SEAMLESS

Analysis of existing research on road data dissemination to in-vehicle devices

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1 Introduction

In the last two decades it has become well understood that European roads authorities must make best use of existing road capacity in order to cope with rising demand while meeting environmental challenges and economical feasibility.

Through the ERA-NET ROAD II call "Mobility: Getting the most out of Intelligent Infrastructure", national roads authorities have recognised the role of intelligent infrastructure in supporting this need.

The "SEAMLESS" project[1] addresses the Mobility topic B "Effective Distribution of Road Authority Data". Distribution of road authority data to travellers is an essential tactic in optimising road network use. Not all available road authority data currently reaches travellers. Much of the data that is distributed uses roadside infrastructure such as variable message signs, but road authorities are seeking to reduce or ultimately remove the reliance on roadside infrastructure in order to reduce capital and operational costs and deliver additional environmental benefits. Furthermore, the collective information distribution to all travellers in the same way does not reflect the individual’s needs in a way to achieve an optimum; route advice from a variable message sign addresses all passing vehicles regardless of their individual destinations.

The greatest potential to reduce reliance on roadside infrastructure comes through delivery of data to in-vehicle devices. There has been significant European research on the use of in-vehicle devices and in cooperative systems in general and there are already significant deployments of in-vehicle information services. Much of the research and most of the deployments have been focussed on motorways and trunk roads. However, uptake of devices will be limited if service coverage is limited to trunk roads only. Trunk roads users make journeys which start and end in non-trunk roads. Even existing service users' confidence in the services may be damaged by a lack of information when journeys move between inter-urban and urban roads.

A reduction in roadside infrastructure is only practical if the coverage of in-vehicle devices is adequate. The use of dynamic in-vehicle information services is increasing, but the growth is slowed by the lack of seamless services. The provision of seamless services for dissemination of data from road authorities, both national and local, has the potential to accelerate the take-up of in-vehicle devices. Therefore seamless services have the potential to bring forward the time when national roads authorities can reduce reliance on roadside infrastructure.

Considerable investment in traffic data collection has been made by public authorities. A secondary use of this data has been to inform drivers of journey times, typically via variable message signs or web portals. Opportunity exists to present this detailed journey time data to drivers through high-volume in-vehicle display devices including satellite navigation systems and GPS-enabled mobile phones.

Project "SEAMLESS" prepares for traffic data dissemination services that work seamlessly across urban and inter-urban networks. It includes data dissemination to in-vehicle systems, and use of cooperative systems.

[1] We are aware that there was an EU agricultural project named "SEAMLESS" in the last decade, but the separate identity of the two projects should be clear from the context.

2 Approach

Since the European countries have different development histories and conditions, the future forms of organisation and technical solutions will vary. Nevertheless, due to the need of a large-scale coverage standards are playing a key role for the market in the future. This is especially valid from an automotive perspective.

For system deployment the interests of the public sector and the related infrastructure requirements from the perspective of cooperative systems must be considered. Although traffic management centres were built up in the urban areas the implementation of innovative cooperative applications is lacking in real test sites today. However, only demonstrations are able to show the potential of existing technology and interface and identify any potential weaknesses in practice. To achieve that, the next important step is to determine actually mature cooperative applications for the public sector on the basis of concrete use cases.

The past has shown that in the area of cooperative systems a huge number of system approaches have been developed in recent decades. A lot of research has been done and there are numerous projects, some of them have moved into the operational business, other results could not successfully be introduced into the market. Most of the projects had their focus on sub areas of cooperative systems and business cases, however few covered all parts of ITS including a link of new systems to the existing world. Generally speaking it is not easy to define a project covering all aspects of ITS from legacy systems to new developments.

In the present work package relevant projects of the cooperative systems domain of recent years have been analysed in this context. At first, an overview of existing and relevant projects was gathered, which is to be found in Annex I. In a next step they were analysed in terms of two criteria, which build the use cases for the SEAMLESS project:

- Traffic Light Phase Assistant
- Seamless urban and inter-urban roads information for in-vehicle devices, with journey times as a particular focus.

With the help of the use cases it is possible to describe for the projects of relevance the state of the art and identify the basis for further analysed with respect to the connection of legacy systems for the following work packages.

The first Use Case is the main working topic of the German project partners, the second one is the main working topic of the UK partners. There will be cross references as both parties will add some transnational input to the other’s use case. The following picture shows this horizontal modelling structure:

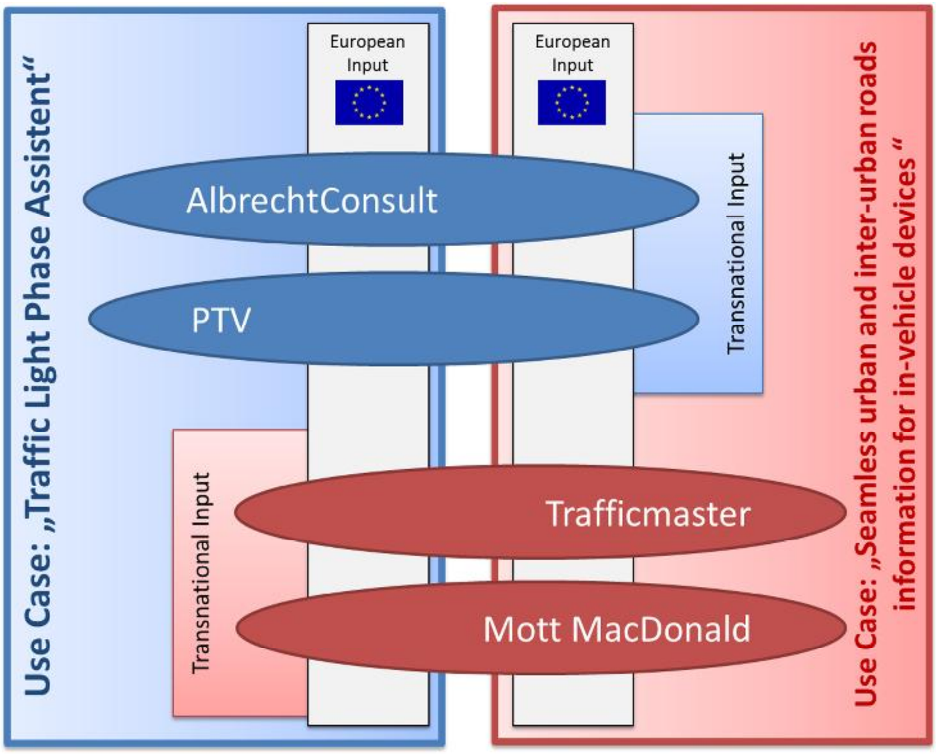

Figure 1 – Information Chain Traffic Information

The document summarises the current state of the art in the business and technology area of in-vehicle information. The outcomes reflect the experience gained from research and commercial projects over the last 10 years. The results will contribute to the conceptual work carried out in the following WP's: WP 2 – Business models, WP 3 architecture and WP 4 protocols.

The deliverable is based on the experience made in previous research projects and in commercial services. Annex 1 gives a comprehensive overview of projects addressing the two use cases presented before. Chapter 3 gives a short introduction in the history of Intelligent Traffic Systems and the current technology landscape for driver information services as well as for traffic management services today. The chapter ends with the presentation of two use cases which will be investigated in the Seamless project. In order to progress business models and to introduce the related technology a very clear understanding of stakeholder area including the goals of each stakeholder is essential. Therefore chapter 4 gives an overview of the institutional organisational structure of today's ITS systems. Chapter 5 describes the two use cases

- Traffic Light Phase Assistant
- Seamless urban and inter-urban information for in-vehicle devices

in detail. Chapter 6 introduces the most important standards needed for the deployment of the use cases. Finally chapter 7 gives recommendation for the further work in WP 2, WP 3 and WP 4 after the consideration of WP 1.

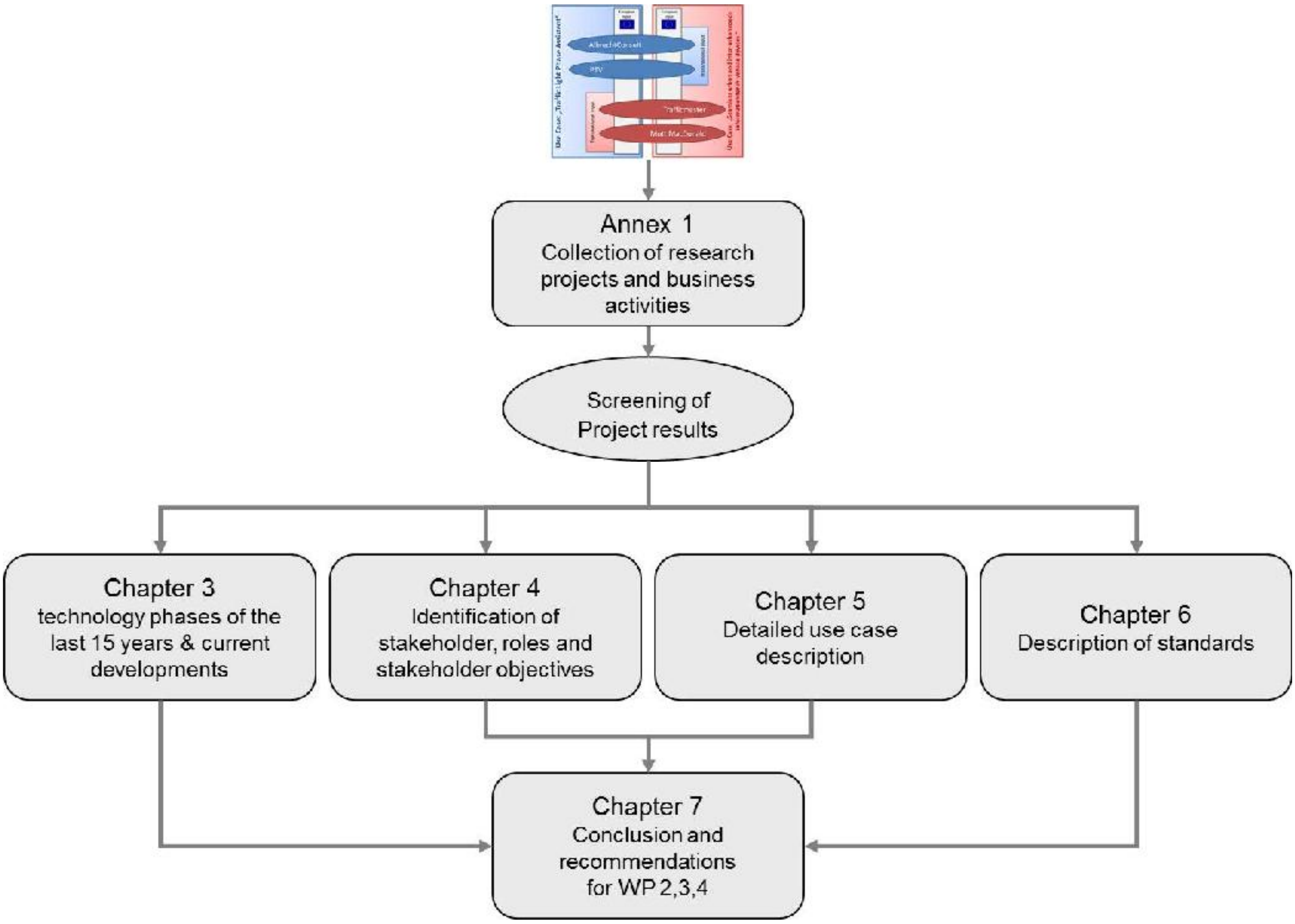

Figure 2 - Seamless project approach

3 Motivation

Business models and the introduction of new services should consider both lessons learned from the past and future technology roadmaps. In order to prepare the work of the following work packages section 3.1 gives an overview of the development phases of telematics and Intelligent Transportation Services. In addition section 3.3 explores the current stage of technology development and standardisation. Compared to the past especially, standards are becoming more and more important for the deployment of innovative service. They should speed up an easy market introduction and they are essential for cost efficient services and solutions.

3.1 Development phases

ITS systems look back on a tradition of almost 30 years, which is characterized by different development priorities. The following overview is intended to classify the current state of discussion. A clear understanding of the past is important in order to select the right deployment for the next generation of Intelligent Transportation Systems.

In the last three decades the development of Intelligent Traffic Systems has been dominated by a close interplay between transport technology, communication technology, automotive industries and services (including navigation). In this context the establishment of technological solutions is closely linked with the different requirements of private service providers (mostly cross-sector business models) and the public needs of road operators. Under consideration of the situation research projects addressed the coordination of systems and objectives of private and public actors. In the early development particular systems stand to the fore, informing the driver about the current traffic situation and travel opportunities. In recent years a new generation is getting more and more important where systems are interacting directly among each other on a machine-to-machine basis. Examples are cooperative driver assistance systems in combination with infrastructure systems. Three phases of development are distinguished:

1. The Pioneers (1998 - 2003): The Phase was greatly influenced by the idea of traffic information provisioning driven by the private sector. The road operator is only delivering the "raw data" for information generation. The ideas were driven by the hopes of ambitious expectations of the market and the corresponding business models. However the hoped-for market success remains was never realised. Reasons were: high communication costs, lack of services (central and terminal equipment), poor quality of information and from the customer side a lack of willingness to pay.
2. Consolidation phase (2003 – 2008): Operators of transport infrastructure identify the information to road users more and more as a task which is important in order to achieve active traffic management. At the same time TMC was discovered to provide information to the increasing number of navigation devices. In the hope of being able to keep communication costs low road operators and in particular the public service broadcasting built a new alliance in order to provide traffic information to the traveller.
3. Dynamic phase (since 2008): three slowly converging directions of development characterise the last years: (1) The international ITS community environment developed the entire technology spectrum of cooperative systems, which allow a

direct interaction between vehicle and infrastructure. Research activities made significant progress and the handover to standardisation bodies was established. (2) Contrary to the fears of the past decade, mobile communication is now ubiquitous. Not only a large numbers of people are using smart phones, even the car-industry offers more and more online services. (3) Navigation systems have become ubiquitous. In addition advanced driver assistance systems are available in mid-class vehicles. Both groups of vehicle systems are increasingly networked with each other and infrastructure information are getting more important.

Across all phases the focus of attention was on the motorway systems, this was partly due to the relatively good availability of data. For example traffic control systems are equipped with a dense network of different sensors for traffic and weather data. Furthermore urgent activities are the improvement of transport efficiency and traffic safety.

Current trends suggest that the future will be characterised by two main developments:

- The current technology development (section 3.2) is very much focused on the definition and introduction of standards. Furthermore the cooperation between stakeholders is becoming a key issue, because no commercially viable business case for closed telematics value-chains exists so far.
- Compared to the past, urban systems are getting more and more important in order to solve the traffic and environmental problems of the cities. The use case selection is reflecting this trend.

3.2 Current technology developments

Currently several attempts to standardize intelligent transportation systems are on-going at both a national and EU level. Standardization is a prerequisite for a cost-effective market introduction of systems and services if the highest possible widespread coverage of future applications is to be achieved.

On the experience of the above-outlined three phases, it seems clear that the future network of transport systems, depending on the application, works with different architectures approaches, communication channels and protocol standards. The attempt of the 1980's to establish a comprehensive standard (the GATS - Global Automotive Telematics Standard) was not successful because of the related IT complexity was too high.

Also, the systems will be designed to allow a flexible role assignment for institutions. From a technological point of view classical boundaries between the "private" service provider and the "public" infrastructure needs no longer to be hard. For example the public side will directly provide information to mobile devices and vehicle or private provide will operate services for the public institutions. The roles will vary depending on the goals and features of each stakeholder, in particular in the European context. The following figure shows an example of possible divisions of activities including interfaces between the players.

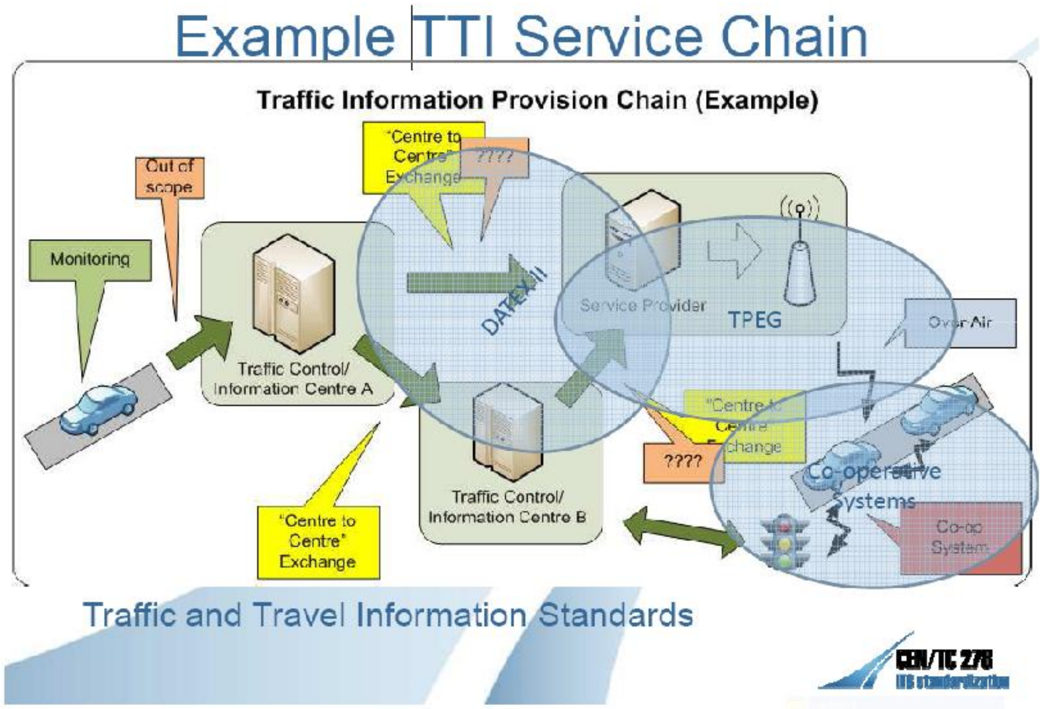

Figure 3 – Information chain Traffic Information

(Source: 3rd ETSI TC ITS WS, February 2011, Dr. Jonathan Harrod Booth)

The vehicles currently send collected data and information to a control centre by using non-standard interfaces. Especially the major navigation manufacturers are playing a strong role. Due to the different penetration of their devices on the market and their online and offline capability, the availability of generated FCD is different from country to country. Between centres the service providers and operators are able to exchange data and information for example via DATEX II, a dedicated and extendible standardized interface concept for traffic-related data. Together with its previous DATEX version the standard is in operation in the highway environment for more than a decade. The information communication back to the vehicles is carried out either via radio using TMC and TPEG, IP connectivity or in the future cooperative systems equipment on the roadside. In most of the cases no volume or time-related costs must be considered. The various communication methods are complementary to each other allowing a technologically seamless interaction through a continuous communication between the various system components. Another element is the Car2Car as well as the direct Car2Infrastructure communication. Both communication approaches are currently under standardization at ETSI and CEN.

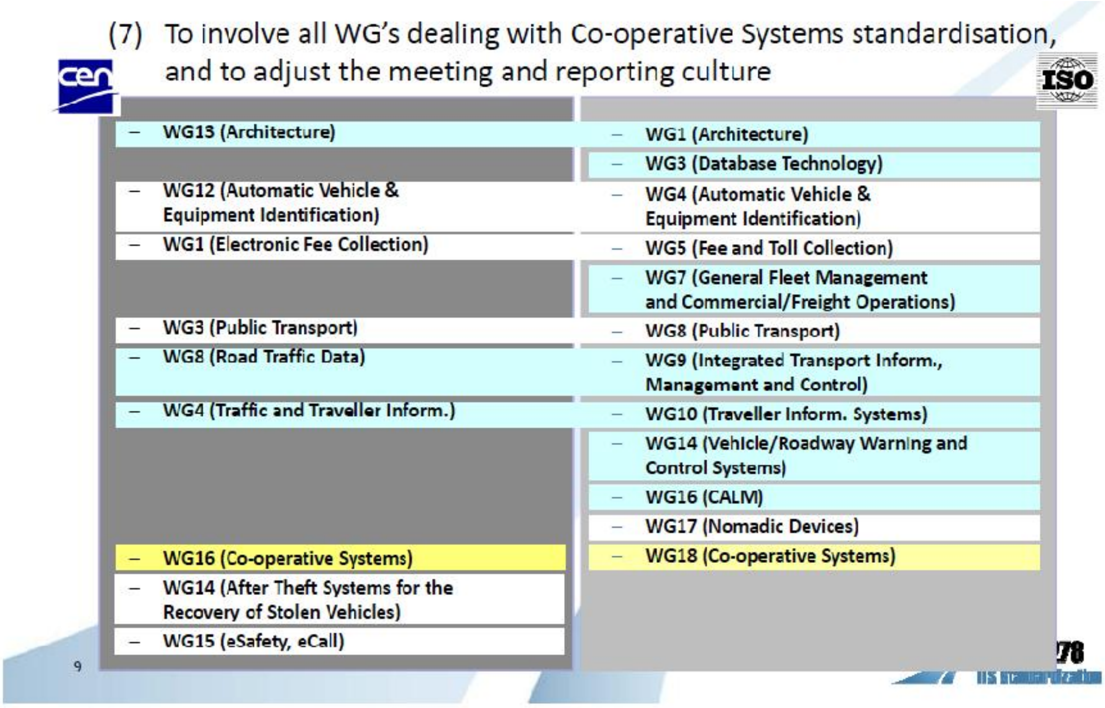

Figure 4 – Working Groups CEN & ISO (Source CEN)

4 Stakeholders and objectives

Typically the development of new and innovative technology is technology-driven. Organisational aspects play a minor role. But the market introduction requires that organisations will offer and operate the developed services either to improve their existing offerings or to realise new business opportunities. For the use cases analysed in the document the organisational situation is quite complex because on the one hand public and private stakeholders have to cooperate; on the other hand the institutional structure is different from state to state. Travellers driving around Europe are not aware of these differences and they are expecting the same service in each county. The structure of business models must be open in order to handle all these differences. Otherwise the business and institutional framework must be strong enough for the European wide service introduction.

After the overview in section 4.1 a classification of actors is given in section 4.2. These actors are able to take over different roles which are characterised in section 4.3. At this stage the document has to consider also how the stakeholders are working together along the value chain. In the next step the objectives of public and private stakeholders will be introduced. They are essential for creating the future business structure and the allocation of responsibilities in the public-private eco-system the document is aiming to develop.

4.1 Overview

In addition to technical aspects especially institutional settings are becoming increasingly important in debate of the development of cooperative systems. For instance the institutional positioning linked to legal frameworks must be considered in system design. This applies both to the public partners (road operator) and to the private side (automotive industry and service provider).

In particular if information or services, e.g. the traffic light phases assistant, will influence safety-critical processes in which more than one entity is involved (infrastructure, car) the clarification of all related legal matters is necessary. Today the automotive industry is offering autonomous assistance systems on the market. In this case the vendors themselves could clarify all issues concerning liability and quality management. The procedures for such an internal product release and quality assurance are already established in each single company. The future will include car-to-car communication, where for the first time the market will offer safety-related systems that use data sent by vehicles from other manufacturers. This situation requires appropriate certification mechanisms. The potential interaction with the infrastructure entities will increase the complexity again: (1) the domain "Automotive" has to interact with an external domain "transportation systems" and (2) traffic signals are not only information, they have legal status.

In addition to the technical system for the introduction of the cooperative systems an institutional architecture should be developed. Therefore the discussion has to consider the various stakeholders, actors and roles. The discussion is based on the following classification:

1 **Institutional framework** of cooperative system. The classification has to distinguish all types of institutions involved in the services. The institutional structure can be different from country to country. In the context cooperative systems have to play with a heterogeneous legal framework across Europe.

2 The **roles** that are needed for deployment of cooperative systems should be standardised across Europe. Each role has a dedicated position in the values chain. Considering the situation in Europe different institutions will take over a certain role.

4.2 Actors

4.2.1 Public

Local authorities

Within the systems discussed in this paper cities are responsible for the urban roadside traffic network infrastructure. This includes the operation of the urban roads as well as the traffic control and management systems. In addition to the technical tasks, they are also legally responsible for the traffic on the urban road network. Local authorities may also be responsible for rural roads.

Federal States

The provinces and states are responsible for the network of rural roads as well as for the national motorway network.

Police

The Police are responsible for the enforcement of traffic related legal issued as well as involvement in the gathering and the distribution of warning messages.

Public Transport

Public transport companies are responsible for operations of public transport. In cities they are operating fleet management and Intermodal Transport Control Systems (ITCS).

Public Broadcasters,

The broadcasters have to distribute safety critical warning by legal regulation.

4.2.2 Private

Private actors are more and more involved in the generation and distribution of traffic information. They act as services provider or equipment manufacturer. The automotive industry is also a part of the private sector and deeply involved in the development and market introduction of cooperative systems for traffic safety and traffic efficiency.

4.2.3 End User / Driver

Drivers and the road users are receiving the information distributed by the different channels.

4.3 Roles

Traffic Management Centre

The actor is responsible for the operation of traffic management inside a city or for motorways. In most of the cases the TMC covers both the traffic control infrastructure (traffic lights) and the information services which are linked to traffic management issues.

Roadside unit (RSU) operator & suppliers

Within the scope of Cooperative Systems roadside unit operators and suppliers participate actively in the value chain. In most of the cases they are also responsible for the classical roadside infrastructure. Normally the companies act as a supplier of the technical infrastructure and they may be responsible for the maintenance based on a contract with the road operator.

Content Centre

The Content Centre collects pre-processed data (raw data) from multiple sources and processes it according to the different requirements of each service.

Service Centre

The Service Centre is responsible for the technical operation of the service infrastructure. It integrates the necessary content, operates a computing centre in which the services runs and is responsible for agreed service levels.

Control Centre

The Control Centre is responsible for the delivery of the software and for monitoring the transactions. It gathers software components that are required for the services and groups them together if necessary. It also serves as a gateway that allows particular client systems to download the application. This actor is still relatively new, but will win with the increasing market penetration of "open platforms" in importance.

Communication Infrastructure Provider

The Communication Infrastructure Provider is responsible for data communication within the telematics chain. Corresponding to the particular requirements of the services a variety of communication channels and technologies are used. A provider may be responsible for one or more of these technologies.

Devices (navigation) manufacturer

Device Manufacturers supply assistance, infotainment and navigation system to the automotive sector as well as selling aftermarket products. The group is also covering the supplier of "open technology platforms," such as mobile phones. The user of these platforms can download applications via one or more control centres. For the future a smooth transition to "open vehicle platforms" is expected.

The market development of the services and systems offered by this group will influence the availability of potential telematics services significantly. It should be borne in mind that some terminals are specifically designed for to transportation-related applications, e.g. navigation systems. Open platforms are another group that can be used for telematic application, but they are not specially designed for it. An example is the use of mobile phones for information services, or for off-board navigation.

OEM

The role of vehicle manufacturers is always of great importance if the system is deeply integrated into the vehicle systems. For more centre-based applications the OEM is therefore a partner who is important for the terminal-side configuration of services. As mentioned earlier, "open platforms" are getting more and more relevant, but the OEM will always control the safety critical applications in the vehicle.

4.3.1 Actor – Role Matrix

The following matrix is matching actors and their potential roles. It is a reflection of the situation we have today and builds the basis for future business models.

	Traffic Management Centre	RSU Operator	Content Centre	Service Centre	Control Centre	Communication Infrastructure Provider	Device Manufacturer	OEM / Automotive
Public	X	X	X	X				
Private		(X)	X	X	X	X	X	X

Table 1 Matrix Actor – Roles

4.3.2 Value Chain

In order to setup cooperation between roles and stakeholders representing the roles a common understanding of the basic value chain is needed. Both on a national level but also on the European level several activities have produced value chains for traffic information services. The following figure shows one discussion result published by TISA, the stakeholder organisation developing the TPEG standard. It also matches the needed steps along the values chain with technologies which can be used for the exchange of information products produced by the segments of the chain.

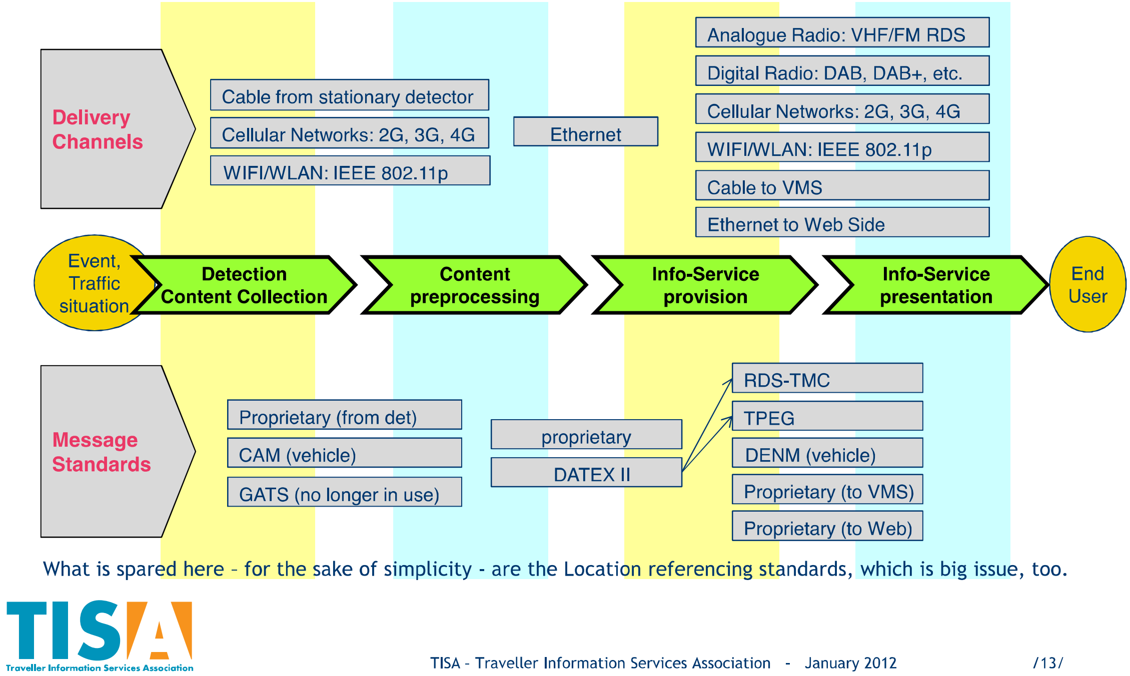

Figure 5 – Value Chain (Source: TISA)

4.4 Objectives and needs: Road Operators

The urban and interurban roads are managed throughout Europe by either public or private Road Operators. Although they do not share the same common goal, since public authorities are non-profit organisations whereas the priority of private companies lies in the maximisation of profit, the needs and objectives in terms of functional and technical availability of efficient and safe road traffic systems as well as reduction of operational costs are of interest for both. In the following it is not distinguished whether the Road Operator is public or private.

There are common objectives of both urban and interurban operators. These are the three global and comprehensive objectives of traffic operators, independent of geographical and structural surrounding conditions:

- Road traffic safety,
- Road efficiency and
- Sustainability

To guarantee above service is the first priority, in addition there are different individual objectives for urban and interurban regions which are highlighted in the following sections.

4.4.1 Urban

The demand of mobility and flexibility led and still leads to an increasing number of registered cars per inhabitants in Europe. In Germany there are more than 40 Million cars registered[2]

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[2] Federal Statistical Office Germany, Verkehr aktuell, 01 / 2012. (http://www.destatis.de/jetspeed/portal/cms/Sites/destatis/Internet/DE/Content/Publikationen/Fachveroeffentlichungen/Verkehr/Querschnitt/VerkehrAktuellPDF__2080110,property=file.pdf)

for a population of approx. 82 Million inhabitants, and rising – the traffic volume is constantly increasing.

Urban areas are characterised by high-density population and a long growing request on available space. The building density and district design in urban areas is often historically developed affecting and defining the physical dimension of existing roads and leaving not much potential for improvisation by means of cross section expansion. The trend of urbanisation together with the relocation of living environments to suburbs further contributes to the traffic volume in cities, which nowadays often exceeds the road capacity, especially during peak hours.

Urban Road Operators are confronted with the effects of the increasing traffic by the demands for higher throughput on the existing roads, for reduction of car park search traffic within city centres and for a reduction of noise pollution. Although the latter ones are more addressing transportation concepts rather than traffic systems they all have a direct influence on one another since the reduction of cars driving around trying to find a parking space clearly contributes to the traffic flow. Until now, the basis for enhancement of the traffic situation in urban areas was mainly a good traffic planning for single intersections and in addition the coordination of several nodes, if possible. Solutions for an adaptive network control have been developed since the 1970s but have not yet become established in the operational use in the large scale.

The OTS system model distinguishes two ways in which an urban Road Operator can influence the traffic in urban areas: traffic control systems (traffic lights, coordinated road sections, …) and traffic guidance systems (information systems, parking guidance systems, P+R, VMS, bollards/exclusion zones). To cope with the rising demand in terms of throughput the needs for urban Road Operators are efficient local solutions (road infrastructure or in-vehicle systems) for both control and guidance to dynamically adapt their switching/guiding behaviour to the surrounding traffic condition. Cooperative Systems seem to have the potential for improving the microscopic problems of urban intersections. Examples are

- the Traffic Light Phase Assistant, where signal information helps the drivers to optimise and adapt their driving behaviour to the current situation or
- systems, where traffic controller collect dynamic information about their surroundings (traffic situation) and optimise their switching behaviour.

For this however it is crucial to have good collective data available, representing the actual situation on the road.

In terms of traffic data and traffic data dissemination the interfaces of interest for urban Road Operators are therefore from the field layer to the central layer as well as from the central layer to the management layer (all bidirectional). Lately interfaces to ITS Central Stations of private services for data on traffic conditions became more and more important. More details on interfaces and their context in the ITS domain can be found in chapter 6.

4.4.2 Interurban

Operators of interurban roads have a slightly different focus. Interurban roads in general are less affected by structural or constructional limitation or noise pollution, though they are affected by the increasing traffic volume, several road sections are regularly or seasonally congested, e.g. during peak hours or on holidays. A measure to counteract these aspects is ITS.

ITS services play an important role; services for traffic control like dynamic lane management, HGV overtaking ban and hard shoulder running are common. In the management of interurban roads the perspective is more on a macroscopic scale. On the basis of routing strategies the operators inform the road user on current situations and guide him on the road network with the help of traffic information (traffic condition, travel times, …) and guidance through internet and VMS. However, nowadays private traffic data providers influence the choice of routes of the user through e.g. navigation services which do not always follow the routing strategies of the road operators.

Today's implemented ITS services require a certain infrastructure in the field, of which procurement and maintenance is rather expensive. With future in-vehicle devices ITS services could be brought directly to the user tailored to the individual needs of the driver. Road operators are researching in-vehicle traffic management in which mandatory instructions are presented via in-vehicle devices as an alternative to physical roadside signs.

In this context once again Cooperative Systems are helping to improve road traffic safety by transferring information into the vehicles. Examples are obstacle- or weather related hazard warnings or brake assistants.

The needs for the road operators are a coordinated agreement on routing strategies for their road network on the one hand, personalised in-vehicle information on the other.

In terms of traffic data and traffic data dissemination the interfaces of interest for interurban Road Operators are therefore from the field layer to the central layer (bidirectional).

4.4.3 Urban – Interurban Coordination

Different operators often manage the urban and interurban roads. This is historically grown and still is the usual mode of operation. In former times a communication between the two parties was rarely necessary which resulted in an independent development of organisational operation and responsibility. Due to the increase of traffic volume, the demand for connected mobility and expansion of urban to conurbation areas the significance of coordination between the two parties rises. A coordinated management however is not easy to achieve because legal differences first need to be solved. A successful implementation is the German Dmotion project, in which the City of Düsseldorf on the one hand and the Federal State of North Rhine-Westphalia on the other hand harmonise their traffic management activities by electronic data exchange (for Dmotion see also annex 1).

By implementing urban-interurban routing strategies, road users can be routed spacious around obstructions by stationary signalling systems. At present, a lot of effort is done to implement strategic routing on navigation systems. A main aspect is to prevent inconsistencies between the different information channels and the different authorities.

4.5 Objectives and needs: Private Sector

4.5.1 Car manufacturer

Car manufacturers are constantly seeking ways to improve their product proposition in order to differentiate the vehicles that they manufacture from those of their competitors and/or support the customers decision to purchase a particular vehicle.

The emergence and development of a broad range of commercially affordable connectivity solutions such as RDS, GPRS, and Wi-Fi have facilitated the development by Car manufacturers of in-vehicle services that are able to consume externally derived data, in order to deliver new in-vehicle driving aids that deliver an improved driving experience

Examples of such services include:

Traffic Light Assistance – where the driver is assisted to travel at the optimum speed between traffic lights

In-vehicle Traffic Services – where real-time traffic information is provided to the driver (normally via the in-vehicle navigation system) enabling the driver to optimise their journey time and avoid unnecessary delays

In developing these services car manufacturers are seeking to ensure that the end solution is:

Safe and Effective for Purpose

The services must operate safely, consistently and intuitively.

Commercially Attractive

The benefits delivered must provide an attractive value based proposition, such that the additional costs associated with delivery of the service are appropriately balanced with the benefits delivered.

Car manufacturers and the general public place different values on in-vehicle services depending on the benefits delivered. For example, safety based services are normally perceived as being more valuable than information based services.

Deployable on a mass market scale

The solution must be capable of being deployed to sufficient volume of production as to warrant the investment in the development and integration of the service in to the vehicle and to provide an acceptable commercial return to the car manufacturer.

Standardisation plays a particularly important role in delivering mass market deployment as it provides Car manufacturers with the reassurance that their in-vehicle equipment will perform as designed in each territory within which the in-vehicle service is offered.

Operable for the lifetime of the vehicle

Car manufacturers typically expect their products to have a lifetime of 10-12 years, with many offering 5-7 year warranties on the vehicle. It is therefore fundamental to the deployment of an in-vehicle information system that the supporting communications bearer can be relied upon to still be operational many years in the future.

A number of motor manufacturers have painful memories of programmes undertaken to achieve in-vehicle integration of first generation mobile phone handsets, only to find that the communications networks rapidly migrated to 2G technology, rendering the expensive integrated equipment useless.

4.5.2 Service Provider and navigation industry

Commercial Service Providers and the navigation industry are keen to exploit the opportunities created by the emergence of communications connectivity with motor vehicles, as this creates an entirely new market for service delivery and revenue generation.

In addition, given the stringent quality and safety requirements of the automotive industry, in-vehicle information-based applications have far greater value than information applications that are freely available via the internet.

For example, navigation instructions can be downloaded from thousands of internet web sites free of charge, whereas motorists are prepared to pay +Euro 1000 for an integrated in-vehicle satellite navigation solution in their vehicles.

Non-Commercial Service Providers, such as government agencies and other public authorities, are less focused on generating direct commercial returns from their roadside infrastructure, as the underlying technology has usually been deployed in order to deliver improved road safety and/or reduce traffic congestion.

The above said, additional applications based on data derived from such infrastructure is of benefit to such Government bodies, as these additional applications deliver incremental benefits to the general public and support the underlying business case for the original investment in the roadside infrastructure.

In developing these in-vehicle services the needs of the Service Providers and navigation industry are closely aligned with those of their key customers in that the solutions must be:

Effective for purpose

The services must operate safely, consistently and intuitively with the in-vehicle equipment

Commercially Attractive

The services must be attractive to the end user and be capable of delivering sufficient revenues through the underlying price/volume matrix in order to support the costs of service development and delivery, and to offer the prospect of delivering a long term commercial return to the service provider

Deployable on a mass market scale

The solution must be capable of being deployed to sufficient volume of vehicles as to warrant the investment in the development of the service and to provide an acceptable commercial return to the service provider.

Standardisation plays a particularly important role in delivering mass market deployment as it provides the service provider with the opportunity to deliver the same service to multiple car manufacturers, as well as the reassurance that the service will perform as designed with each different car manufacturer's in-vehicle equipment.

4.5.3 Broadcaster/Communications Provider

Commercial Broadcasters and Communications providers are primarily focused on maximising their investments in the radio spectrum that they have purchased, whilst complying with the regulatory obligations of their broadcast licences.

Public Broadcasters may have additional obligations placed on them by regulators/Government, such as delivering a specified range of 'public service' features within their broadcast output.

In developing in-vehicle services, the Broadcast/Communications providers typically operate as providers of the communications transport layer, as such they are less interested in the individual services offered than the Service Provider and Car Manufacturer groups.

The solutions delivered must therefore be:

Commercially Attractive

The services must be capable of providing a reasonable return to the broadcaster on the basis of the bandwidth that they consume. This often means that the Service Provider or Car Manufacturer has to guarantee to purchase a certain amount of bandwidth in order to secure the necessary communications spectrum from the Broadcaster/Communications Provider. Such as procuring a minimum number of Sim cards with a bundle of data for €x/month, or procuring a block of DAB spectrum for a fixed fee of €x/month.

Widely Deployable

Standards are also important to the communications/broadcast providers, as they ensure that the in-vehicle services that are developed can be supported within the overarching standards for the communications bearer.

4.6 Business Structure

Several on-going activities are aiming to improve the co-operation between the public sectors (mainly the road operators) and private company. Especially the exchange of data is in the focus of cooperation models. The road operators are mostly providing data to the private content providers. Besides raw data the distribution of traffic management strategies and their integration in navigation services are an issue, which is getting more and more import. The ITS Action Plan is also addressing the needs of exchanging strategy information.

In the Netherlands and in Germany data exchange platform are under operation. They make the data access easier and they support information about legal and commercial issues. The platforms support both selling data and buying data for all stakeholder groups.

The public TMC (Traffic Message Channel) services offered by the broadcast companies are working on the basis of an open cooperation model. Each cooperating partner can realise a win-win-situation for its own business. The broadcasters are aiming to increase their audience. The navigation system providers are looking for additional content in order to make the navigation product more attractive. Traffic information is a matter of marketing and customer relationship management.

Due to the fact that the end-customer’s willingness to pay is quite limited, win-win cooperation models are quite promising. The pure car-to-car services are following the same approach. The road operators have new possibilities to collect traffic data and to improve the traffic situation. The automotive sector is able to offer more advanced driver support functions.

5 Use Cases

Chapter 5 introduces in more detail the use cases which will be analysed in following work packages. Section 5.1 is describing the functionality of the services. In relation to this section 5.2 shows first findings concerning information models already implemented or developed in research projects.

5.1 Overview

5.1.1 Traffic Light Assistant

5.1.1.1 Local optimisation

This use case consists of a traffic light broadcasting timing data associated with its current state (e.g. time remaining before switching to orange, red). When receiving this information, a speed advice can be given to the driver according to its relative distance to the traffic light and to its current speed.

Basic application will use the speed advice pure driver information. More advanced information are receiving the traffic signal information for driver assistant system. Currently ACC systems are under development, which is optimized for driving in urban environments. More advanced systems will use the information for engine control in order to reduce fuel consumption.

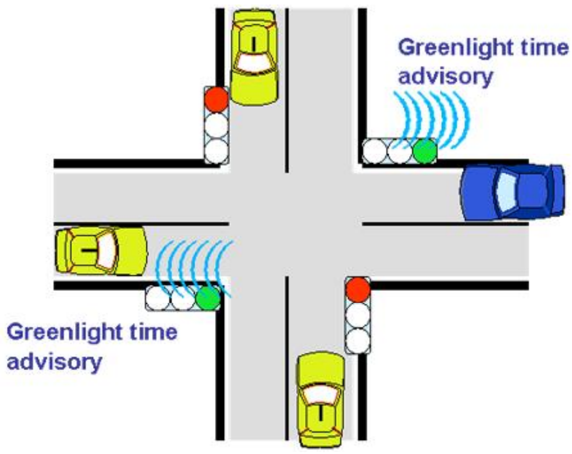

Figure 6 – Local Optimisation (Source: ETSI)

The use case includes several sub use case describing the drive at intersections in a more detailed way:

1. Supporting the approach to signal light. The function requires that cars receive the signal in around 100-meter distance.
2. Supporting the driver during the waiting time. In addition to an optimized approach a cooperative start-stop-function can reduce fuel consumption in urban areas by stopping and starting the engine under consideration of the received traffic signal.
3. Supporting the green light start. If the traffic signal is switching to green the start of single cars as well as following process can be supported.

5.1.1.2 Green wave

In addition to the optimisation of single intersection providing green waves can optimise a sequence of intersections. The provided information gives support to the driver to surf on green waves. In this context the innovative ACC systems will stabilise car platoons in order to realise the positive effects of green waves in a more efficient way.

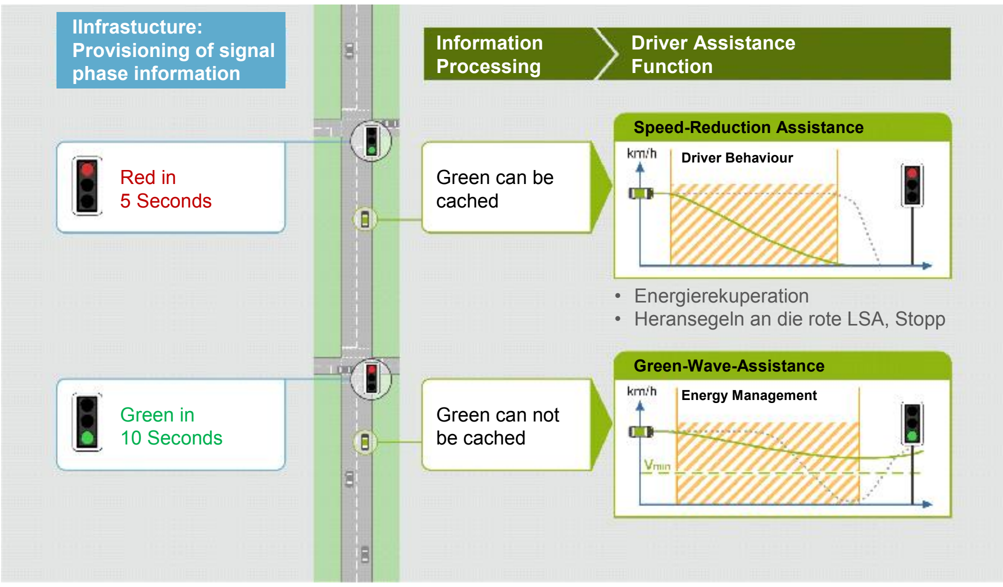

Figure 7 – Green Wave (Source: BMW)

5.1.1.3 Cooperative Adaptive network control

The next step is the integration of the traffic light assistance in an overall adaptive network approach. In this case all traffic lights are interlinked and the centre is calculation the best signal control strategy under consideration of the current traffic state. The centre side send the optimized control strategy to local traffic light controllers. They are acting as cooperative Road Side Unit and they are sending the signal phase information to the cars. One Example is the TRAVOLUTION project lead by AUDI.

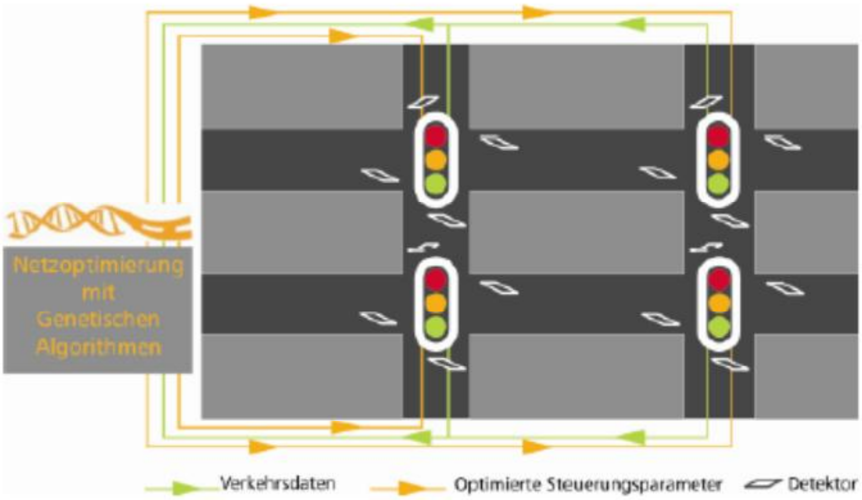

Figure 8 – Adaptive Network Control (Source Gevas Software)

5.1.1.4 Priority

To give priority to public transport and other public vehicles (police, rescue) is a well known function in urban areas and already introduced in most of the cities. The use case is influencing the local control directly and provides up-to-date signal phase information to the surrounding cars in combination with warnings.

5.1.1.5 Red light violation

A road side unit (e.g. traffic light or stop) will warn all surrounding vehicle drivers (including the one being at the origin of the event) that a given vehicle will be violating a road signal. All information on the vehicle type, heading, speed, etc. will be communicated by the RSU. The use case is combining the traffic signal messages distributed by the traffic light RSU and the CAM messages provides by all vehicles at the intersection.

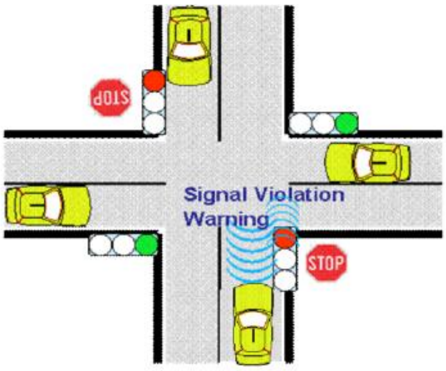

Figure 9 – Red Light Violation (Source ETSI)

5.1.1.6 Detection data

The use case is extending the use cases mentioning above by gathering of local detection data. The mid-term objective is the replacement of local detectors by floating car data describing in detail the traffic situation for each intersection. From the road operator view point the combination of detection data with signal phase information is essential for an overall concept of local and network wide traffic control.

5.1.2 Road Information

National and local road authorities perform automatic data collection using a wide range of technologies. Data collected provides speed, flow, journey time, weather conditions and other measures of the network. Additionally, manually entered data, such as recording of incidents, is also undertaken. Layered on top of this data is a level of human interpretation, which provides additional value, derived from knowledge and experience of the road authority personnel. Additionally, private sector companies, who are also able to provide instrumentation of the network with roadside sensors and floating vehicle data, generate a level of journalistic data.

In the Seamless project, the Road Information use case will have special focus on journey times, which should be seamlessly available across all jurisdictions to improve information services to road users.

As a road user, the travelling public are generally unconcerned with regard to the source of traffic information. End users do not, and ought not to have to, consider which authority is managing the road on which they are travelling, particularly as the journey will cross a number of management boundaries throughout its length. Similarly, the underlying technology generating network measurements, or algorithms, which aggregate and filter such data, are of little import.

The ultimate desire of the end user is for timely, relevant and accurate information supporting an informed route choice, or directly providing route guidance. This can be achieved through seamless provision of data through free or premium services.

Two key channels are to be considered for this:

- Smartphone, through an app deployed by the user on the smartphone
- Dedicated in-car device, usually a satellite navigation system

The main types of information which can be provided to the end user are:

- Delay information. This is particularly useful and practical where the user is navigating a pre-defined route, derived from a satellite navigation device. However, it can also be applied for the current and adjacent roads on which the vehicle is travelling
- Weather information, allowing drivers to be cognisant of dangers such as black ice, fog, or other hazardous conditions
- Traffic control information such as speed restrictions and dynamic hard shoulder running
- Routing strategies, offering alternative, shorter travel time routes based on current conditions.

Much of the information above can be provided to the driver “as-it-happens” as an on-screen alert or voice message to the driver. However, there a number of information elements which may best be presented as “virtual signs”. Virtual signs can provide general or specific information. For example, they may be used as reminders of low temperatures, or risk of fog. They can provide advisory speed limits, based on road conditions ahead.

Virtual signs are particularly apt for information which a driver may need to be reminded of several times over an element of the road network, e.g. reduced mandatory or advisory speed limit. As a virtual sign will have an area of influence, and direction, they can be specific to one carriageway and location, thus avoiding issues with broadcast messages, even those which are based on GPS location information. However, there is another school of thought that information should be given to a wide range of drivers, to let them do the filtering on relevance for their own circumstances. (This topic should be considered in Seamless WP 2.)

A final element to be considered is closing the loop with the end user. Having been provided with information on which to make a route choice, or provided with a route influence, the end user ought to be able to confirm that the modification to their journey resulted in a favourable reduction in the worst case travel time for the route to their chosen destination.

5.1.2.1 Are today's services seamless?

Taking the use of journey times in UK as an example, the current situation is that service providers use journey times on trunk roads, as supplied by the national road operators, but typically do not yet consume speed or journey time information from local authorities. The Seamless project WP 2 should consider in more detail why this is the case and what is required to move towards seamless services. The journey times are currently used for example to deliver "level of service" information via TMC and for routing and warnings to premium customers.

5.2 Information model

5.2.1 Traffic Light Assistant

Several research projects developed a huge number of application based on the interaction between car and traffic lights. Most of the projects used proprietary message formats for the data exchange. The SPaT message was developed in the US under the IntelliDrive program. The message is part of the US Standard SAE J2735 - Dedicated Short Range Communications (DSRC) Message Set Dictionary. The Standard SAE J2735 for dedicated short range communication (DSRC) is intended to meet the requirements of applications that depend upon transferring information between vehicles and roadside devices as well as between vehicles themselves. Typically, this type of communication occurs between moving vehicles entering a communications zone with fixed roadside communication equipment or directly between moving vehicles. DSRC provides the foundation for a variety of applications including vehicle safety, emergency vehicle notification, automated tolling, enhanced navigation, traffic management and many others.

In Europe the two standardisation organisations ETSI (TC ITS) and CEN/ISO (CEN/TC278/WG16 and ISO/TC204/WG18) are preparing a standard for traffic light status and timing as well. The work is planned for the year 2012. Results are expected by end of 2012.

5.2.1.1 Example SPAT Message

(Source: Investigating the Potential Benefits of Broadcasted Signal Phase and Timing (SPAT) Data under IntelliDriveSM: Susan Dickey Jim Misener Steve Shladover)

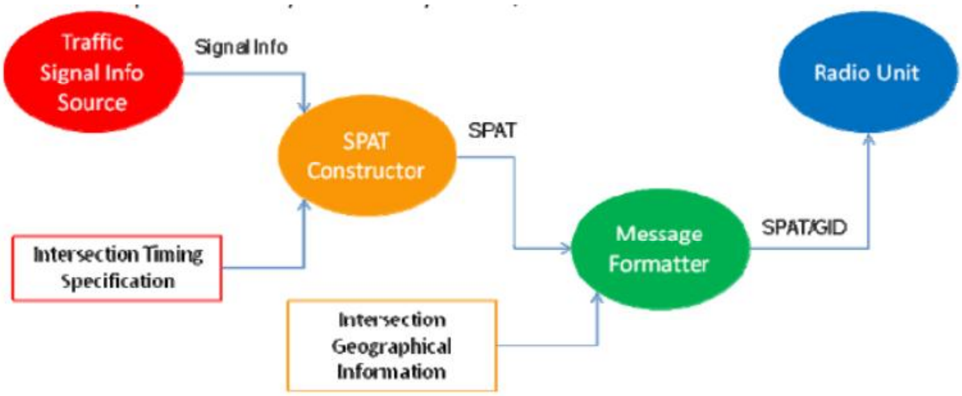

Figure 10 – SPAT Message construction

The “SPAT” is actually a complex of four messages:

Signal Phase and Timing – SPAT: Describes the signal state of the intersection and how long this state will persist for each approach and lane that is active. The SPAT message sends the current state of each phase, with all- red intervals not transmitted. Movements are given to specific lanes and approaches by use of the lane numbers present in the message.

Map Data - MAP: Describes the static physical geometry of one or more intersections, i.e., lane geometries and the allowable vehicle movements for each lane and introduces the idea of “intersection data frame” which describes barriers, pedestrian walkways, shared roadways and rail lines that may affect vehicle movements. Within SAE J2735, this message is precisely defined as the MSG_MapData. It is an object that includes complex intersection descriptions and can also described curved approaches. The contents of this message are at times referred to within the IntelliDrive program as the Geometric Intersection Description (GID) layer.

Signal Request Message – SRM: Requests pre-empt or priority services for public safety and transit applications. The current signal pre-emption and priority status, e.g., when active, are also sent.

Signal Status Messages – SSM: Describes the internal state of the signal controller. Provides a more complete summary of any pending priority or preemption events.

5.2.1.2 SPaT Message Set

The practice of SPaT and MAP is well-illustrated in Appendix H of SAE J2735, a portion of which is quoted below:

The overall use of the SPaT message is to reflect the current state of all lanes in all approaches in a single intersection. Any preemption or priority then follows in a structure for the whole intersection. Lanes that are at the same state (with the same end time) are combined. Thus the simplest SPaT message consists on two such states, one for the then active lanes/approach, and another for all the other lanes that at that time share the state being stopped (a red state). The stopped (red) lanes are optionally not sent at other times (the presumption being that any lane not enumerated in the SPaT is in fact set red).

Here is a message fragment illustrating this:

```
SPaT Message
            Msg id = 0x0c (indicates a SPaT message)
            SPaT id = TBD (indicates a unique value for this intersection)
            States

            State #1
            Lane Set (list of lanes this applies to) 1, 2
            Movement State (signal state or pedestrian state)
            SignalState = Green light
            TimeToChange = 12.3 seconds
            YellowSignalState =

            State #2
            Lane Set u(list of lanes this applies to) 3,4.5.6, etc...
            Movement State (signal state or pedestrian state)
            SignalState = Red light
            TimeToChange = Indeterminate for this state
            YellowSignalState
```

5.2.2 Road Information

Various standards have been developed to deliver traffic information derived from roadside infrastructure in to in-vehicle devices.

The most common formats are:

<u>Service Provider to In-Vehicle Systems</u>

<u>RDS TMC</u>

Background

This service has been designed to use the analogue FM radio data sub-carrier, as the communications transport layer, for encoded traffic information messages and the location of the traffic event.

As a result of the very limited bandwidth within the FM RDS spectrum, the system is based on a predefined set of available traffic message types, and a specified set of TMC location codes which represent points on the major road network.

This allows coded traffic events to be broadcast, and placed in the map within a satellite navigation system by use of the location codes that are broadcast with the event, and also embedded in the map.

The relevant RDS TMC standards and Information models can be found within the EN ISO 14819 series of standards.

Adoption

RDS TMC has been widely adopted by Traffic information providers, Car Manufacturers and the Satellite Navigation industry, with the vast majority of all in-vehicle satellite navigation systems supplied by Car Manufacturers in Western now being RDS TMC enabled.

Seamless focus - Journey times

Journey times are not directly represented, but can be used to provide speed bands.

<u>DAB TPEG</u>

Background

Many European countries are now moving to licence Digital Audio Broadcasting DAB services, which offer the potential for better utilisation of the radio spectrum, improved audio listening quality and increased bandwidth for data based services.

In view of the relative maturity of RDS TMC, it is unsurprising that the standardisation body for RDS TMC has also moved to develop Traffic Information standards within DAB, known as TPEG

These standards build on TMC, but also take advantage of the increased bandwidth available within DAB, facilitating more detailed descriptions of the traffic data, and more precise formats of location referencing.

In addition, and in order to take advantage of the additional bandwidth available within DAB, standards have also been defined within TPEG for additional in-vehicle information services such as: Parking, Petrol Prices, Weather etc

The relevant DAB TPEG standards and information models can be found within the ISO/TS 18234 series of standards, and the Location Referencing for Geographic Databases within ISO 17572.

Adoption

DAB TPEG is still in the early phases of adoption, as many European markets have either not yet licensed national DAB multiplexes or have only recently done so. This has limited the potential scale of deployment for DAB based services, and in consequence the Car Manufacturers continue to distribute RDS based devices in preference to DAB based systems.

<u>XML TMC/TPEG</u>

Background

With the rapid development of mobile phone networks delivering advanced data communications through GPRS/3G based technologies, it has also become economically possible to deliver TMC and/or TPEG encoded traffic information through mobile phone based communications transport layers, using the same techniques as are commonly adopted for internet based data services.

These methods utilise the same data structures as have been defined for TMC and TPEG but delivered in an XML encoded format.

Adoption

XML TMC/TPEG has benefited from the maturity and ubiquitous availability of GPRS/3G communications across Europe, coupled with the slow roll-out of DAB in some territories and the plans to end analogue FM transmissions in others. This has attracted an increasing number of Car Manufacturers and Navigation suppliers to adopt 'connected' technology rather than 'broadcast' based solutions on their latest generation of in-vehicle entertainment platforms.

Seamless focus - Journey times

TPEG includes the module "CTT - Congestion and Travel-Time", which is reported to be in the late design phase.

Roadside Infrastructure

UTMC

Background

Launched in 1997, the UTMC programme is a UK Department for Transport (DfT) initiative designed to assist local government authorities to gain the most from their ITS investments by allowing the different applications used within modern traffic management systems to communicate and share information with each other.

UTMC adopts an appropriate, but not over constraining, set of standards to allow users, suppliers and integrators of UTMC systems to plan and supply systems cost-effectively in an open market. UTMC has become the preferred ITS platform for UK towns and cities.

The key data objects defined in UTMC for exchanging data between systems are:

- Access Control, representing equipment such as rising bollards, and including attributes such as current state
- Accident, representing road traffic accidents, including location and severity.
- Air quality, describing air quality measurement equipment and associated readings
- Car Park, describing a physical car park, and associated status (such as open or closed, or number of available spaces)
- CCTV, describing location and type of CCTV camera, current status and latest image
- Detector, describing vehicle detection equipment and associated data, such as flow , headway and occupancy information
- Event, representing planned events that could have an impact on traffic
- Incident, representing unplanned incidents that are relevant to traffic management
- Meteorological, describes the weather conditions at a current point in time or the forecast conditions at a given location
- Roadworks, representing an instance of roadworks at a defined location, including start/end times and lanes affected.
- Traffic Signal, traffic signals, their status and configuration

- Transport Link defines road links within a system of traffic monitoring, including details of the traffic monitoring technology, its configuration and dynamic data.
- Transport Route representing routes and properties that apply to routes.
- VMS representing on-street VMS, including current status and sign settings

Additionally, the following MIBs are defined to allow interaction with infrastructure:

- Air quality monitor, supporting retrieval of air quality measurements
- VMS, supporting setting and retrieval of VMS sign settings and status
- UTC, supporting setting and retrieval of traffic signal configuration and status
- Car Park Monitor, supporting setting and retrieval of count and status information
- Traffic Counter, supporting retrieval of count information

Seamless focus - Journey times

Journey times are included in the UTMC data model within the "Transport Link" and "Transport Route" data objects as shown in the UML class diagrams below. Additionally journey times could be derived from speeds, supplied in the UTMC "Detector" data object. Full details of the information models are available in the form of navigable UML models at the ITS Metadata Registry (www.itsregistry.org.uk).

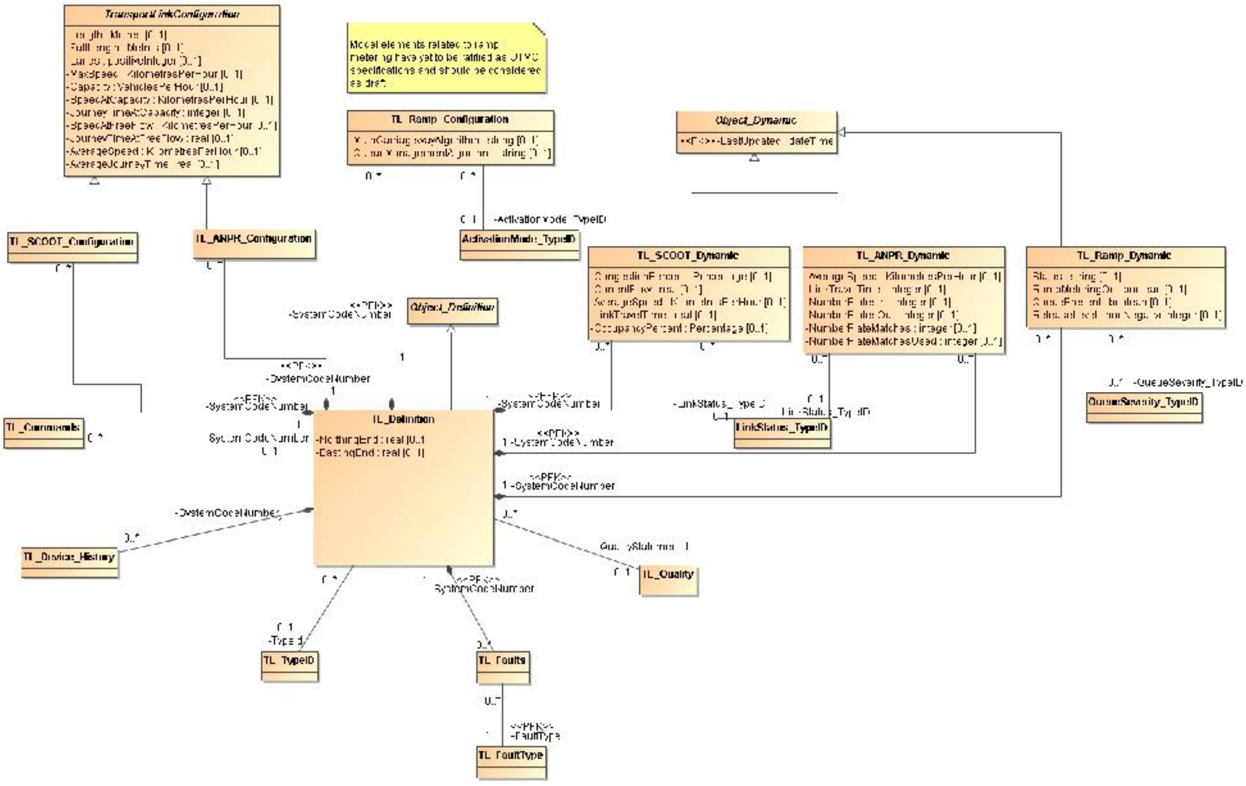

Figure 11 UTMC Transport Links

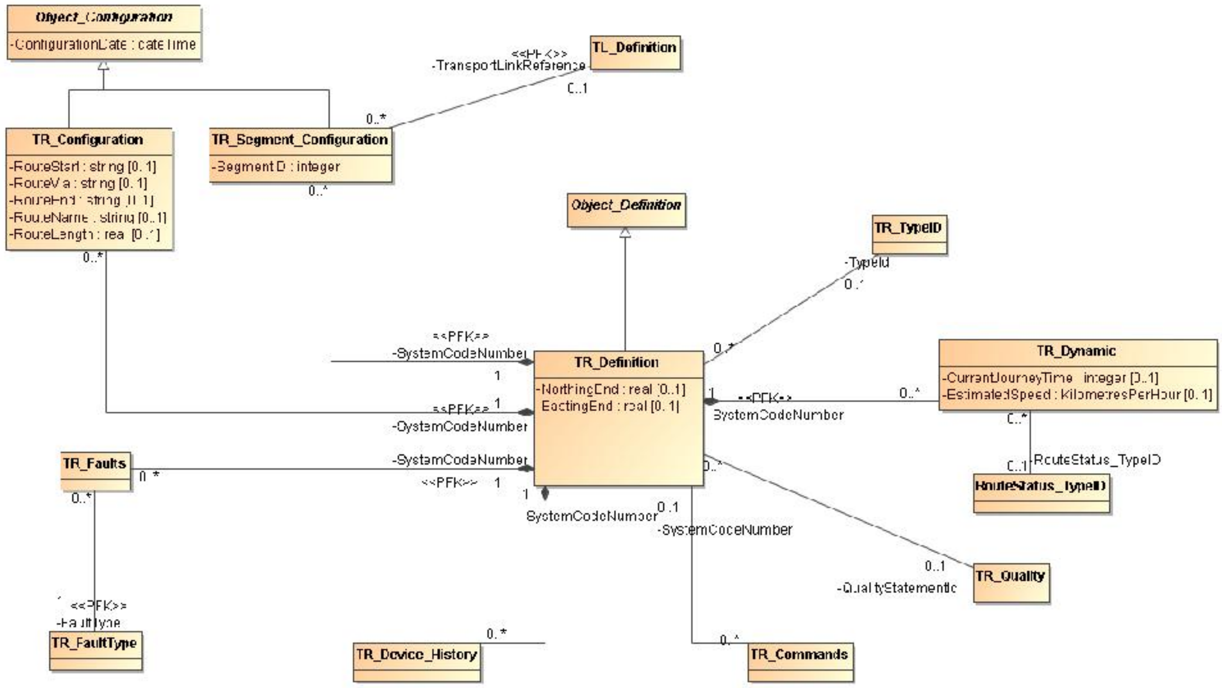

Figure 12 UTMC Transport Routes

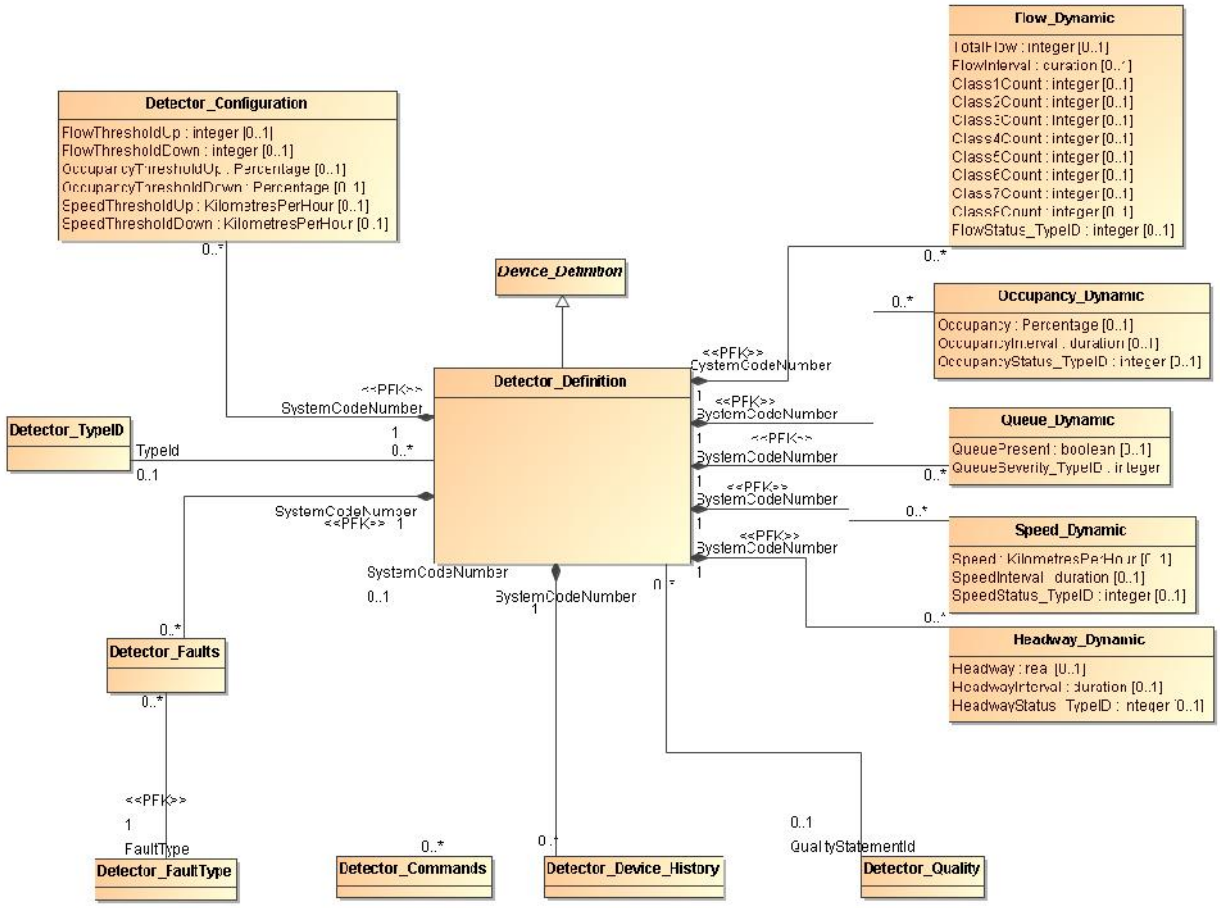

Figure 13 UTMC Detector information

Adoption

UTMC is very widely implemented in UK, with over 100 authorities (county-based, conurbation-based and regional) having implemented UTMC systems.

Public Sector to Service Provider

In the UK, local authorities may provide either access to their central UTMC systems, or in some cases they provide a separate DATEX II feed for external organisations.

Seamless focus - Journey times

In DATEX II journey times are held in the TravelTimeData class, a subclass of BasicData which can be used within a MeasuredDataPublication or an ElaboratedDataPublication.

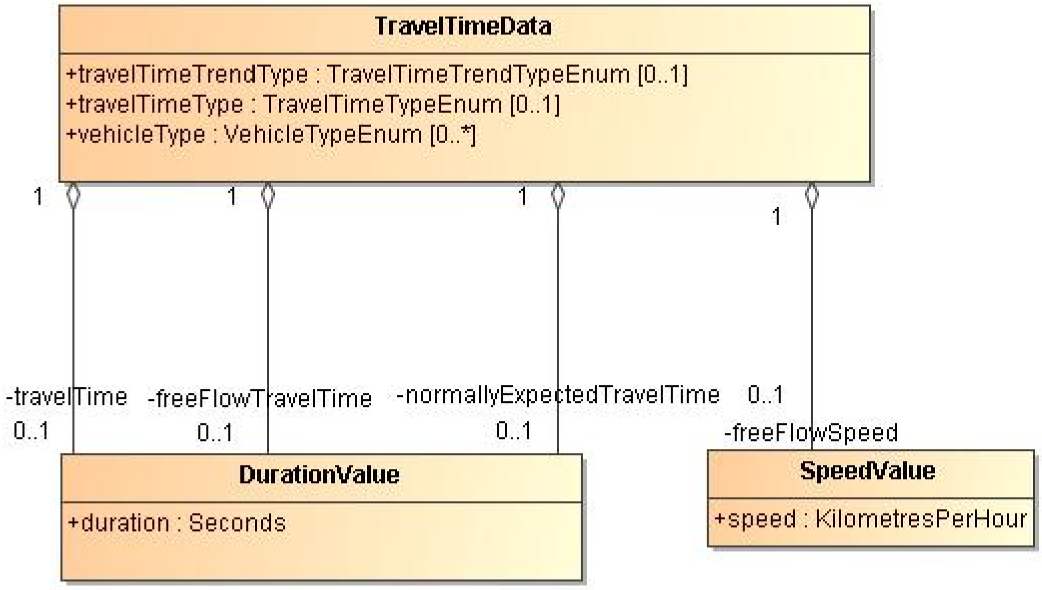

Figure 14 DATEX II Travel Times

6 Standards

In the following section provides information about the relevant standards and de-facto standards. It starts with an overview of the UK situation followed by Germany in section 6.2. Section 6.3 covers the European context and the related standardisation activities. Finally section 6.4 considers the newest Car2Car and Car2Infrastructure developments.

6.1 Infrastructure UK

6.1.1 UTMC

Name: Urban Traffic Management and Control

Licence: Open standard

Version: UTMC-TS003_003:2009 (UTMC Framework Technical Specification), UTMC-TS004.006:2010 (UTMC Objects Registry)

Reference / Specification / Norm: UTMC-TS003_003:2009 (UTMC Framework Technical Specification), UTMC-TS004.006:2010 (UTMC Objects Registry)

Implementation focus: The UTMC technical specification describes an architecture with 5 node types:

- Node A: external systems which connect via Node B;
- Node B: UTMC management centres;
- Node C: UTMC outstations
- Node D: UTMC controlled units
- Node E: mobile units which have an external connection to the UTMC system via Nodes B,

Interconnection of these node types is summarised in *Figure 15*. UTMC seeks to support data transfer between each of these node types, with the following characteristics:

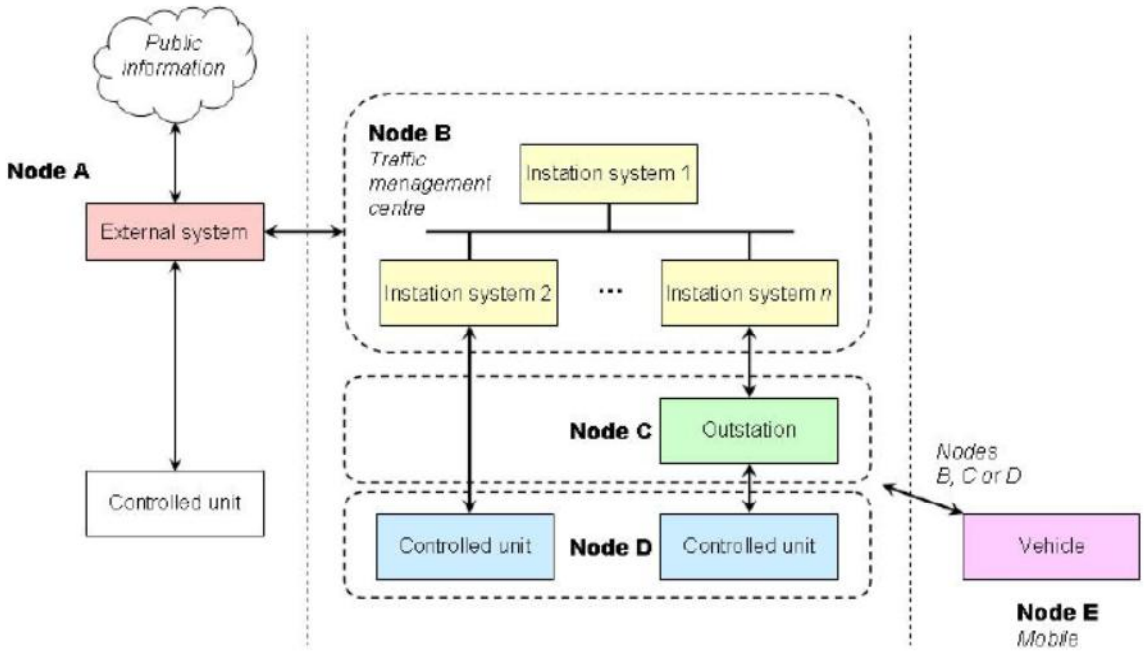

Figure 15: UTMC logical reference model

(extracted from framework Technical Specification)

Urban/Interurban usage: Developed for Urban, but evolving in inter-urban

Communication protocol (s): CORBA IIOP (supporting Data Object exchange), XML over HTTP (supporting Data Object exchange), SNMP (supporting MIBs)

Channel*:* Any IP transport layer

Functional content:

Database Objects are units of information. They were developed primarily for use between applications within Node B, and between Nodes B and C, via the Common Database. They may also form the basis of the message content for other transactions (eg VMS messages to Node D or flow reports to Node A). In information systems terms, these are “entities” with “attributes”. XML Objects are transaction structures for the exchange of data over XML/HTTP. They are intended primarily for exchanges between Node B and Node A, but may also be used within Node B (between applications or to user screens) or, where bandwidth is sufficient, over other links. XML Objects will be XML schemas.

MIB Objects are frameworks for local information management in managed devices. They are Management Information Bases (MIB) and are intended specifically for use over SNMP. Their primary role is seen as between Nodes B/C and D, though they may be applicable to other contexts too (eg to Node E where applications involve reading in-vehicle tags, such as access control).

Services are frameworks which establish the protocols of data exchanges between Components. This would include IDL scripts for CORBA environments, as well as Web Service descriptions based on WSDL/SOAP etc.

For further information see www.utmc.uk.com. The above details are extracted from the Technical Specification and Objects Registry

6.1.2 National Infrastructure

While UTMC is used by local authorities in UK, national bodies own additional specifications for communications with infrastructure. These national specifications are not publicly available, but for most of them access can be granted by the national bodies for legitimate purposes and they are otherwise open. The Highways Agency Traffic Management Systems (HATMS) equipment follows a suite of specifications known as "NMCS2". Transport Scotland is increasingly using UTMC but has significant legacy equipment following various specifications including NMCS2.

6.2 Infrastructure Germany

6.2.1 OTS

Name: Open Traffic Systems

Licence: Open

Website: http://www.opentrafficsystems.org

Version: 91213-1

Reference / Specification / Norm: DIN SPEC

Implementation focus: Center – Center, Center – Infrastructure

Urban/Interurban usage: Urban and Interurban

Communication protocol (s): XML, SOAP, HTTP, based on standard protocols

Channel: cable

Functional content:

No own data model. Fully supports the data models of DATEX II and OCIT-Instations and is extensible.

Additional textual description: OTS is both an interface description and gives process support.

6.2.2 OCIT

6.2.2.1 OCIT-O

Name: Open Communication Interface for Road Traffic Control Systems - Outstations

Licence: Open, one-off costs for manufacturers

Website: http://www.ocit.org/

Version: V2.0

Reference / Specification / Norm: -

Implementation focus: Center – Infrastructure

Urban/Interurban usage: mainly urban usage

Communication protocol (s): BTPPL, based on standard TCP/IP protocols

Channel: cable or radio, unicast

Functional content:

Functional coverage:

- Switching commands
- Status information
- Messages
- Raw traffic data
- Aggregated traffic data
- Public transport

Additional textual description: OCIT-O is used for communication between centre systems and traffic lights in urban areas. There are only few implementations on interurban roads.

6.2.2.2 OCIT-I

Name: Open Communication Interface for Road Traffic Control Systems - Instations

Licence: Open

Version: V1.1

Reference / Specification / Norm: -

Implementation focus: Center – Center,

Urban/Interurban usage: only urban usage

Communication protocol (s): XML, SOAP, HTTP, based on standard protocols

Channel: cable, unicast

Functional content:

Functional coverage:

- Status information
- Traffic data
- Messages
- Control data
- Configuration management data
- public transport

Additional textual description: This standard was developed by the OTEC, is still in use but is not maintained any further since OTEC does not exist anymore.

6.2.2.3 OCIT – C

Name: Open Communication Interface for Road Traffic Control Systems - Center to Center

Licence: Open

Website: http://www.ocit.org/

Version: V1

Reference / Specification / Norm: -

Implementation focus: Center – Center

Urban/Interurban usage: Urban and/or Interurban usage

Communication protocol (s): XML, SOAP, HTTP, based on standard protocols

Channel: cable or radio, unicast

Functional content:

Functional coverage:

- Traffic data
- Centre sub systems
- Messages
- Park traffic data
- environmental data
- sign systems
- public transport

Additional textual description: OCIT-C is used for communication between centre systems (traffic computer, parking systems, systems for quality assurance, configuration management, …).

6.2.3 Marz

Name: Merkblatt für die Ausstattung von Verkehrsrechnerzentralen und Unterzentralen

Licence: Open

Version: 1999

Reference / Specification / Norm: -

Implementation focus: Center – Center

Urban/Interurban usage: Interurban usage

Communication protocol (s): -

Channel: -

Functional content:

Functional coverage:

- Role of the centre system
- Description of the traffic-related requirements
- Requirements to Hard- and Software
- Mode of communication between centre systems

Additional textual description: The MARZ supplements the TLS specification. It is a guideline for the equipment of traffic centre systems.

6.2.4 TLS

Name: Technische Lieferbedingungen für Streckenstationen (TLS)

Licence: Open

Version: 2002

Reference / Specification / Norm: -

Implementation focus: Center – infrastructure

Urban/Interurban usage: Interurban usage

Communication protocol (s): TLS

Channel: cable, uni-/broadcast

Functional content:

Functional coverage:

- Requirements on road infrastructure
- Test instructions
- Architecture and protocols for traffic data detection and traffic control on interurban roads

Additional textual description: TLS is a guideline which was developed by the German Federal Highway Research Institute in cooperation with industry and Länder administrations. It is supplemented by the MARZ.

6.3 Infrastructure EU

6.3.1 DATEX II

Name: Intelligent transport systems - DATEX II data exchange specifications for traffic management and information

Licence: Open standard

Website: http://www.datex2.eu

Version: DATEX II v2.0 (from July 1st, 2011)

Reference / Specification / Norm: CEN TS 16157 Part 1-3:

1. Context and Framework
2. Location Referencing
3. Situation Publication

Implementation focus: mostly Center to Center, but there are also other layouts of connections, see ITS architecture model

Urban/Interurban usage: origin of DATEX II was interurban focus, but due to its extension features meanwhile it covers also urban features

Communication protocol (s):

XML via SOAP or HTTP

There are two DATEX exchange protocol profiles specified (PUSH/PULL with web services, PULL with http) which are not yet element of the CEN standardisation. This part is currently being reengineered by EASY WAY ESG5 in cooperation with ISO TC204 WG9.

Channel: usually cable

Functional content:

Functional coverage:

- Level of service on the network, both in terms of messages for specific situations or as an overall status on the network
- Travel times, be it on short network links or for long distance travel itineraries
- All types of incidents and accidents
- Road works
- Road infrastructure status
- Closures, blockages and obstructions
- Road weather, again as events as well as status / measurements
- All kinds of traffic related measurements (speed, flow, occupancy)
- Public events with impact on traffic
- Current settings of variable message signs

Additional textual description:

The DATEX II organisation offers several working groups which maintain and refine the standard. On www.datex2.eu, users can download all necessary information and modelling issues and use forums or an issue tracker system for communication.

6.4 Service and Car-Centric Standards

6.4.1 TMC

Name: Traffic Message Channel

Licence: For influencing the further development of the standard the TISA (Traveller Information Services association) membership is necessary. In practice the usage of TMC is open.

Version: -

Reference / Specification / Norm: ISO TC 204 WG 10

Implementation focus: Center – Car/Mobile Device

Urban/Interurban usage: Urban & Interurban; the message distribution is limited by a fixed location table.

Communication protocol (s): The message format is protocol independent.

Channel: radio, broadcast, cellular

Functional content: TMC is a specific application of FM RDS used for broadcasting real-time traffic and weather information. Data messages are received silently and decoded by a TMC-equipped navigation system, and delivered to the driver, typically by offering dynamic route guidance - alerting the driver of a problem on the planned route and calculating an alternative route to avoid the incident.

6.4.2 TPEG

Name: Transport Protocol Expert Group

Licence: For influencing the further development of the standard the TISA (Traveller Information Services association) membership is necessary. In practice the usage of TMC is open.

Version: -

Reference / Specification / Norm: ISO TC 204 WG 10

Implementation focus: Centre - Car

Urban/Interurban usage: Urban / Interurban. TPEG is supporting on-the-fly location referencing methods.

Communication protocol (s): The message format is protocol independent.

Channel: radio, broadcast, cellular

Functional content: TPEG specifications offer a method for transmitting multimodal traffic and travel information, regardless of client type, location or required delivery channel (e.g. DAB, HD radio, Internet, DVB-x, DMB, GPRS, Wi-Fi …). Language independence has also been a prime principle in the design.

6.4.3 ETSI - Car2X

Name: ETSI – Technical Committee Intelligent Transport Systems

Licence: IPR issues are completely clear for the moment

Version: First official version is expected in summer 2012

Reference / Specification / Norm: ETSI TC ITS

Implementation focus: Car – Car, Centre – Car, Infrastructure – Car

Urban/Interurban usage: Urban & Interurban

Communication protocol (s): ITS Transport & TCP

Channel: cellular, short-range

Functional content: Intelligent Transport Systems (ITS) include telematics and all types of communications in vehicles, between vehicles (e.g. car-to-car), and between vehicles and fixed locations (e.g. car-to-infrastructure). However, ITS are not restricted to Road Transport - they also include the use of information and communication technologies (ICT) for rail, water and air transport, including navigation systems.

6.4.4 ISO/CEN Car2X

Name: WG Co-operative Systems

Licence: IPR issues are completely clear for the moment

Version: First official version is expected end of 2012

Reference / Specification / Norm: ISO TC 204 WG 18 in cooperation with CEN TC 278 WG 16

Implementation focus: Car – Car, Centre – Car, Infrastructure – Car

Urban/Interurban usage: Urban & Interurban

Communication protocol (s): ITS Transport & TCP (preferred but also other protocols are possible)

Channel: cellular, short-range

Functional content: Standardisation of co-operative system from an infrastructure operator viewpoint.

7 Conclusion with respect to WP 2, WP 3, WP 4

Currently a huge number of standardisation and business development activities are ongoing. The outcomes of the subsequent work packages must reflect these activities. In particular all the work of TISA as well as of ETSI/CEN will influence the future market introduction of the services, which are in focus of the Seamless project, significantly. The innovation-oriented activities are mainly based on the following projects (see annex 1):

- COMeSAFTEY is consolidation the outcomes of the research projects.
- CVIS/SafeSpot/Coopers are providing basic technology oriented results on a European level. Aktive is playing a similar role for Germany.
- SimTD and Drive C2X are the most relevant field operation tests (FOT) preparing the market introduction both from a technical and institutional viewpoint.

Beside of the projects the existing landscape of commercial and traffic management services must be considered because the introduction of new services must be based on sound migration strategy.

7.1 Business models

The further analysis and recommendation concerning the business models and structures in the field of intelligent transportation systems has to consider the following developments of the last years:

- Road operators are recognising traffic information as a powerful tool for the traffic management in urban areas and on motorways. They are investing in both detection infrastructure and information services. The ITS Action Plan of the European Commission is forcing new public activities in the future. As a consequence the quality of public services is improving significantly.
- On the private side we see a number of established business activities in traffic information on a (at least) European scale. Companies are producing high quality traffic information mainly based on floating car and floating mobile data. In most of the cases they are offering the data to private service providers on a commercial basis.
- Depending on the market a dedicated service provider is aiming to address, two data sources will be available in the future: free of charge data coming from the road operators, and commercial data provided by private content suppliers. At the moment the quality of the second source is significantly better. Nevertheless the public data have a value for certain services.
- Although content providers are offering high quality data the road operators are interested to buy commercial data in addition to the traditional fixed detection infrastructure in order to improve quality and to reduce costs. But it is in the interest of road operators, too, that service providers are integrating traffic management strategies in their services.
- Looking to future services, especially the integration of traffic light information in innovative driver assistance systems in addition to the classical traffic information, other infrastructure information are becoming more important, e.g. traffic light data. In comparison to the situation today these types of data can only be provided by the road operators.
- From an end-user perspective the willingness to pay for traffic information is still very

limited, but Apps running on smart phones and App stores have changed the commercial eco-system in the last three years. A huge number of road users are buying traffic services for a very limited amount of money. As a consequence on the one hand a new type of market for traffic information services is emerging. On the other hand new data sources will be available because all the new services are able to send back up-to-date traffic data to services centres.

In total in WP 2 there is room for the development of blue prints for business models. Due to the variety of stakeholders and interests more than one business model will be needed. The work has to consider that in the commercial world business models are describing the business activities and relation between stakeholders by providing financial figure. All experience of the past shown that working with figures in such a project is not possible. More important is to outline the business structure of the relationship between partners. WP 2 has to figure out a set of principles for the relationship between stakeholders having both commercial and social interest. Furthermore a “Value Network” will replace the traditional values chain, which is representing a more technology-oriented view. In most of the cases a dedicated stakeholder will represent two roles: provider of information and supplier of information.

7.2 Architecture

The work on the architecture in WP 3 should bring together the standardisation work currently running on European level and the standards which are already established in the member states of the European Commission. The activities in Europe are driven by ETSI and CEN/ISO based on a mandate of the European commission. They are essential in order to bring infrastructure information into vehicles because these kinds of services must be harmonised (at least in Europe). The results produced by the two organisations are touching the needs of legacy systems only marginally, though. To ensure the deployment of innovative services, like traffic signal assistance, migration concepts are needed which are joining the new upcoming standards with the technology, which is already in place. WP 3 will contribute to this work with special focus on the transnational technology setup in Germany and UK.

7.3 Protocols

The protocol related work in WP 4 has to be closely linked to the architecture related outcomes. The standardisation work in Europe will influence the potential protocol implementation as well. Considering the transport channels in use it can be seen that broadcast, cellular communication and short-range communication will be used in parallel. The technology-oriented stakeholders must be able to handle the related transport protocols.

The discussion has to distinguish between the transport protocol itself and the data structure, which will be implemented for the information exchange. Most of the new developments in this field define data communication structures that can be used independently from the communication channels or rather from the communication protocol. Out of the analysis it can be said with respect to standard interfaces it appears that WP 4 should consider the following data structures for the data exchange:

- DATEX II for the information exchange between centres. Depending on the future role of road-side-station the discussion has to figure out, if DATEX II is also the appropriate mean for this communication link.
- For direct communication between centres and vehicles, TPEG is the leading

candidate. Current activities are starting to develop a TPEG based data structure for the exchange of traffic signal information.

- ETSI/CEN C2X-standard will cover the communication between cars as well as the car-to-roadside unit communication.

All mentioned data structures have strengths and weaknesses depending on the use case and the systems set-up. The development will show that all three groups must be implemented in parallel to meet the requirements of different services.

8 Appendix 1 – Projects

DRIVE C2X		
Project Organisation	Coordinator	Matthias Schulze, Daimler
	Partner involved	OEM, suppliers, reserach, academia
	Contact Seamless	Dr.-Ing. Thomas Benz
	Start date	01.01.2010
	End date	31.12.2012
Application Use Cases	Description	Safety systems: Traffic Jam Ahead Warning, Roadwork's Warning, Car Breakdown Warning, Approaching emergency vehicle, Weather warning, Emergency electronic brake lights, Slow vehicle warning, Post Crash Warning, Obstacle Warning, Wrong way driving in gas station, Motorcycle warning Efficiency systems: In-vehicle signage, Green Light Optimal Speed Advisory, Traffic Info and recommended itinerary, Infotainment and commercial systems: Insurance and Financial Services, Dealer Management, POI notification, Fleet Management
	Category	x Safety x Efficiency ☐ Environment x Urban x Interurban
	Relevance for SEAMLESS	Newest implementation of C2X Services. Refelcts the state of the art. x UC Traffic Light x UC Journey Time
Business Structure	Stakeholder	x Road Operator x Automotive x Service Provider
	B2C payment	x Free of Charge x Paid service
	B2B / B2A payment	x Free of Charge ☐ Paid service
	Contracts	Technology development and field operational test; no commercial Contracts
Expected Benefits of the cooperation	Infrastructure	Increase efficiency of the road traffic
	Automotive	Increase safety by using C2C Communication
	Service Provider	--
Information Exchange	Content Semantic	Mainly ETSI ITS (Car2x)

	Communication Protocol	Mainly ETSI ITS (Car2x)
	Channel	☐ Broadcast X Cellular x Short Range
Architecture	Entities	☐ Center - Center x Center - Car x Center - Infrastructure x Car - Infrastructure x Car – Car
	Description	Based on the ETSI ITS station architecture; integration in different European test fields under consideration of local standards.

Table 2 Project overview Drive Car2x

SafeSpot		
Project Organisation	Coordinator	CRF
	Partner involved	OEM, suppliers, reserach, academia
	Contact Seamless	Dr.-Ing. Thomas Benz, Dr.-Ing. Michael Ortgiese
	Start date	1.04.2008
	End date	30.6.2010
Application Use Cases	Description	SAFESPOT Vehicle based applications, are vehicular applications which are implementing the Safety Margin Assistance concept: Road Intersection Safety, Lane Change Manoeuvre, Safe Overtaking, Head On Collision Warning, Rear End Collision, Speed Limitation and Safety Distance, Frontal Collision Warning, Road Condition Status – Slippery Road, Curve Warning, Vulnerable Road User Detection and Accident Avoidance SAFESPOT infrastructure based applications are those where data is processed and decisions are taken by the road infrastructure in cooperation with vehicles. The applications defined are: Speed alert, Hazard and incident warning, Road departure prevention, Intelligent Cooperative Intersection Safety, Safety margin for assistance and emergency vehicles. These applications aim to provide the most

		efficient recommendation to the driver through the onboard HMI and through road side communication devices like VMS or flashing lights (4).
	Relevance for SEAMLESS	First implementation of safety relevant C2X services. ☐ UC Traffic Light x UC Journey Time
	Category	x Safety ☐ Efficiency ☐ Environment x Urban x Interurban
Business Structure	Stakeholder	x Road Operator x Automotive x Service Provider
	B2C payment	x Free of Charge ☐ Paid service
	B2B / B2A payment	x Free of Charge ☐ Paid service
	Contracts	--
Expected Benefits of the cooperation	Infrastructure	Increase safety.
	Automotive	Increase safety.
	Service Provider	Not in the focus of the project.
Information Exchange	Content Semantic	C2X safety messages
	Communication Protocol	Focus on short range communication: 11p
	Channel	☐ Broadcast ☐ Cellular x Short Range
Architecture	Entities	☐ Center - Center ☐ Center - Car ☐ Center - Infrastructure x Car - Infrastructure x Car – Car
	Description	Decentralised architecture in a research phase; Results were influencing the ETSI station architecture.

Table 3 Project overview SafeSpot

CVIS		
Project Organisation	Coordinator	ERTICO
	Partner involved	OEM, suppliers, reserach, academia
	Contact Seamless	Dr.-Ing. Thomas Benz, Dr.-Ing. Michael Ortgiese

	Start date	01.04.2008
	End date	30.06.2010
Application Use Cases	Description	Cooperative network management, Cooperative Area Routing, Flexible Lane Management, Flexible Lane Allocation, Cooperative Driver Awareness, Travellers Assistance, monitoring and guidance of dangerous goods, parking zone management, an access control to sensitive infrastructures. Cooperative Traffic Monitoring
	Relevance for SEAMLESS	Architecture for C2X services based on a hybrid communication architecture. x UC Traffic Light x UC Journey Time
	Category	☐ Safety x Efficiency ☐ Environment x Urban x Interurban
Business Structure	Stakeholder	x Road Operator x Automotive ☐ Service Provider
	B2C payment	x Free of Charge ☐ Paid service
	B2B / B2A payment	x Free of Charge ☐ Paid service
	Contracts	--
Expected Benefits of the cooperation	Infrastructure	Increase the efficiency of the traffic network
	Automotive	Benefits for the customers, e.g. reduction of travel time.
	Service Provider	--
Information Exchange	Content Semantic	Proprietary information model for the different use cases.
	Communication Protocol	IPv6
	Channel	☐ Broadcast x Cellular x Short Range
Architecture	Entities	x Center - Center ☐ Center - Car x Center - Infrastructure x Car - Infrastructure x Car – Car
	Description	Decentralised architecture in a research phase; Results were influencing the ETSI station architecture.

Table 4 Project overview CVIS

Coopers		
Project Organisation	Coordinator	Alexander Frötscher, AustriaTech
	Partner involved	OEM, suppliers, reserach, academia
	Contact Seamless	Dr.-Ing. Thomas Benz, Dr.-Ing. Michael Ortgiese
	Start date	01.04.2008
	End date	30.06.2010
Application Use Cases	Description	Virtual VMS, Cooperative Traffic infor-mation on motorways
	Relevance for SEAMLESS	Architecture and message set for motorway traffic information. ☐ UC Traffic Light x UC Journey Time
	Category	x Safety x Efficiency ☐ Environment ☐ Urban x Interurban
Business Structure	Stakeholder	x Road Operator x Automotive ☐ Service Provider
	B2C payment	x Free of Charge ☐ Paid service
	B2B / B2A payment	x Free of Charge ☐ Paid service
	Contracts	--
Expected Benefits of the cooperation	Infrastructure	Increase safety and efficiency
	Automotive	More customer satisfaction by providing of traffic information services.
	Service Provider	
Information Exchange	Content Semantic	Traffic stat information and driver warnings
	Communication Protocol	TPEG based communication
	Channel	x Broadcast ☐ Cellular x Short Range
Architecture	Entities	☐ Center - Center ☐ Center - Car x Center - Infrastructure x Car - Infrastructure ☐ Car – Car
	Description	Decentralised architecture in a research phase; Results were influencing the ETSI station architecture.

Table 5 Project overview Coopers

Aktiv – Verkehrsmanagement		
Project Organisation	Coordinator	Dr.-Ing. Michael Ortgiese
	Partner involved	OEM, suppliers, reserach, academia
	Contact Seamless	Dr.-Ing. Thomas Benz, Dr.-Ing. Michael Ortgiese
	Start date	01.09.2006
	End date	31.12.2010
Application Use Cases	Description	Cooperative Traffic light, Cooperative monitoring and information platform, Virtual VM, Rpad construction assistance system, adaptive navigation
	Relevance for SEAMLESS	Implementation of TPEG TEC and TFP. Architecture for information services on motorways. x UC Traffic Light x UC Journey Time
	Category	☐ Safety x Efficiency ☐ Environment ☐ Urban x Interurban
Business Structure	Stakeholder	x Road Operator x Automotive ☐ Service Provider
	B2C payment	x Free of Charge ☐ Paid service
	B2B / B2A payment	x Free of Charge ☐ Paid service
	Contracts	---
Expected Benefits of the cooperation	Infrastructure	Improve network efficiency
	Automotive	Improve customer satisfaction by providing information and assistance systems.
	Service Provider	--
Information Exchange	Content Semantic	TPEG TFP & TEC, proprietary protocols
	Communication Protocol	IPv4, C2X based on 11p
	Channel	☐ Broadcast x Cellular x Short Range
Architecture	Entities	☐ Center - Center x Center - Car x Center - Infrastructure x Car - Infrastructure ☐ Car – Car
	Description	Integration of C2X station prototypes in the environment of an existing traffic management centre.

Table 6 Project overview Aktiv VM

Invent – Netzausgleich IV		
Project Organisation	Coordinator	Dr.-Ing. Klaus Bogenberger, BMW
	Partner involved	OEM, suppliers, reserach, academia
	Contact Seamless	Dr.-Ing. Thomas Benz, Dr.-Ing. Michael Ortgiese
	Start date	01.04.2001
	End date	30.09.2005
Application Use Cases	Description	Strategic Routing Cooperative ADAS
	Relevance for SEAMLESS	Supply of traffic management strategies for navigation systems. ☐ UC Traffic Light x UC Journey Time
	Category	☐ Safety x Efficiency ☐ Environment x Urban x Interurban
Business Structure	Stakeholder	x Road Operator x Automotive x Service Provider
	B2C payment	☐ Free of Charge x Paid service
	B2B / B2A payment	☐ Free of Charge x Paid service
	Contracts	
Expected Benefits of the cooperation	Infrastructure	Efficient use of the traffic network
	Automotive	Increase customer satisfaction
	Service Provider	Offering commercial service
Information Exchange	Content Semantic	Traffic information and route description.
	Communication Protocol	IPv4
	Channel	☐ Broadcast x Cellular ☐ Short Range
Architecture	Entities	x Center - Center x Center - Car ☐ Center - Infrastructure ☐ Car - Infrastructure ☐ Car – Car
	Description	Classical service provider to vehicle approach.

Table 7 Project overview Invent

Dmotion		
Project Organisation	Coordinator	Heiko Böhme, City of Düsseldorf
	Partner involved	Düsseldorf, OCA, Albrecht Consult, PTV, Geavs, BMW, RWTH Aachen, IfaK
	Contact Seamless	Dr.-Ing. Thomas Benz, Dr.-Ing. Michael Ortgiese
	Start date	01.04.2005
	End date	31.12.2008
Application Use Cases	Description	strategic Routing, traffic information, coop-erative Monitoring, strategy management
	Relevance for SEAMLESS	Urban traffic management architecture ☐ UC Traffic Light x UC Journey Time
	Category	☐ Safety x Efficiency ☐ Environment x Urban x Interurban
Business Structure	Stakeholder	x Road Operator x Automotive ☐ Service Provider
	B2C payment	☐ Free of Charge x Paid service
	B2B / B2A payment	x Free of Charge ☐ Paid service
	Contracts	---
Expected Benefits of the cooperation	Infrastructure	Improve network efficiency in urban areas; collaboration between city and motorway
	Automotive	Increase customer satisfaction
	Service Provider	--
Information Exchange	Content Semantic	Traffic information based on TMC; proprietary route description;
	Communication Protocol	IPv4
	Channel	☐ Broadcast x Cellular ☐ Short Range
Architecture	Entities	x Center - Center x Center - Car ☐ Center - Infrastructure ☐ Car - Infrastructure ☐ Car – Car
	Description	Urban traffic management centre – service centre of the automotive company – vehicle

Table 8 Project overview Dmotion

DIVA		
Project Organisation	Coordinator	Georg Obert, BMW
	Partner involved	BMW, ADAC, BMT, Gewi, BR, PTV, TU München
	Contact Seamless	Dr.-Ing. Thomas Benz, Dr.-Ing. Michael Ortgiese
	Start date	01.06.2005
	End date	31.03.2008
Application Use Cases	Description	Virtual VMS based in TPEG
	Relevance for SEAMLESS	VMS information provided via DAB; messages types and architecture. ☐ UC Traffic Light x UC Journey Time
	Category	x Safety ☐ Efficiency ☐ Environment ☐ Urban ☐ Interurban
Business Structure	Stakeholder	x Road Operator x Automotive ☐ Service Provider
	B2C payment	x Free of Charge ☐ Paid service
	B2B / B2A payment	x Free of Charge ☐ Paid service
	Contracts	---
Expected Benefits of the cooperation	Infrastructure	Improve safety
	Automotive	Improve safety
	Service Provider	--
Information Exchange	Content Semantic	VMS information including speed limits
	Communication Protocol	DAB
	Channel	x Broadcast ☐ Cellular ☐ Short Range
Architecture	Entities	☐ Center - Center x Center - Car ☐ Center - Infrastructure ☐ Car - Infrastructure ☐ Car – Car
	Description	Broadcast short cut between traffic management centre and vehicle.

Table 9 Project overview DIVA

EcoMove		
Project Organisation	Coordinator	ERTICO
	Partner involved	OEM, suppliers, reserach, academia
	Contact Seamless	Dr.-Ing. Thomas Benz, Dr.-Ing. Michael Ortgiese
	Start date	01.04.2010
	End date	31.03.2012
Application Use Cases	Description	eCoMove will develop and evaluate the following interacting applications, which combined can deliver up to 20% overall fuel savings and CO2 emissions reduction: eco-pre-Trip Planning, advising optimal departure time and greenest route, ecoSmartDriving “virtual coach” providing dynamic green driving and routing guid-ance, ecoMonitoring information derived from vehicles’ post trip eco record is dis-tributed in a fully anonymous way to the traffic control centre, to identify energy blackspots; Dynamic ecoDriver Coaching for commer-cial vehicle drivers including training and incentive scheme; ecoTour Planning for logistics companies to define eco-efficient tours considering drivers’; ecoAdaptive Balancing & Control strate-gies for energy-optimised traffic distribution at network and local levels, e.g. traffic signal optimisation (green waves); ecoAdaptive Traveller Support to drivers by sending information on traffic state, route recommendations and speed profile data needed by on-board assistance sys-tems; ecoMotorway Management measures for energy-optimised flow management on the interurban network coupled with ramp metering and merging assistance at individual vehicle level.
	Relevance for SEAMLESS	Architecture for cooperative services in cities. x UC Traffic Light x UC Journey Time
	Category	☐ Safety x Efficiency x Environment ☐ Urban ☐ Interurban

Business Structure	Stakeholder	x Road Operator x Automotive ☐ Service Provider
	B2C payment	x Free of Charge ☐ Paid service
	B2B / B2A payment	x Free of Charge ☐ Paid service
	Contracts	---
Expected Benefits of the cooperation	Infrastructure	Improve efficiency and environment
	Automotive	Make vehicles cleaner and more efficient
	Service Provider	--
Information Exchange	Content Semantic	Messages based on TPEG and Car2X standards
	Communication Protocol	IVv6 und 11p
	Channel	☐ Broadcast x Cellular x Short Range
Architecture	Entities	☐ Center - Center x Center - Car x Center - Infrastructure x Car - Infrastructure ☐ Car – Car
	Description	First prototype implementation of the ETSI station architecture.

Table 10 Project overview EcoMove

DIANA / XTS		
Project Organisation	Coordinator	Gerd Riegelhuth, HLSV
	Partner involved	HR, PTV, HLSV, Harmann Becker
	Contact Seamless	Dr.-Ing. Thomas Benz, Dr.-Ing. Michael Ortgiese
	Start date	01.06.2005
	End date	30.06.2005
Application Use Cases	Description	Cooperative monitoring and enhanced traffic information services.
	Relevance for SEAMLESS	Architecture for traffic information generation based on FCD. ☐ UC Traffic Light x UC Journey Time
	Category	☐ Safety x Efficiency ☐ Environment ☐ Urban ☐ Interurban

Business Structure	Stakeholder	x Road Operator ☐ Automotive x Service Provider
	B2C payment	x Free of Charge ☐ Paid service
	B2B / B2A payment	x Free of Charge ☐ Paid service
	Contracts	---
Expected Benefits of the cooperation	Infrastructure	Efficient use of the road network
	Automotive	
	Service Provider	Improving the service quality
Information Exchange	Content Semantic	TMC based traffic information and proprietary FCD messages.
	Communication Protocol	RDS and IPv4
	Channel	x Broadcast x Cellular ☐ Short Range
Architecture	Entities	x Center - Center x Center - Car ☐ Center - Infrastructure ☐ Car - Infrastructure ☐ Car – Car
	Description	System layout: Traffic management centre – data centre – broadcaster - vehicle

Table 11 Project overview DIANA / XTS

ROSATTE		
Project Organisation	Coordinator	ERTICO
	Partner involved	
	Contact Seamless	Dr.-Ing. Thomas Benz, Dr.-Ing. Michael Ortgiese
	Start date	01.04.2008
	End date	31.03.2010
Application Use Cases	Description	Cooperative management of static Road content for driver information and assistance systems.
	Relevance for SEAMLESS	Cooperation model for information exchange based on PPP models. ☐ UC Traffic Light x UC Journey Time

	Category	x Safety ☐ Efficiency ☐ Environment ☐ Urban ☐ Interurban
Business Structure	Stakeholder	x Road Operator ☐ Automotive x Service Provider
	B2C payment	x Free of Charge ☐ Paid service
	B2B / B2A payment	x Free of Charge ☐ Paid service
	Contracts	---
Expected Benefits of the cooperation	Infrastructure	Distribution of static rod content to improve safety
	Automotive	
	Service Provider	Direct access to road content to improve the service quality.
Information Exchange	Content Semantic	Speed limits and on-the-fly geo-reference
	Communication Protocol	IPv4
	Channel	☐ Broadcast ☐ Cellular ☐ Short Range
Architecture	Entities	x Center - Center ☐ Center - Car ☐ Center - Infrastructure ☐ Car - Infrastructure ☐ Car – Car
	Description	Client –Server Architecture

Table 12 Project overview ROSATTE

GoodRoads		
Project Organisation	Coordinator	Angelos Bekiaris, CERTH/HIT
	Partner involved	
	Contact Seamless	Dr.-Ing. Thomas Benz, Dr.-Ing. Michael Ortgiese
	Start date	01.04.2006
	End date	31.03.2009
Application Use Cases	Description	monitoring and guidance of dangerous goods, Vehicle data to infrastructure oper-ator
	Relevance for	Information exchange architecture for

	SEAMLESS	logistic services (dangerous goods) ☐ UC Traffic Light x UC Journey Time
	Category	x Safety ☐ Efficiency ☐ Environment ☐ Urban ☐ Interurban
Business Structure	Stakeholder	x Road Operator x Automotive ☐ Service Provider
	B2C payment	x Free of Charge ☐ Paid service
	B2B / B2A payment	x Free of Charge ☐ Paid service
	Contracts	---
Expected Benefits of the cooperation	Infrastructure	Improving safety on sensible road segments
	Automotive	
	Service Provider	
Information Exchange	Content Semantic	Vehicle date, traffic information and route desciptions based on proprietary protocols;
	Communication Protocol	11p and IPv4
	Channel	☐ Broadcast x Cellular x Short Range
Architecture	Entities	☐ Center - Center x Center - Car x Center - Infrastructure x Car - Infrastructure ☐ Car – Car
	Description	Communication between service centre and vehicle in combination with road side units.

Table 13 Project overview GoodRoads

CoCities		
Project Organisation	Coordinator	Martin Böhm, AustriaTech
	Partner involved	
	Contact Seamless	Dr.-Ing. Thomas Benz, Dr.-Ing. Michael Ortgiese
	Start date	01.06.2011
	End date	31.03.2012

Application Use Cases	Description	Interoperable and multimodal RTTI services to end-users, offered by Traffic Information Service Providers (TISPs), will use different hardware and software platforms such as personal navigation devices, smart phones and web services and develop Europe–wide services based on regional traffic and travel data.
	Relevance for SEAMLESS	Architecture and messages for user generated content. ☐ UC Traffic Light x UC Journey Time
	Category	☐ Safety x Efficiency ☐ Environment c Urban ☐ Interurban
Business Structure	Stakeholder	x Road Operator ☐ Automotive x Service Provider
	B2C payment	x Free of Charge x Paid service
	B2B / B2A payment	x Free of Charge ☐ Paid service
	Contracts	--
Expected Benefits of the cooperation	Infrastructure	Change travellers behaviour by offering intermodal traffic information; get feedback about the service quality.
	Automotive	
	Service Provider	Improving service quality;
Information Exchange	Content Semantic	Traffic information based on standardised web-services (OGC)
	Communication Protocol	IPv4
	Channel	☐ Broadcast x Cellular ☐ Short Range
Architecture	Entities	☐ Center - Center x Center - Car ☐ Center - Infrastructure ☐ Car - Infrastructure ☐ Car – Car
	Description	Standard web bases communication between service centre and mobile clients.

Table 14 Project overview CoCities

SimTD		
Project Organisation	Coordinator	Christian Weiß, Daimer
	Partner involved	OEM, suppliers, reserach, academia
	Contact Seamless	Dr.-Ing. Thomas Benz, Dr.-Ing. Michael Ortgiese
	Start date	01.04.2009
	End date	31.03.2012
Application Use Cases	Description	Infrastructure data collection, car centric data collection, Weather, traffic state, local traffic information, road construction information, enhanced navigation, bypass information, cooperative traffic lights, hazard warning, emergency vehicle warning cooperative ADAS incl. traffic light assistanc, internet services
	Relevance for SEAMLESS	First implementation of ETSI C2X standards in Germany. x UC Traffic Light x UC Journey Time
	Category	x Safety x Efficiency ☐ Environment x Urban x Interurban
Business Structure	Stakeholder	x Road Operator x Automotive x Service Provider
	B2C payment	x Free of Charge x Paid service
	B2B / B2A payment	x Free of Charge x Paid service
	Contracts	Designing business models is part of the project,
Expected Benefits of the cooperation	Infrastructure	Validation of cooperative technology in a large scale test.
	Automotive	Validation of cooperative technology in a large scale test.
	Service Provider	Validation of cooperative technology in a large scale test.
Information Exchange	Content Semantic	If possible Information exchange via TPEG and ETSI standards
	Communication Protocol	C2X Geocast, IP
	Channel	☐ Broadcast x Cellular x Short Range
Architecture	Entities	☐ Center - Center x Center - Car x Center - Infrastructure

		x Car - Infrastructure x Car – Car
	Description	Integration of new C2X components in an existing traffic management environment.

Table 15 Project overview SimTD

In-Time		
Project Organisation	Coordinator	Martin Böhm, AustriaTech
	Partner involved	
	Contact Seamless	Dr.-Ing. Thomas Benz, Dr.-Ing. Michael Ortgiese
	Start date	01.04.2012
	End date	31.03.2012
Application Use Cases	Description	Intermodal traffic information, Intermodal journey planning
	Relevance for SEAMLESS	Traffic information services based on OGC standards. ☐ UC Traffic Light x UC Journey Time
	Category	☐ Safety x Efficiency ☐ Environment x Urban ☐ Interurban
Business Structure	Stakeholder	x Road Operator ☐ Automotive x Service Provider
	B2C payment	x Free of Charge ☐ Paid service
	B2B / B2A payment	x Free of Charge ☐ Paid service
	Contracts	…
Expected Benefits of the cooperation	Infrastructure	Improve traffic efficiency by changing travellers behaviour.
	Automotive	
	Service Provider	Improving service quality
Information Exchange	Content Semantic	Traffic in formation and intermodal routing based on OGC standards.
	Communication Protocol	IP
	Channel	☐ Broadcast x Cellular ☐ Short Range
Architecture	Entities	☐ Center - Center x Center - Car

		☐ Center - Infrastructure ☐ Car - Infrastructure ☐ Car – Car
	Description	Standard web-architecture

Table 16 Project overview In Time

KoFAS		
Project Organisation	Coordinator	Heimann, ZENTEC GmbH
	Partner involved	
	Contact Seamless	Dr.-Ing. Thomas Benz, Dr.-Ing. Michael Ortgiese
	Start date	01.07.2010
	End date	30.06.2012
Application Use Cases	Description	ADAS in combination with infrastructure information
	Relevance for SEAMLESS	Communication architecture for C2X services. x UC Traffic Light ☐ UC Journey Time
	Category	x Safety ☐ Efficiency ☐ Environment x Urban x Interurban
Business Structure	Stakeholder	x Road Operator x Automotive ☐ Service Provider
	B2C payment	x Free of Charge ☐ Paid service
	B2B / B2A payment	x Free of Charge ☐ Paid service
	Contracts	---
Expected Benefits of the cooperation	Infrastructure	Improve safety by using innovative driver assistance systems.
	Automotive	Improve safety by using innovative driver assistance systems.
	Service Provider	
Information Exchange	Content Semantic	ETSI C2X information set
	Communication Protocol	

	Channel	☐ Broadcast ☐ Cellular x Short Range
Architecture	Entities	☐ Center - Center ☐ Center - Car x Center - Infrastructure ☐ Car - Infrastructure ☐ Car – Car
	Description	ETSI station architecture for decentralise information exchange,

Table 17 Project overview KoFas

KOLINE		
Project Organisation	Coordinator	Technische Universität Braunschweig Geschäftsstelle des Niedersächsischen Forschungszentrums Fahrzeugtechnik Frau Dipl.-Ing. Ann-Christin Bartölke
	Partner involved	
	Contact Seamless	Dr.-Ing. Thomas Benz, Dr.-Ing. Michael Ortgiese
	Start date	01.07.2010
	End date	30.06.2012
Application Use Cases	Description	Cooperative traffic light control in combination with public transport priority.
	Relevance for SEAMLESS	Cooperative traffic light information in combination with PT priority. x UC Traffic Light ☐ UC Journey Time
	Category	☐ Safety x Efficiency ☐ Environment x Urban ☐ Interurban
Business Structure	Stakeholder	x Road Operator x Automotive ☐ Service Provider
	B2C payment	x Free of Charge ☐ Paid service
	B2B / B2A payment	x Free of Charge ☐ Paid service
	Contracts	---
Expected Benefits of the cooperation	Infrastructure	Improve network efficiency; public transport priorisation,
	Automotive	Improve network efficiency
	Service Provider	
Information Exchange	Content Semantic	Data exchange between vehicles and traffic lights.

	Communication Protocol	IP
	Channel	☐ Broadcast ☐ Cellular x Short Range
Architecture	Entities	☐ Center - Center ☐ Center - Car x Center - Infrastructure x Car - Infrastructure ☐ Car – Car
	Description	Decentralised Ca2/X architecture.

Table 18 Project overview Koline

DIAMANT		
Project Organisation	Coordinator	Gerd Riegelhuth, HLSV
	Partner involved	
	Contact Seamless	Dr.-Ing. Thomas Benz, Dr.-Ing. Michael Ortgiese
	Start date	01.06.2005
	End date	31.05.2005
Application Use Cases	Description	Virtual VMS
	Relevance for SEAMLESS	First implementation DENM; C2X architecture for VMS on motorways. ☐ UC Traffic Light x UC Journey Time
	Category	x Safety ☐ Efficiency ☐ Environment ☐ Urban x Interurban
Business Structure	Stakeholder	x Road Operator x Automotive ☐ Service Provider
	B2C payment	x Free of Charge ☐ Paid service
	B2B / B2A payment	x Free of Charge ☐ Paid service
	Contracts	---
Expected Benefits of the cooperation	Infrastructure	Improve safety
	Automotive	Improve safety
	Service Provider	
Information Exchange	Content Semantic	C2X messages for VMS information

	Communication Protocol	
	Channel	☐ Broadcast ☐ Cellular x Short Range
Architecture	Entities	☐ Center - Center ☐ Center - Car ☐ Center - Infrastructure x Car - Infrastructure ☐ Car – Car
	Description	ETSI station architecture

Table 19 Project overview DIAMANT

SPITS		
Project Organisation	Coordinator	Ralph von Vignau, NXP
	Partner involved	
	Contact Seamless	Dr.-Ing. Thomas Benz, Dr.-Ing. Michael Ortgiese
	Start date	
	End date	
Application Use Cases	Description	Parking Service, Contextual Infotainmen, CVIS/SafeSpot Apps, World Map, E-Call/B-Call, Remote Diagnostics, Follow-me, Stolen Vehicle Tracking, Pay As You Drive, Local Events, Road Works, Down-loadable Services, Sync Route Planner, ADAS, Infotainment, Road Pricing (ABvM), Traffic Flow
	Relevance for SEAMLESS	State-of-art field operational test for coop-erative system in the Netherlands. x UC Traffic Light x UC Journey Time
	Category	x Safety x Efficiency x Environment x Urban x Interurban
Business Structure	Stakeholder	x Road Operator x Automotive x Service Provider
	B2C payment	x Free of Charge x Paid service
	B2B / B2A payment	x Free of Charge x Paid service
	Contracts	---
Expected Benefits of	Infrastructure	Validation of cooperative technology

the cooperation	Automotive	Validation of cooperative technology
	Service Provider	Validation of cooperative technology
Information Exchange	Content Semantic	If possible based on standards
	Communication Protocol	
	Channel	☐ Broadcast x Cellular x Short Range
Architecture	Entities	☐ Center - Center x Center - Car x Center - Infrastructure x Car - Infrastructure x Car – Car
	Description	Integration of cooperative technology in a real environment.

Table 20 Project overview SPITS

Travolution		
Project Organisation	Coordinator	Cornelius Mehling, Audi
	Partner involved	Audi, Gevas, Ingolstadt, TU Müchen
	Contact Seamless	Dr.-Ing. Thomas Benz, Dr.-Ing. Michael Ortgiese
	Start date	
	End date	
Application Use Cases	Description	Intelligent traffic light assistant in combination with adaptive traffic light control
	Relevance for SEAMLESS	Architecture for cooperative traffic light services x UC Traffic Light ☐ UC Journey Time
	Category	☐ Safety x Efficiency ☐ Environment x Urban ☐ Interurban
Business Structure	Stakeholder	x Road Operator x Automotive ☐ Service Provider
	B2C payment	x Free of Charge ☐ Paid service
	B2B / B2A payment	x Free of Charge ☐ Paid service

	Contracts	---
Expected Benefits of the cooperation	Infrastructure	Improve network efficiency
	Automotive	Improve network efficiency
	Service Provider	
Information Exchange	Content Semantic	Traffic light information
	Communication Protocol	
	Channel	☐ Broadcast ☐ Cellular x Short Range
Architecture	Entities	☐ Center - Center ☐ Center - Car x Center - Infrastructure x Car - Infrastructure ☐ Car - Car
	Description	ETSI station architecture

Table 21 Project overview Travolution

CoCarX		
Project Organisation	Coordinator	Friedhelm Ramme, ERICSON
	Partner involved	ERICSON, Ford, Opel, BaSt, Vodafone, Volkswagen, Daimler
	Contact Seamless	Dr.-Ing. Thomas Benz, Dr.-Ing. Michael Ortgiese
	Start date	01.07.2009
	End date	30.06.2011
Application Use Cases	Description	Traffic information and cooperative driver warnings based on LTE communication technology.
	Relevance for SEAMLESS	Architecture for C2X services based on cellular networks. Design of cooperation models. ☐ UC Traffic Light x UC Journey Time
	Category	x Safety x Efficiency ☐ Environment ☐ Urban ☐ Interurban
Business Structure	Stakeholder	x Road Operator x Automotive ☐ Service Provider
	B2C payment	x Free of Charge x Paid service

	B2B / B2A payment	x Free of Charge ☐ Paid service
	Contracts	Some results concerning the business structure
Expected Benefits of the cooperation	Infrastructure	Safety and network efficiency
	Automotive	Safety and network efficiency
	Service Provider	
Information Exchange	Content Semantic	Based on TPEG and ETSI ITS
	Communication Protocol	IP
	Channel	☐ Broadcast x Cellular ☐ Short Range
Architecture	Entities	☐ Center - Center ☐ Center - Car ☐ Center - Infrastructure x Car - Infrastructure x Car – Car
	Description	Implementation of C2X services by using cellular communication.

Table 22 Project overview CoCarx

COMeSafety		
Project Organisation	Coordinator	Markus Strassberger, BMW
	Partner involved	CRF, Daimler, Renault, BMW, Volvo, BaSt, ERTICO
	Contact Seamless	Dr.-Ing. Thomas Benz, Dr.-Ing. Michael Ortgiese
	Start date	1.01.2011
	End date	31.12.2013
Application Use Cases	Description	Support of on-going standardisation activities, cooperation in EU-US task force, Preparation of European Work Shops in cooperative systems.
	Relevance for SEAMLESS	Harmonisation for C2X architectures developed in other research projects. Basis work for standardisation.

		x UC Traffic Light x UC Journey Time
	Category	x Safety x Efficiency ☐ Environment x Urban x Interurban
Business Structure	Stakeholder	x Road Operator x Automotive x Service Provider
	B2C payment	x Free of Charge x Paid service
	B2B / B2A payment	x Free of Charge x Paid service
	Contracts	…
Expected Benefits of the cooperation	Infrastructure	
	Automotive	
	Service Provider	
Information Exchange	Content Semantic	Consolidation of project results in order to prepare standardisation work.
	Communication Protocol	
	Channel	☐ Broadcast x Cellular x Short Range
Architecture	Entities	x Center - Center x Center - Car x Center - Infrastructure x Car - Infrastructure x Car – Car
	Description	Consolidation of project results in order to prepare standardisation work.

Table 23 Project overview COMeSafety

Source@F		
Project Organisation	Coordinator	Gerard Segarra , Reanult
	Partner involved	
	Contact Seamless	Dr.-Ing. Thomas Benz, Dr.-Ing. Michael Ortgiese
	Start date	01.09.2010
	End date	31.03.2013
Application Use Cases	Description	Roas Safety: Cooperative Awareness, Collision Risk Warning, Intersection Collision Risk warning Traffic Efficiency: vVMS, Cooperative

		Monitoring (RSU + FCD), traffic information, Traffic Light violation, Green light optimal seed, Engine Stop – Start, Fleet Management
	Relevance for SEAMLESS	Field operational test in France. C2X integration in legacy systems. x UC Traffic Light x UC Journey Time
	Category	x Safety x Efficiency ☐ Environment ☐ Urban ☐ Interurban
Business Structure	Stakeholder	x Road Operator x Automotive ☐ Service Provider
	B2C payment	x Free of Charge ☐ Paid service
	B2B / B2A payment	x Free of Charge ☐ Paid service
	Contracts	…
Expected Benefits of the cooperation	Infrastructure	Improve safety and network efficiency
	Automotive	Improve safety and network efficiency
	Service Provider	
Information Exchange	Content Semantic	Based on ETSI Car2X
	Communication Protocol	Geocast, IP
	Channel	☐ Broadcast x Cellular x Short Range
Architecture	Entities	☐ Center - Center ☐ Center - Car x Center - Infrastructure x Car - Infrastructure x Car - Car
	Description	Based on ETSI station architecture

Table 24 Project overview Source@F

Inter Safe 2		
Project Organisation	Coordinator	Bernd Roessler, IBEO
	Partner involved	
	Contact Seamless	Dr.-Ing. Thomas Benz, Dr.-Ing. Michael

		Ortgiese
	Start date	01.06.2008
	End date	30.05.2011
Application Use Cases	Description	The INTERSAFE-2 project aims to develop and demonstrate a Cooperative Intersection Safety System (CISS) that is able to significantly reduce injury and fatal accidents at intersections.
	Relevance for SEAMLESS	Message formats for C2X services at intersection.
	Category	x Safety ☐ Efficiency ☐ Environment x Urban x Interurban
Business Structure	Stakeholder	x Road Operator x Automotive ☐ Service Provider
	B2C payment	x Free of Charge ☐ Paid service
	B2B / B2A payment	x Free of Charge ☐ Paid service
	Contracts	---
Expected Benefits of the cooperation	Infrastructure	Improve safety
	Automotive	Improve safety
	Service Provider	
Information Exchange	Content Semantic	Based on ETSI ITS
	Communication Protocol	Geocast, IP
	Channel	☐ Broadcast x Cellular x Short Range
Architecture	Entities	☐ Center - Center x Center - Car x Center - Infrastructure x Car - Infrastructure x Car – Car
	Description	Based on ETSI station architecture

Table 25 Project overview InterSafe

COSMO		
Project Organisation	Coordinator	Gino Franco, Mizar

	Partner involved	Mizar, ASFINAG, CRF, ERTICO, Geosolution, Kapsch, Swarco, Lindholm Sience Park, SVEVIA, tecnalia, Volvo
	Contact Seamless	Dr.-Ing. Thomas Benz, Dr.-Ing. Michael Ortgiese
	Start date	2010
	End date	2013
Application Use Cases	Description	Environmentally sensitive traffic control strategies, Eco-driving for private vehicle and for public transport, Multimodal real-time information systems, Advanced energy efficient technologies integrated in roadside equipment, Dynamic City Access Management strategy, Advanced Real-Time Congestion Management System
	Relevance for SEAMLESS	Architecture for C2X services in urban areas. ☐ UC Traffic Light x UC Journey Time
	Category	☐ Safety x Efficiency x Environment x Urban ☐ Interurban
Business Structure	Stakeholder	x Road Operator x Automotive ☐ Service Provider
	B2C payment	x Free of Charge ☐ Paid service
	B2B / B2A payment	x Free of Charge ☐ Paid service
	Contracts	---
Expected Benefits of the cooperation	Infrastructure	Improve network efficiency
	Automotive	Improve network efficiency
	Service Provider	
Information Exchange	Content Semantic	
	Communication Protocol	IP
	Channel	☐ Broadcast x Cellular x Short Range
Architecture	Entities	☐ Center - Center x Center - Car x Center - Infrastructure x Car - Infrastructure x Car – Car
	Description	

Table 26 Project overview COSMO

FREILOT		
Project Organisation	Coordinator	
	Partner involved	VOLVO, Renault Trucks, PEEK Traffic, CTAG, CERTH, LET, Interface Transport, MLC-EUSKADI, THETIS S.p.A., GERTEK SA, POLIS, CNRS, Université Lumière Lyon 2, Cities of Lyon (Grand Lyon and Ville de Lyon), Helmond and Bilbao. The Krakow pilot site is supported by the Polish National Road Administration (GDDKiA).
	Contact Seamless	Dr.-Ing. Thomas Benz, Dr.-Ing. Michael Ortgiese
	Start date	
	End date	
Application Use Cases	Description	Traffic management: Energy efficiency optimised intersection control Vehicle: Adaptive acceleration and speed limiters Driver: Enhanced “green driving” support Fleet management: Real-time delivery space booking
	Relevance for SEAMLESS	Architecture for logistic C2X services. ☐ UC Traffic Light x UC Journey Time
	Category	☐ Safety x Efficiency ☐ Environment ☐ Urban ☐ Interurban
Business Structure	Stakeholder	x Road Operator x Automotive ☐ Service Provider
	B2C payment	x Free of Charge ☐ Paid service
	B2B / B2A payment	x Free of Charge ☐ Paid service
	Contracts	----
Expected Benefits of the cooperation	Infrastructure	Validation of new technology for urban fleet management
	Automotive	Validation of new technology for urban fleet management
	Service Provider	
Information Exchange	Content Semantic	Proprietary formats

	Communication Protocol	IP
	Channel	☐ Broadcast x Cellular ☐ Short Range
Architecture	Entities	x Center - Center x Center - Car ☐ Center - Infrastructure ☐ Car - Infrastructure ☐ Car – Car
	Description	

Table 27 Project overview Freilot

EcoGem		
Project Organisation	Coordinator	Marco Borac, Temsa
	Partner involved	
	Contact Seamless	Dipl.-Ing. Wolfgang Kipp, PTV
	Start date	01.04.2010
	End date	31.03.2012
Application Use Cases	Description	Iraffic information information about charging station
	Relevance for SEAMLESS	Traffic information services based on OGC standards ☐ UC Traffic Light x UC Journey Time
	Category	☐ Safety x Efficiency ☐ Environment ☐ Urban ☐ Interurban
Business Structure	Stakeholder	X Road Operator x Automotive x Service Provider
	B2C payment	X Free of Charge ☐ Paid service
	B2B / B2A payment	X Free of Charge ☐ Paid service
	Contracts	---
Expected Benefits of the cooperation	Infrastructure	Improve network efficiency, new mobility concepts based on electric vehicle
	Automotive	
	Service Provider	Services for green driving

Information Exchange	Content Semantic	Traffic Information and re-charging station
	Communication Protocol	IP
	Channel	☐ Broadcast x Cellular ☐ Short Range
Architecture	Entities	x Center - Center ☐ Center - Car x Center - Infrastructure ☐ Car - Infrastructure ☐ Car – Car
	Description	Client-server web-Service architecture

Table 28 Project overview EcoGem

iTour		
Project Organisation	Coordinator	Marco Borac, Temsa
	Partner involved	
	Contact Seamless	Dr.-Ing. Thomas Benz, Dr.-Ing. Michael Ortgiese
	Start date	01.04.2010
	End date	31.12.2013
Application Use Cases	Description	Internet based intermodal traffic information delivered on the basis of standard interfaces
	Relevance for SEAMLESS	Traffic information services based on OGC standards ☐ UC Traffic Light x UC Journey Time
	Category	☐ Safety x Efficiency ☐ Environment c Urban ☐ Interurban
Business Structure	Stakeholder	x Road Operator ☐ Automotive x Service Provider
	B2C payment	x Free of Charge X Paid service
	B2B / B2A payment	x Free of Charge ☐ Paid service
	Contracts	---
Expected Benefits of the cooperation	Infrastructure	Improve network efficiency
	Automotive	

	Service Provider	Services for Green Driving
Information Exchange	Content Semantic	Traffic Information
	Communication Protocol	IP
	Channel	☐ Broadcast x Cellular ☐ Short Range
Architecture	Entities	☐ Center - Center x Center - Car ☐ Center - Infrastructure ☐ Car - Infrastructure ☐ Car – Car
	Description	Client-server web-Service architecture

Table 29 Project overview iTour

IntelliDrive		
Project Organisation	Coordinator	Number of Projects
	Partner involved	
	Contact Seamless	Dr.-Ing. Thomas Benz, Dr.-Ing. Michael Ortgiese
	Start date	
	End date	
Application Use Cases	Description	Important for SEAMLESS: SPAT Message for traffic signal information exchange.
	Relevance for SEAMLESS	SPAT Message for traffic signal information exchange. x UC Traffic Light x UC Journey Time
	Category	x Safety x Efficiency ☐ Environment x Urban ☐ Interurban
Business Structure	Stakeholder	x Road Operator x Automotive ☐ Service Provider
	B2C payment	x Free of Charge ☐ Paid service
	B2B / B2A payment	x Free of Charge ☐ Paid service

	Contracts	---
Expected Benefits of the cooperation	Infrastructure	Improve network efficiency
	Automotive	Safety and efficiency at intersections
	Service Provider	
Information Exchange	Content Semantic	Traffic signal phase information
	Communication Protocol	DSRC
	Channel	☐ Broadcast ☐ Cellular x Short Range
Architecture	Entities	☐ Center - Center ☐ Center - Car ☐ Center - Infrastructure x Car - Infrastructure ☐ Car – Car
	Description	Decentralised car to infrastructure architecture.

Table 30 Project overview IntelliDrive

MDM – Mobility Data Marketplace		
Project Organisation	Coordinator	Lutz Rittershaus, BaSt
	Partner involved	Cites, motorway operators, private service provider
	Contact Seamless	Dr.-Ing. Thomas Benz, Dr.-Ing. Michael Ortgiese
	Start date	01.06.2009
	End date	On-going
Application Use Cases	Description	Back-end platform supporting data exchange between stakeholders.
	Relevance for SEAMLESS	Technical and organisational architecture for traffic data exchange in Germany. (X) UC Traffic Light x UC Journey Time Planned
	Category	☐ Safety x Efficiency ☐ Environment ☐ Urban ☐ Interurban
Business Structure	Stakeholder	x Road Operator x Automotive

		x Service Provider
	B2C payment	x Free of Charge x Paid service
	B2B / B2A payment	x Free of Charge x Paid service
	Contracts	Standard contracts available
Expected Benefits of the cooperation	Infrastructure	Improve network efficiency
	Automotive	More quality for in-car services: traveller information and efficient driving
	Service Provider	Access to data
Information Exchange	Content Semantic	Loop data, LOS, Messages
	Communication Protocol	IP
	Channel	☐ Broadcast ☐ Cellular ☐ Short Range
Architecture	Entities	x Center - Center ☐ Center - Car ☐ Center - Infrastructure ☐ Car - Infrastructure ☐ Car – Car
	Description	Data exchange platform for Germany

Table 31 Project overview MDM

Ruhrpilot		
Project Organisation	Coordinator	Benno Hense, Ruhrpilot Besitzgesellschaft
	Partner involved	
	Contact Seamless	Dr.-Ing. Thomas Benz, Dr.-Ing. Michael Ortgiese
	Start date	01.04.2002
	End date	On-going
Application Use Cases	Description	Data platform Ruhr area, Detection infra-structure, dynamic intermodal routing, incident messages , traffic information
	Relevance for SEAMLESS	Decentralised technical architecture for traffic management in regions. ☐ UC Traffic Light x UC Journey Time
	Category	☐ Safety x Efficiency ☐ Environment

		x Urban x Interurban
Business Structure	Stakeholder	x Road Operator ☐ Automotive ☐ Service Provider
	B2C payment	x Free of Charge ☐ Paid service
	B2B / B2A payment	☐ Free of Charge x Paid service
	Contracts	Contracts for data access
Expected Benefits of the cooperation	Infrastructure	Improve network efficiency
	Automotive	
	Service Provider	
Information Exchange	Content Semantic	LOS, Messages, stationary detectors
	Communication Protocol	IP
	Channel	☐ Broadcast ☐ Cellular ☐ Short Range
Architecture	Entities	x Center - Center ☐ Center - Car ☐ Center - Infrastructure ☐ Car - Infrastructure ☐ Car - Car
	Description	Consolidation of 16 urban traffic management centres in the area

Table 32 Project overview Ruhrpilot

VIB – Traffic Information Agency Bavaria		
Project Organisation	Coordinator	Uwe Strubbe, VIB GmbH
	Partner involved	Siemens, PTV, mdv
	Contact Seamless	Dr.-Ing. Thomas Benz, Dr.-Ing. Michael Ortgiese
	Start date	01.01.2006
	End date	On-going
Application Use Cases	Description	data platform for Bavaria, Traffic state calculation and forecasting, dynamic intermodal routing, incident messages
	Relevance for SEAMLESS	PPP architecture for traffic information services in Bavaria.

		☐ UC Traffic Light x UC Journey Time
	Category	☐ Safety x Efficiency ☐ Environment ☐ Urban x Interurban
Business Structure	Stakeholder	x Road Operator ☐ Automotive ☐ Service Provider
	B2C payment	x Free of Charge ☐ Paid service
	B2B / B2A payment	☐ Free of Charge x Paid service
	Contracts	Contracts for data exchange
Expected Benefits of the cooperation	Infrastructure	Improve network efficiency
	Automotive	
	Service Provider	
Information Exchange	Content Semantic	LOS, messages, loop data
	Communication Protocol	IP
	Channel	☐ Broadcast ☐ Cellular ☐ Short Range
Architecture	Entities	x Center - Center ☐ Center - Car ☐ Center - Infrastructure ☐ Car - Infrastructure ☐ Car – Car
	Description	Architecture for county wide intermodal traveller services.

Table 33 Project overview VIB

National Data Warehouse Netherlands		
Project Organisation	Coordinator	RWS
	Partner involved	
	Contact Seamless	PTV/Locatienet (Michael Ortgiese, Sebaastian Raphorst)
	Start date	01.06.2009
	End date	On-going
Application Use Cases	Description	Back-end data platform for data exchange between stakeholders. Detection

		infrastructure operation.
	Relevance for SEAMLESS	Architecture and interfaces for a country-wide data exchange platform. ☐ UC Traffic Light x UC Journey Time
	Category	☐ Safety x Efficiency x Environment ☐ Urban ☐ Interurban
Business Structure	Stakeholder	x Road Operator ☐ Automotive x Service Provider
	B2C payment	☐ Free of Charge ☐ Paid service
	B2B / B2A payment	x Free of Charge x Paid service
	Contracts	Standard contracts
Expected Benefits of the cooperation	Infrastructure	Improve network efficiency
	Automotive	
	Service Provider	Access to data
Information Exchange	Content Semantic	Loop data, messages, LOS
	Communication Protocol	IP
	Channel	☐ Broadcast ☐ Cellular ☐ Short Range
Architecture	Entities	x Center - Center ☐ Center - Car ☐ Center - Infrastructure ☐ Car - Infrastructure ☐ Car - Car
	Description	Data exchange platform

Table 34 Project overview NDW NL

Connected Navigation - Aftersales		
Project Organisation	Contact	Ralf-Peter Schäfer, TomTom
	Partner involved	TomTom
	Contact Seamless	Dr.-Ing. Thomas Benz, Dr.-Ing. Michael Ortgiese
	Start date	Since 2009
	End date	On-going

Application Use Cases	Description	After sales navigation in combination with real time traffic information. The information generation is partly based on FCD delivered by navigation devices. The content provider is considering external information sources (e.g. loops, police) also.
	Relevance for SEAMLESS	Considering the need of private service provider. ☐ UC Traffic Light x UC Journey Time
	Category	x Safety ☐ Efficiency ☐ Environment ☐ Urban ☐ Interurban
Business Structure	Stakeholder	☐ Road Operator x Automotive x Service Provider
	B2C payment	☐ Free of Charge x Paid service
	B2B / B2A payment	☐ Free of Charge x Paid service
	Contracts	
Expected Benefits of the cooperation	Infrastructure	
	Automotive	
	Service Provider	Business oriented
Information Exchange	Content Semantic	Speed on link, Messages
	Communication Protocol	IO
	Channel	☐ Broadcast x Cellular ☐ Short Range
Architecture	Entities	x Center – Center x Center - Car ☐ Center - Infrastructure ☐ Car - Infrastructure ☐ Car – Car
	Description	Closed architecture for commercial services

Table 35 Project overview Connected Navigation - Aftersales

Connected Navigation – OEM (i.e. Inrix/BMW)		
Project Organisation	Contact	Martin Hauschild, BMW
	Partner involved	BMW
	Contact Seamless	Dr.-Ing. Thomas Benz, Dr.-Ing. Michael

		Ortgiese
	Start date	Since 2008
	End date	On-going
Application Use Cases	Description	OEM sales navigation in combination with real time traffic information. The information generation is partly based on FCD delivered by navigation devices. The content provider is considering external information sources (e.g. loops, police) also.
	Relevance for SEAMLESS	Integration of Traffic Management information in in-car devices. Up-to-date commercial service. ☐ UC Traffic Light x UC Journey Time
	Category	x Safety x Efficiency x Environment x Urban x Interurban
Business Structure	Stakeholder	x Road Operator x Automotive x Service Provider
	B2C payment	☐ Free of Charge x Paid service
	B2B / B2A payment	☐ Free of Charge x Paid service
	Contracts	
Expected Benefits of the cooperation	Infrastructure	Increase Network efficiency
	Automotive	Improvement of service quality
	Service Provider	
Information Exchange	Content Semantic	Messages, LOS, traffic forecast
	Communication Protocol	IP
	Channel	☐ Broadcast x Cellular ☐ Short Range
Architecture	Entities	x Center - Center x Center - Car ☐ Center - Infrastructure ☐ Car - Infrastructure ☐ Car – Car
	Description	Up-to date architecture for commercial services.

Table 36 Project overview Connected Navigation - OEM

Traffic Information Automobile Clubs (e.g. ADAC, ANBW)		
Project Organisation	Contact	Markus Bachleitner, peter Mikolascheck (ADAC), Wil Botman (ANBW)
	Partner involved	
	Contact Seamless	Dr.-Ing. Thomas Benz, Dr.-Ing. Michael Ortgiese
	Start date	Since 2000
	End date	On-going
Application Use Cases	Description	Traffic information services (internet, Smart Phone apps), Call Centre service, Fleet management services.
	Relevance for SEAMLESS	Strong cooperation between public broadcaster, road operator and service provider. ☐ UC Traffic Light x UC Journey Time
	Category	x Safety x Efficiency ☐ Environment x Urban x Interurban
Business Structure	Stakeholder	x Road Operator ☐ Automotive x Service Provider
	B2C payment	x Free of Charge x Paid service
	B2B / B2A payment	☐ Free of Charge x Paid service
	Contracts	Commercial contracts
Expected Benefits of the cooperation	Infrastructure	Improve network efficiency
	Automotive	
	Service Provider	Service for club members
Information Exchange	Content Semantic	LOS, Messages
	Communication Protocol	IP
	Channel	☐ Broadcast x Cellular ☐ Short Range
Architecture	Entities	x Center - Center x Center - Car ☐ Center - Infrastructure ☐ Car - Infrastructure ☐ Car – Car
	Description	Standard architecture for commercial

		services.

Table 37 Project overview Traffic Information Automobile Clubs

TMC Services – Broadcaster (e.g. ARD)		
Project Organisation	Contact	Thomas Kusche, WDR
	Partner involved	
	Contact Seamless	Dr.-Ing. Thomas Benz, Dr.-Ing. Michael Ortgiese
	Start date	Since 1998
	End date	On-going
Application Use Cases	Description	Broadcast TMC service for navigation devices.
	Relevance for SEAMLESS	Integration of public broadcaster ☐ UC Traffic Light x UC Journey Time
	Category	x Safety x Efficiency ☐ Environment x Urban x Interurban
Business Structure	Stakeholder	x Road Operator x Automotive x Service Provider
	B2C payment	x Free of Charge ☐ Paid service
	B2B / B2A payment	x Free of Charge ☐ Paid service
	Contracts	---
Expected Benefits of the cooperation	Infrastructure	Improve network efficiency
	Automotive	
	Service Provider	Service for customer
Information Exchange	Content Semantic	Traffic messages
	Communication Protocol	RDS/TMC
	Channel	x Broadcast ☐ Cellular ☐ Short Range
Architecture	Entities	☐ Center - Center x Center - Car ☐ Center - Infrastructure ☐ Car - Infrastructure ☐ Car - Car

	Description	Broadcast infrastructure

Table 38 Project overview TMC via Broadcast

In Vehicle Traffic Management		
Project Organisation	Coordinator	Stuart White – Highways Agency
	Partner involved	Highways Agency / URS Scott Wilson, Mott MacDonald
	Contact Seamless	Ian Cornwell, Mott MacDonald
	Start date	01.01.2011
	End date	31.03.2012
Application Use Cases	Description	A long term strategy that is seeking to find new ways of presenting traffic management information to road users. Phase 1 (completed in June 2010 established the feasibility of providing HA traffic management information by means of in-vehicle devices. Phase 2 (completing March 2012) will derive a functional specification for In Vehicle Traffic Management (IVTM). Later (2) Phases will develop this functionality so that, when implemented, tactical messages will be displayed by means of in-vehicle devices.
	Relevance for SEAMLESS	☐ UC Traffic Light x UC Journey Time
	Category	x Safety x Efficiency x Environment ☐ Urban x Interurban
Business Structure	Stakeholder	x Road Operator ☐ Automotive ☐ Service Provider
	B2C payment	x Free of Charge ☐ Paid service
	B2B / B2A payment	☐ Free of Charge ☐ Paid service
	Contracts	
Expected Benefits of the cooperation	Infrastructure	Reduces need for roadside infrastructure
	Automotive	
	Service Provider	
Information Exchange	Content Semantic	Traffic management instructions

	Communication Protocol	To be determined
	Channel	☐ Broadcast ☐ Cellular ☐ Short Range
Architecture	Entities	x Center - Center x Center - Car ☐ Center - Infrastructure ☐ Car - Infrastructure ☐ Car – Car
	Description	Some initial architectural characteristics have been defined. It is intended to modify the existing HATMS architecture to add transmissions from roadside to vehicles.

Table 39 Project overview In Vehicle Traffic Management

ITIS Floating Vehicle RDS TMC		
Project Organisation	Coordinator	Gary Gates - ITIS
	Partner involved	ITIS, Mott MacDonald
	Contact Seamless	Fraser Macdonald, Mott Macdonald
	Start date	01.01.2005
	End date	On-going
Application Use Cases	Description	Generation of Traffic information from Floating Vehicle data which was broadcast via ITIS TMC servioce.
	Relevance for SEAMLESS	☐ UC Traffic Light x UC Journey Time
	Category	☐ Safety ☐ Efficiency ☐ Environment ☐ Urban ☐ Interurban
Business Structure	Stakeholder	☐ Road Operator ☐ Automotive ☐ Service Provider
	B2C payment	☐ Free of Charge ☐ Paid service
	B2B / B2A payment	☐ Free of Charge ☐ Paid service
	Contracts	
Expected Benefits of the cooperation	Infrastructure	
	Automotive	

	Service Provider	
Information Exchange	Content Semantic	
	Communication Protocol	
	Channel	☐ Broadcast ☐ Cellular ☐ Short Range
Architecture	Entities	☐ Center - Center ☐ Center - Car ☐ Center - Infrastructure ☐ Car - Infrastructure ☐ Car – Car
	Description	

Table 40 Project overview IT IS Floating Vehicle RDS

Leeds UTMC SMS messaging		
Project Organisation	Coordinator	Gordon Robertson - Leeds City Council
	Partner involved	Leeds City Council, Mott MacDonald
	Contact Seamless	Fraser Macdonald, Mott MacDonald
	Start date	01.01.2007
	End date	On-Going
Application Use Cases	Description	Generation of automatic travel time alerts sent to travelers via SMS for their registered route. UTMC provided a number of data publication channels including RSS, TWITER, DATEX II
	Relevance for SEAMLESS	☐ UC Traffic Light x UC Journey Time
	Category	☐ Safety ☐ Efficiency ☐ Environment ☐ Urban ☐ Interurban
Business Structure	Stakeholder	☐ Road Operator ☐ Automotive ☐ Service Provider
	B2C payment	☐ Free of Charge ☐ Paid service
	B2B / B2A payment	☐ Free of Charge ☐ Paid service
	Contracts	

Expected Benefits of the cooperation	Infrastructure	
	Automotive	
	Service Provider	
Information Exchange	Content Semantic	
	Communication Protocol	
	Channel	☐ Broadcast ☐ Cellular ☐ Short Range
Architecture	Entities	☐ Center - Center ☐ Center - Car ☐ Center - Infrastructure ☐ Car - Infrastructure ☐ Car - Car
	Description	

Table 41 Project overview Leads UTMC SMS Messages

IHOP2		
Project Organisation	Coordinator	Fraser Macdonald - Mott MacDonald
	Partner involved	Mott MacDonald
	Contact Seamless	Fraser Macdonald
	Start date	01.01.2009
	End date	On-Going
Application Use Cases	Description	iPhone application delivering UK national traffic information. Utilises Datex II to gather information from UTMC systems. ☐ UC Traffic Light x UC Journey Time
	Relevance for SEAMLESS	
	Category	☐ Safety ☐ Efficiency ☐ Environment ☐ Urban ☐ Interurban
Business Structure	Stakeholder	☐ Road Operator ☐ Automotive ☐ Service Provider
	B2C payment	☐ Free of Charge ☐ Paid service

	B2B / B2A payment	☐ Free of Charge ☐ Paid service
	Contracts	
Expected Benefits of the cooperation	Infrastructure	
	Automotive	
	Service Provider	
Information Exchange	Content Semantic	
	Communication Protocol	
	Channel	☐ Broadcast ☐ Cellular ☐ Short Range
Architecture	Entities	☐ Center - Center ☐ Center - Car ☐ Center - Infrastructure ☐ Car - Infrastructure ☐ Car - Car
	Description	

Table 42 Project overview IHOP 2

9 Appendix 2 – Abbreviations

A list of abbreviations and acronyms occuring in this document
(including a selection of projects and companies)

ACC	Adaptive Cruise Control
ADAC	German automobile association (Allgemeiner Deutscher Automonilclub)
ADAS	Advanced Driver Assistance Systems
ANBW	Royal Dutch Touring Club
ARD	A German television broadcaster (Erstes Deutsches Fernsehen)
ASFINAG	An Austrian company
AUDI	A German car manufacturer
B2A	Business-To-Administration
B2B	Business-To-Business
B2C	Business-To-Consumer
BMT	British company
BMW	Bayerische Motoren Werke – a German car manufacturer
BR	German company
BTPPL	Data protocol used for OCIT-Outstations
C2C	Car-To-Car
C2X	Car-To-Car and Car-To-Infrastructure
CAM	Cooperative Awareness Message (used in C2C systems)
CCTV	Closed Circuit Television
CEN	European Committee for Standardisation
CERTH	Centre for Research & Technology, Greece
CISS	Cooperative Intersection Safety System
CNRS	Centre national de la recherche scientifique
CO^2	Carbon dioxide
CORBA	Common Object Request Broker Architecture
COSMO	A Cooperative Systems project
CRF	Centro Ricerche Fiat S.C.p.A. – an Italian company
CTAG	Centro Tecnológico de Automoción de Galicia
CTT	Congestion and Travel-Time – a TPEG module
CVIS	A Cooperative Systems project
DAB	German digital radio

DATEX II	An interface for exanging road and travel data
DENM	Decentralized Environmental Notification Message
DIAMANT	A Cooperative Systems project
DIANA	A Cooperative Systems project
DIN	Deutsche Industrie Norm (German industry standard)
DIN SPEC	The entirety of all specifications at DIN
DIVA	A Cooperative Systems project
DMB	Digital Multimedia Broadcasting
DRIVE C2X	A Cooperative Systems project
DSRC	Dedicated Shor- Range Communication
EASY-WAY	Project for Europe-wide ITS deployment
EN	European Norm
ERA-NET ROAD	Partnership of National Road Administrations for research programmes
ERICSON	A company
ERTICO	Network of Intelligent Transport Systems and Services stakeholders in Europe
ESG	European Study Group (of EASY-WAY)
ETSI	European Telecommunications Standards Institute
EU	European Union
FCD	Floating Car Data
FOT	Field Operation Test
FREILOT	A Cooperative Systems project
GATS	Global Automotive Telematics Standard
GERTEK SA	A company
Gewi	A German company
GDDKiA	General Directorate for National *Roads* and Highways (Polish Road Administration)
GID	Geometric Intersection Description
GPRS	General Packet Radio Service
GPS	Global Positioning System
HA	Highways Agency
HATMS	Highways Agency Traffic Management System
HD	High Definition

HGV	Heavy Good Vehicles
HIT	Hellenic Institute of Transport
HLSV	Hessisches Landesamt für Straßen- und Verkehrswesen (Hessen Mobil)
HMI	Human Machine Interface
HR	Hessischer Rundfunkt (German Radio Broadcaster)
HTTP	Hype Text Transfer Protocol
IBEO	Company for driver assistence systems
ICT	Information and Communications Technologies
IDL	Interface Description Language
IHOP, IHOP2	Cooperative Systems projects
IIOP	Internet Inter-ORB Protocol
INTERSAFE-2	A Cooperative Systems project
IP	Internet Protocol
IPR	Intellectual Property Rights
IRS	ITS Roadside Station
ISO	International Organization for Standardization
ITCS	Intermodal Transport Control Systems
ITIS	A Cooperative Systems project
ITS	Intelligent Transport Systems
IV	German: Individualverkehr (individual traffic)
IVTM	In Vehicle Traffic Management
KOLINE	A Cooperative Systems project
LET	A company
LOS	Level Of Service
LTE	Long Term Evolution
MAP	Map Data (part of Signal Phase and Timing Message)
MARZ	German code of practise for Traffic Management Centers (Merkblatt für die Ausstattung von Verkehrsrechnerzentralen und Unterzentralen)
MDM	Mobility Data Market Place (German data exchange node)
MIB	Management Information Base
MLC-EUSKADI	Basque Mobility and Logistics Cluster
NDW	National Data Warehosue (Netherlands)
NL	The Netherlands

NMCS	National Motorway Communication System
NXP	A company (semiconductors)
OCA	Open Traffic City Association (Urban stakeholders from Germany, Austria, Switzerland)
OCIT	Open Communication Interface for Road Traffic Control Systems
OCIT-C	OCIT-Central
OCIT-I	OCIT-Instations (interface for central layer)
OCIT-O	OCIT-Outstations (interface for field layer)
OEM	Original Equipment Manufacturer
OGC	Open Geospatial Consortium
OTEC	Open Communication for Traffic Engineering Components (consortium has closed its partnership)
OTS	Open Traffic Systems
P+R	Park and Ride
PEEK	A company from The Netherlands
POI	Point Of Interest (also as TPEG module)
POLIS	European Cities and Regions Networking for innovative Transport Solutions
PPP	Public Private Partnership (in IT context also: Point-To-Point Protocol)
PT	Public Transport
PTV AG	German company (Planung Transport Verkehr; one of the project partners)
PULL	Style of internet based communication
PUSH	Style of internet based communication
RDS	Radio Data System
ROSATTE	A Cooperative Systems project
RSS	Really Simple Syndication (Website-Feed)
RSU	Road Side Unit, also: IRS = ITS Roadside Station
RTTI	Real Time Traffic Information
RWS	Rijkswaterstaat (Netherlands)
RWTH	Rheinisch Westfälische Technische Hochschule Aachen
SAE	Global association of engineers and technical experts (standardisation)
SAFESPOT	A Cooperative Systems project
SEAMLESS	A Cooperative Systems project

SMS	Short Message Service
SNMP	Simple Network Management Protocol
SOAP	*originally:* Simple Object Access Protocol
SPaT	Signal Phase and Timing (-Message)
SPITS	A Cooperative Systems project
SRM	Signal Request Message
SSM	Signal Status Message
SVEVIA	Swedish road management contractor
TC	Technical Comittee
TCP	Transmission Control Protocol
THETIS	An Italian company
TISA	Traveller Information Services Association
TLS	German regulations for interurban infrastructure (Technische Lieferbedingungen für Streckenstationen)
TMC	Traffic Message Channel
TPEG	Transport Protocol Experts Group
TPEG TEC	Traffic Event Compact
TPEG TFP	Traffic Flow Prediction
TRAVOLUTION	A Cooperative Systems project (in Ingolstatdt)
TS	Technical Spezification
TU	Technical university
TWITTER	Internet based messaging service
UC	Use Case
UK	United Kingdom
UML	Unified Modeling Language
URS	A company
US	United States
UTC	Universal Time Coordinated
UTMC	Urban Traffic Management and Control
VIB	A Cooperative Systems project (Traffic Information Agency Bavaria)
VM	Virtual Maschine
VMS	Variable Message Signs
VOLVO	Swedish car manufacturer

WDR	German radio and television broadcaster (Westdeutscher Rundfunk)
WG	Working Group
WP	Workpackage
WS	Workshop
WSDL	Web Services Description Language
XML	Extensible Markup Language
XTS	A Cooperative Systems project
ZENTEC	A German company