and could therefore provide experience and views in the formulation of standards. These include the MIST (Multi-Industry Scenarios for Transport) task force and projects such as EUROSCOPE, COMETA, INFOLOG, ARTEMIS, INACT and KAREN itself. In addition, links between the work done in ISO TC22 and the regulation specifications for the electronic tachograph can provide scope for reactivating standardisation activities in this domain.

The COMETA project (***COM***mercial vehicle ***E***lectronic and ***T***elematic ***A***rchitecture, EC DG-IST 4th Framework Telematics project) designed modular associations of on-board functions for commercial vehicles, allowing for efficient interfacing with global transport telematics systems, and also developed some standardisation and harmonisation proposals. It has taken the KAREN and FLEETMAP projects into account (the latter concerning standardisation of home base - vehicle communication) to develop an open system architecture for on-board freight, fleet and cargo management systems with standardised interfaces for Europe-wide applications.

Fleet Application Protocol (FAP) covers standards for vehicle location, messaging, dynamic pools, assistance calls and traffic information. It aims to allow for a standardised communication protocol interface between in-house applications and a “fleet protocol server” concept, in order to avoid the need for transport companies to have a number of systems installed in parallel.

Standards relating to FAP are as follows:

[1] CEN TC278 WG2 N124: ***Freight and Fleet Management Systems: Reference architecture and terminology – Part 1: High level architecture***, July 1997 and ***Part 2: Detailed architecture*** (draft), September 1997.

ISO 8824	1993	Information processing systems - Open Systems Interconnection Specification of abstract syntax notation - 1 (ASN.1): Part 1: Specification of the Basic Notation Part 2: Information Object Specification Part 3: Constraint Specification Part 4: Parameterisation of the ASN.1 Specification.
ISO 8825	1993	Information processing systems - Open Systems Interconnection Specification of ASN.1 encoding rules: Part 1: Basic Encoding Rules Part 2: Packed Encoding Rules Part 3: Distinguished Encoding Rules.
GATS standards:		GATS 1: Event coding GATS 2: Geo-coding

MicroPross data transfer protocol (MDTP) is a file format using ASCII codes, and is composed of a header record (identifying file type, sender, etc), data records (indicating events, vehicles, drivers, dates, information sources, etc) and an end record.

The DIS (Delta Industrie Service) standard provides an interface between the products of major freight and fleet management solution providers (Volvo, Thomson, ICS, Transics, etc) and DIS software (Scan4 and Visio-Truck) - this standard is principally related to tachograph content and concerns, driving time, work time, rest time, kilometres driven, etc, but also areas such as refuelling and expenses.

Recommendations

In order to develop standards in freight and fleet management, a real level of support and commitment is required among the users of the freight and fleet reference architecture. The key aim, however, should be to refine existing standards in this field rather than to create new ones, and to deal both with gaps and with links/overlaps between areas.

CEN TC278 WG2 should be re-activated.

For EDI messages (status reporting, task orders, etc), standards on structured information are required to reduce non-processable information (i.e. free text), similar to what has been achieved with DATEX-Net data exchange.

The development of some measure of harmonisation (if not actual standards) for HMI is important from an ergonomic/ease of use, interoperability and safety point of view.

Standardisation of the integration of tachographs into the on-board system are needed, including standardised information and easy plugging/unplugging of components into the on-board system, regardless of manufacturer.

4.8 Physical Architecture links to the outside world

Any system, including the systems and subsystems described in this chapter, has links, or interfaces, either with other systems/sub-systems, with the outside world, or more commonly, both. This chapter has described links with other related systems within the same Framework Architecture, which can be considered as internal.

External links are described in the European ITS Framework Architecture as “Terminators”. A Terminator describes how the outside world is expected (or assumed) to behave. There are 20 terminators for the Framework Architecture, as follows:

- Ambient Environment;
- Bridge/Tunnel Infrastructure;
- Consignor/Consignee;
- Driver (including private drivers, emergency vehicle drivers, freight vehicle drivers, hazardous freight vehicle drivers and Public Transport drivers);
- Emergency Services;
- External Service Provider (including geographic information providers, multi-modal travel information providers, planned event organisers, bookable service providers, general information providers, vehicle rental agencies, freight storage rental agencies, broadcasters, and traffic and travel information providers);
- Financial Clearinghouse;
- Freight Equipment;
- Law Enforcement Agency;
- Location Data Source;
- Maintenance Organisation;
- Multi-modal System;
- Operator (including fleet, freight, parking, public transport, emergency, road network, toll and traveller information operators);
- Related Road System;
- Road Pavement;
- Traffic;
- Transport Planner;
- Traveller (including drivers, public transport passengers, pedestrians, cyclists and car-poolers) – these may be dynamic travellers (i.e. actually making their journey) or static travellers (i.e. planning or anticipating a journey, and possibly requiring pre-trip information, reservations, etc);
- Vehicle (including private, emergency, freight, hazardous goods and public transport vehicles);
- Weather systems.

A full description of each of these terminators is provided in the European ITS Physical Architecture document (D3.2).

A Terminator may be a one-way or a two-way link with the System. For example the “Driver” terminator is two-way as an ITS application and the driver of a vehicle can influence, affect and exchange information or instructions with each other, whereas the “Ambient Environment” link is one way, i.e. to the System (the System can receive information from the surrounding environment, but cannot inform, instruct or manage in any way the ambient weather conditions in return).

Many of the interactions with the outside world are concerned with HMI (how a person interacts with a System). This is addressed earlier in this chapter (Section 4.4: vehicle Systems).

5 First Priorities

5.1 Traffic data exchange and location referencing

There is a need for addressing location referencing in urban areas for meeting the requirements of data exchange between UTC and other TCCs, public transport management (vehicle tracking), and data exchange between vehicles and UTC (link between ACC and traffic light control, etc).

One priority is to extend the traffic data dictionary, which currently only concerns interurban situations, to cover urban road networks as well. This extension should pay particular attention to the needs in urban areas to exchange basic data between different systems rather than elaborated data. ISO204 WG1 has produced a “Glossary of Terms” which should be used as a starting point for any dictionary.

Furthermore, particularly in urban areas, data exchange should cover all transport modes and not only road traffic. Where multi-modal centres are involved, there could be more of a need for standards. Either DATEX needs to be expanded to other modes, or a CORBA/JAVA platform (as being developed by the TRIDENT project) should be adopted, the latter allowing data exchange to take place without the need of a common dictionary.

There is also a need to improve the interface between urban and interurban networks in most European countries, such as by extending DATEX to urban traffic control centres.

Besides the technical standardisation, there is also a need for organisational standardisation, concerning who should send data to whom (TCCs, police, local authorities, motorway operators, etc), what sort of data, by what means and on what terms (further dissemination/use of data, cost, etc). This is best achieved by means of formal bilateral data interchange agreements, as a European standard would be over-bureaucratic in this case and would not take account of local and national circumstances. Consensus activities could work to produce a “model” interchange agreement for use by all affected bodies, which would streamline and simplify the procedure, and could be modified to suit local circumstances where necessary.

5.2 Vehicle to road communication systems, including EFC applications and emergency call

There is a need for vehicles requesting priority to have a certain level of standardisation in terms of their communication systems, to ensure interoperability with the roadside systems. The requirement implies the use of a close range radio system possibly DSRC, which is the subject of standardisation activities in the field of EFC.

Considering Dedicated Short Range Communication, there is the need to address the problem raised by metallic windscreens for the operation of on-board units (OBU) which rely on DSRC for ITS and especially ETC. European car manufacturers are introducing metallised windscreens on a wide scale throughout Europe which can compromise the correct functioning of communications for EFC. However, CEN/TC278/WG9 has now begun to address this issue in a Work Item on DSRC - physical integration with the vehicle of OBUs for EFC.

A second aspect concerning DSRC is the need to meet European, North American and Japanese requirements in connection with ISO/TC204/WG15, harmonisation of ISO DSRC layer 7 “application layer”. A further project team will be necessary to carry out this work.

A standard is also needed for an application identifier protocol, and standardisation of location, time and possibly sharing these components between applications would also be valuable.

Vehicle/driver to control centre communication systems, including emergency call applications

There is no obvious need for regulation regarding the provision of emergency call on the market side; any need for regulation should only be through the licensing of the network operators. However with regard to the implementation of Pan-European Emergency Call, ERTICO partners have identified the requirements and issues that need attention from both the emergency authorities and the network operators

With regard to the Deployment of pan-European Emergency Services, a discussion is urgently needed on which standard protocols to be used. While WAP is a possible solution as far as the transport mechanism is concerned, it does not define the application (e.g. the message format and content). One possibility would be to use a GATS application on top of WAP.

Some automobile manufacturers are currently looking at the automation of the generation of emergency calls in case of accidents, whereby information from different sensors could be incorporated in the distress message so that the emergency services could get a better picture of the type of accident.

Consensus building is needed on location referencing in relation to emergency systems, as well as other standard information elements (time, direction of travel, etc). Minimum information standards in these areas would be valuable.

5.3 Control centre to road communication systems

The NTCIP (National Transportation Communications for ITS Protocol) in the USA deals with key links such as between control centres and roadside units. Many European countries have developed their own protocols and are now investigating if NTCIP could be adopted. A common approach is then required in Europe.

However, many implementations are using the TCP IP protocol (a de facto standard) and a proprietary data dictionary. Using this solution therefore implies a need for further work on the data dictionary, message protocol (to enable the sharing of communications infrastructure with other services), and most importantly, location referencing.

5.4 Control centre to vehicle communication systems

Priorities for standardisation in CEN/TC278/WG3 include data exchange between vehicles and control centres or service providers, by means of DAB, TETRA and GSM, data exchange between authorities and public transport control centres and standardisation of exchanges between traffic servers and vehicles based on the concept of “smart” intersections, to allow public transport priority at junctions.

In addition, due to increasing of environmental concerns in cities, links need to be established with external systems in charge of monitoring ambient conditions. These links should consider the exchange of data in both directions, e.g. data on current and projected emissions are necessary for devising traffic management strategies aiming at alleviating the problem. Data on current and forecasted traffic are in the same way useful for predicting the level of pollution.

These type of exchanges have been, for the time being considered as internal to the traffic management system. The European ITS Framework Architecture has clearly identified different functions in different areas, taking into account that the responsibility for traffic and environment can rest within different authorities.

Standardisation of data between UTC and the “Ambient Conditions” terminator are then to be proposed.

A proposal could be to reactivate WG5 with a focus on data exchange between UTC and public transport management systems.

5.5 Vehicle to vehicle communication systems

The following aspects require consideration:

- Communications between vehicles for driver warning, information exchange, etc, for which telecommunication bearers such as 433 MHz or Bluetooth can be envisaged.
- Communications between vehicles for which more powerful and secure data transmission bearers are necessary. This area includes platooning, car following applications, etc. The relevance of a 63GHz communication link has already been identified for this purpose.

In both cases, more effort on standardisation work is necessary

5.6 In-vehicle systems

In this area, most of the items are still at the stage of research and evaluation. Some systems are autonomous while other require communications or interaction with infrastructure and/or other vehicles. Depending on the selected solutions, this will give different level of priority for standardisation work.

Today, focus should be given on integrity of data communication as it appears to be a topic common to various systems.

Key interfaces where standardisation would have a major positive impact are OBU/smart card and in-vehicle bus/outside world.

5.7 Traveller information/assistance and route guidance

There has been no standards work undertaken by the CEN and ISO Working Groups in the area of Dynamic Route Guidance systems. Systems are being introduced that have proprietary data interfaces, routing algorithms and Human Machine Interfaces. However many of the systems have data interfaces that can accept RDS-TMC and GATS messages.

There has not as yet been any standardisation effort on payment issues for Traveller Information Services. There is no implicit charging method for RDS-TMC, GATS relies on the charging mechanisms within GSM, and TPEG has “hooks” to a charging mechanism if required, but this has not yet been developed. There is therefore a need to develop standards relating to interfaces between the user, payment clearing houses and service providers.

For the medium term, consideration could be given to the following topics:

- coherence of messages in a door-to-door travel information concept, when several different databases are supplying information (linked to the above suggestion in PT);
- criteria allowing to assess the quality of information; and
- floating car data: collection of information, criteria for good performance of the service;

while for the long term, a major revision could be required to add functionality and the use of another data representation like ASN.1.

RDS-TMC is an area where standards exist, but implementation is slow for other reasons, such as the fact that commercial companies have not always been enthusiastic in developing and promoting it.

Though location referencing rules have been developed within WG7, this is still a key issue for RDS-TMC, in particular for the integration with more elaborated location referencing systems that are use for navigation.

5.8 Law enforcement systems

Future standardisation work must stress:

- technical constraints (possibility of destruction, perturbation, falsification, identification, etc impeding the operation of law enforcement systems);
- legal constraints;
- economic constraints;

There should also be more attention devoted on cross-border continuity, or at least cross-border information (both to users, so that they are aware of the different laws, and to enforcement authorities, making it easier to trace and prosecute offenders in one country who then pass into another country). An example is that of after-theft systems, whose success depends on cross-border interoperability.

Harmonisation of procedures is also needed in order to allow mutual acceptance of evidence (e.g. speeding offences captured on video, EFC lane violations, etc).

Concerning the digital tachograph, consideration is needed of the potential impacts on standardisation requirements induced by its introduction. Standards are under development but none are yet ready for use. This is because of the lack of links between the legal provisions for the use of the new digital tachograph (EC regulation n°2135/98) and the technical specifications refined by the CATP (Committee for Adaptation to the Technical Progress) concerning print-outs, warnings, display, pictograms, data organisation in the vehicle unit as well as in the driver card, modes of operation of the vehicle unit, external and downloading interface, card issuing and security principles. At this stage, it is necessary to adapt the membership and to select experts. The problem of funding is of crucial importance.

5.9 Freight & fleet management systems

In order to develop standards in freight and fleet management, a real level of support and commitment is required among the users of the freight and fleet reference architecture. The key aim, however, should be to refine existing standards in this field rather than to create new ones, and to deal both with gaps and with links/overlaps between areas.

In-vehicle systems such as WAP, GPRS and UTMS will shortly become relevant to freight and fleet management, particularly as logistics systems are now becoming available on the Internet. Standardisation issues are therefore similar to those for on-trip traveller information (e.g. information content, definitions, etc).

CEN TC278 WG2 should be re-activated.

For EDI messages (status reporting, task orders, etc), standards on structured information are required to reduce non-processable information (i.e. free text), similar to what has been achieved with DATEX-Net data exchange.

The development of some measure of harmonisation (if not actual standards) for HMI is important from an ergonomic/ease of use, interoperability and safety point of view.

Standardisation of the integration of tachographs into the on-board system is needed, including standardised information and easy plugging/unplugging of components into the on-board system, regardless of manufacturer.

6 Conclusions

This report has described current and evolving European and international standards relating to ITS for road, with reference to the "Example Systems" described in the European ITS Physical Architecture. Where standards are seen to be insufficient, recommendations have been made as to the priority actions.

In summary, these concern the following areas:

- Standardisation of communication interfaces:
  - technical standardisation, e.g. DSRC, EFC;
  - car bus standardisation;
  - integrity of data communication;
  - cross-border continuity.
- Standardisation of information exchange:
  - organisational standardisation, e.g. Interchange Agreements;
  - communications protocols;
  - location referencing, including in urban areas, and its convertibility by means of a clear structure/architecture;
  - data exchange between vehicles and control centres or service providers, by means of DAB, TETRA and GSM;
  - data exchange between authorities and public transport control centres and standardisation of exchanges between traffic servers and vehicles based on the concept of "smart" intersections;
  - common data models/structures to create a stable basis for new and updated data dictionaries;
  - DATEX;
  - RDS-TMC;
  - EDI messages (status reporting, task orders, etc) for freight and fleet management;
  - integration of tachographs into the on-board system are needed;
  - standardisation of time and timing.
- Standardisation of applications:
  - data exchange between UTC and public transport management systems.
  - standard protocols for the Deployment of pan-European Emergency Services,
  - consensus building on location referencing and HMI;
  - floating car data;
  - digital tachograph.

Standards are vital in many areas, an illustration of this being their mandatory use for public purchasers in Europe, who must refer to appropriate standards in their tendering process and base procurement on European standards[1] where available.

It is important however to note that a standard does not make a workable system. In addition to standards, procedures are often needed, e.g. MoUs, guidelines (Bluebook), etc. Many of the RTTT areas discussed in this report (enforcement, EFC, emergency call, etc) not only need technical specifications, but also require agreement among all the actors in the chain on the application of the standard. Failure to approve and implement standards in the appropriate time delay will make it more difficult to provide interoperable services in Europe and could hinder the development of the ITS market.

It is also the case that formal standards are costly and time-consuming to produce, because of the amount of consensus needed. In some cases, a standard may emerge after the systems have been developed or even deployed. It is therefore important that, where standards are desirable, that they are produced in advance of the product development.

To make compliance to an architecture compulsory is neither desired nor, usually, beneficial. Similarly, the development of formal standards, while important in some areas, is not always the most efficient or effective solution (it should, for example, be noted that where formal standards exist, companies are obliged to purchase the material describing the standard).

Experience in all fields of IT is showing that “universal” adherence to de facto standards such as TCP/IP is sometimes spontaneous simply because all actors realise that benefits are evident and time/costs can be saved. However, where this is not the case, there is a need for leadership from European organisations such as CEN and the EC. This should be used to determine, firstly, whether a standard is actually needed (i.e. what, if any, benefit would it provide, and to whom) and if so, whether formal standardisation work is the best solution or whether consensus groups or European projects are more appropriate.

In addition to this report, standardisation issues for ITS are addressed in the RAID report[2], which proposed a specific mitigation strategy devoted to standardisation. Briefly, this is as follows:

> *Participation in European and International standards activities must be better organised through the preparation of a strategic plan defined by **European Authorities** in consultation with **Standardisation Groups** and **European Organisations**. Then, according to priorities, actions to further develop harmonisation and interoperability should be encouraged in domains such as interfaces between ITS systems, Human-Machine Interfaces (HMI), data exchange, enforcement and travel and traffic information. Support to standardisation activities should be limited to areas where benefits are expected for European manufacturers and users, and support should be reinforced in these cases.*

[from RAID Final Report: Executive Summary - see reference (d)]

[1] European Council of Ministers’ decision 87/95/EEC

[2] Risk Analysis of ITS Deployment: Reference (d)

It is therefore recommended that the European Commission gives its active support to formal standards only if there is a clear pan-European benefit. Otherwise, it should consider promoting the setting up of industry consensus groups, which can often achieve a result more easily than the formal standardisation process. The EC also has a role, not only in R&D activities relating to standardisation, but also in supporting concerted actions aimed at offering interoperable solutions.

In order for the European ITS Framework Architecture to be effectively and successfully used, future activities have to be planned. These should make sure that on the one hand systems and services are encouraged to comply with it, and on the other hand that the Architecture evolves rapidly enough to be able to keep showing the benefits of its use.

Structures are needed both to keep the Framework Architecture operational and to maintain and update relevant standards. Key public and private actors, operating in the architecture domain, should be represented as well as the users of the ITS services which the Architecture supports. Required activities/organisations include monitoring of standards and of the Architecture, technical committees and technical support in each domain and discussion forums. Active links are needed between standardisation bodies and organisations involved in architecture development and maintenance.

One way forward would be the creation of a forum covering each major technical standard to look at issues such as operational procedures and quality issues. An ad-hoc structure could also give shape to informal links between standardisation bodies.

The continuous development of technologies, changes in user needs and expectations, and changes in transport policy means that standardisation work, like ITS architectures, must be dynamic and that the links between the two need to be regularly reviewed. One or several expert groups are therefore needed to discuss and propose new and modified standards relating to ITS for road as well as to keep the European Framework Architecture up to date.

7 References

(a) EUROLUM/ISIS Mandate 270 Phase 1: **Standards for Road Transport and Traffic Telematics** (Volumes 1 and 2), CEN TC278, Project Team 12, May 1999.

(b) KAREN Project (R.A.P. Bossom, et al): **European ITS Physical Architecture**, European Commission DG IST Transport Telematics project KAREN, August 2000.

(c) KAREN Project (J-F. Gaillet, et al): **Deployment approach and scenarios**, European Commission DG IST Transport Telematics project KAREN, August 2000.

(d) RAID Project (L. Berghout, et al): **Final Report: Constraint Analysis, Mitigation Strategies and Recommendations**, European Commission DG IST Transport Telematics project RAID, February 1999.

(e) CEN TC278 WG2 N124: **Freight and Fleet Management Systems: Reference architecture and terminology – Part 1: High level architecture**, July 1997 and **Part 2: Detailed architecture** (draft), September 1997.

(f) CEN TC287 CR 287002:1998, Secretariat: AFNOR, **Geographic Information - Fundamentals - Overview**, July 1997.

(g) CONVERGE Project: **Services and Functions: Where do we stand?** European Commission DG IST Transport Telematics project CONVERGE, November 1996.