Telematics – Changing Roads and Roles

- Recommendations for Priorities in the Field of Transport Telematics

WERD – FEHRL – FERSI
Telematics Group

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FEHRL – *Forum of European National Highway Research Laboratories*
FERSI – *Forum of European Road Safety Institutes*

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1. Executive Summary

Telematics are rapidly becoming an integral part of the work of Road Authorities in many countries. Therefore WERD together with FEHRL and FERSI decided to form an expert group on telematics to advice the Road Authorities and research institutions about priorities in the field.

Road Authorities pursue a wide range of different policy objectives. Many of the tools to address these objectives are of a telematic nature. This in itself requires Road Authorities to be aware of the possibilities and able to specify their needs in terms of telematics. Many of the solutions offer a wide range of added possibilities above their original intention. E.g. data collected for one purpose may be of great value for another functionality. Data may have a market value in areas where Road Authorities have traditionally not been very active. There is, therefore, a potential for private investment. The co-operation with the private sector is not always problem-free as the aims pursued by the private sector may be in conflict with the aims of Road Authorities. Therefore development of proper co-operation is an important recommendation.

To support a seamless ITS system throughout Europe much effort is invested in developing standards for interfaces between subsystems, databases, etc. It is recommended that Road Authorities consider working closer together in this effort in order to get a stronger representation of the buyers of some of the ITS technology.

Implementation and operation of ITS in not entirely a technical issues. Much attention needs to be devoted to organisational and legal matters, as these may be more difficult to handle than the technical matters. Especially areas like protection of privacy will require attention. In addition liability issues may grow into a major issue as more and more driving tasks are automated or supported. Also cross border enforcement of offenders registered by automatic enforcement equipment may be given attention.

The decision to implement ITS on a large scale will be based on proper assessment of costs and expected benefits. Much work has been done in trying to establish the benefit cost ratios of different systems. Too little of that information is being made available in a form useful to other Road Authorities. Therefore it is recommended that Road Authorities exchange knowledge in this field.

One of the most promising effects of a number of ITS applications is an increased safety. As this is also high on the political agenda it is recommended that more effort be devoted to the further development of safety related ITS applications.

Finally it is recommended that Road Authorities play a larger role in co-ordination of development with stakeholders like the automotive industry, the European Commission, etc.

With respect to R&D it is recommended that mental load on drivers from information systems be studied as well as how to meet the needs of vulnerable road users. Also basic research should be given further attention.

2. Introduction

Telematics applications have developed rapidly and in many countries are now becoming integral parts of the everyday life of the travellers of Europe as well as that of the Road Authorities. Telematics applications make transport safer for the traveller, faster for the shipper and easier to administer for the Road Authorities. Telematics applications will help Road and other transport authorities, transport operators and individual travellers make better co-ordinated and more "intelligent" decisions based on good up to date information. Thus the terminology most often used for telematics applications is "Intelligent Transport Systems" or just ITS.
ITS is already being used in such different areas as traveller information, traffic management, emergency operations and electronic payment. Every year major new applications are being suggested, development projects started, tests performed, conclusions drawn and knowledge put into action. The buzzwords of today (RDS-TMC, Intelligent Speed Adaption, Road Pricing, etc.) could very well be the everyday business of Road Authorities tomorrow. If this rapid development is ignored Road Authorities may find that they no longer determine the path of developments in the road sector. New actors (public as well as private) will emerge who will play a significant role in the areas of traffic operations and information distribution. Only by being well prepared can Road Authorities face the challenge and take their proper role in a new environment where sharing responsibilities will be a key characteristic.

Placed into the traditional framework of a national Road Authority i.e.

Construction	Maintenance	Operation

ITS as an integral part of operations. ITS will itself lead to construction because much of the equipment associated with telematics is placed within the physical infrastructure and because traffic informatics may suggest new or modified roads. ITS therefore completes the circle of main activities of the Road Authorities. However, while the Road Authorities are in full control of construction and maintenance operations they will not be in total control of all ITS applications. They will often find that they need to co-operate with other stakeholders. This is a new situation for Road Authorities and will need to be addressed in order to ensure the smooth and efficient operation of the road network and its links to other modes of transport. Certain ITS applications also have international implications because their very structure is international and their purpose is to ensure international interoperability of the road transport networks. Equally industry is increasingly looking to developments that suit large markets. It will be particularly important to seek co-operation with the vehicle industry to ensure compatibility between the in-vehicle and roadside systems.

In short: ITS is set to become an integral and indispensable management tool and therefore is a challenge to be carefully explored by the Road Authorities. The many facets of ITS have meant that numerous actors are already involved in the development and use of ITS. Within the public domain the European Commission has established a High Level Group on Road Transport Telematics to discuss priorities and set guidelines for the deployment of ITS within the road transport sector. The private sector, notably the car manufacturers, have invested large sums in ITS applications and the organisation ERTICO (European Road Telematics Implementation Co-ordination Organisation) seeks to co-ordinate the development in co-operation with the European Commission.

The many ITS activities as well as the complexity of the many possible uses of ITS has given rise to some concern among WERD as well as FEHRL and FERSI. Their respective roles in the use of ITS and the further need for R&D within the Road Authorities were issues the three parties agreed to explore jointly. Consequently a small group of experts from WERD, FEHRL and FERSI was established to undertake an evaluation of common interests in the use of ITS for the Road Authorities. The detailed terms of reference appears as annex A, which also lists the members of the group.

3. Policy Issues

ITS can be used to meet some transport policy objectives. This chapter explores policies where ITS can play a role in meeting the objectives.

The introduction of ITS was stimulated by

- development of electronics and telecommunication technology (= supply driven)
- increasing traffic and transport problems (= demand drive).

The rapid development of ITS is the consequence of the fact that technology development (supply) and market demand are well aligned. Market surveys reveal a huge commercial potential of ITS. ITS is appreciated as a promising technology ensuring commercial activities and employment in the future.

This underlines the fact that ITS concerns not only the transport sector, but also societal development and conditions in general. ITS has considerable effects on

- Transport and traffic management
- Environment
- Economic development and employment

These politically sensitive fields make ITS a politically important issue.

3.1 Actors

Traffic Management (TM) has a fairly long tradition with very positive results especially on motorways as a measure to avoid congestion, to improve safety in case of tailbacks and to improve the exploitation of road network capacity. Variable message sign systems and traffic broadcasts as main instruments have been tested, fine-tuned and provide the backbone of TM. The integration of these instruments with shared databases yield considerable synergetic effects by mutual complementation.

The new ITS applications go far beyond the legal obligations of public authorities; they ”provide service” to their users. Consequently, private actors have entered the scene to exploit these new technologies. Private actors are e.g.

- Broadcasters, Datacasters, Internet Service Providers
- Telecommunication operators
- Telecommunication industry
- Vehicle manufacturers

There are clear overlaps of actions and interests of private and public actors. This requires a reconsideration and definition of roles. Actors belonging to the private sector may follow different objectives than public authorities, and therefore both sectors have to be taken into account and to be given sufficient and politically well-balanced attention. This is further explored in chapter 5.

3.2 Policy Objectives Guiding Public Authorities

The political mandates given to **Public Authorities** include the following main policies and sub goals, which may be affected by the use of telematics.

Table 3.1

Transport Policy Objectives	**Sub goal**
Meet the demands of a mobile society	• Ensure mobility of people and goods
Meet the special demands of low-mobility road users	• Meet mobility requirements of disabled people and other less mobile groups
Accessibility to cities and regions	• Creation of comparable or adequate conditions for living, working, business, recreation etc.
Sustainable mobility	• Priority to necessary and/or highly efficient transports • Avoidance of unnecessary transports • Appropriate use of all transport modes
Traffic and Transport efficiency	• Avoidance of congestion • Undisturbed and homogeneous traffic flows • Efficient exploitation of available network capacity • Efficient handling of travel, transport and parking demand • Improved co-operation between transport modes • Reduction of transport costs • Enabling road maintenance without excessive impacts on road capacity, safety and environmental conditions.
Fair transport cost allocation	• Allocation of costs to the entity that is responsible for their creation • Fair competition in the transport market
Traffic safety, individual security	• Avoidance of hazardous situations • Alerting drivers in case of unavoidable hazardous situations; • Protection of vulnerable road users • Quick reaction in case of accidents and incidents • Ensure efficient incident management and rescue systems • Protection of the individual and of his property
Environmental Policy Objectives	**Sub goal**
Protection of the environment	• Protection of sensitive environments (e.g. residential areas, nature) • Reduction of pollutants emission • Better use of energy in transport
Economic Policy Objectives	**Sub goal**

Creation of a framework for private services in the transport sector	• Creation of a legal framework that will encourage private initiative in this area • Standardisation of communications protocols for interconnections • Definition of basic services provided free of charge • Removal of barriers to private initiatives, provided that standards are followed
Enabling international competitiveness of the European ITS industry	• Open possibilities of the ”Information Society” within the Transport sector for suppliers as well as consumers • Removing trade barriers between European countries to create a pan-european market • Promotion of European ITS industry in the global competition • Secure employment in Europe • Exploitation of information technology as means of production
European coherence	• Interoperability of ITS in Europe • Pan-european usability of ITS equipment, where appropriate

3.3 Objectives Guiding Private Actors

The incentives for the **private sector** are basically of commercial nature. Main objectives are for instance:

Table 3.2

Objectives	**Sub goals (list is not exhaustive)**
Economic success	• To achieve a maximum return on investment • To make optimum use of available service capacities (i.e. of transmission channels)
Technological leadership	• To be technologically ahead of competitors • To attract clients and keep them loyal by offering advanced service and technology
Overtaking competitors	• To gain a leading position on the market • To control market access by granting licences • To set market rules
Setting standards	• To lead by setting de-facto standards • To keep the technological lead

The expectation of a huge market demand was the incentive for industrial decision-makers to invest in the development of ITS technologies and applications. National and international research programmes supported by industry and public funds contributed to speed up the process. (References: PROMETHEUS, DRIVE, TAP, etc). Especially the EU programmes were very successful by their strategy to bring together industry, research organisations, authorities and other concerned actors on a European level.

3.4 Conflict of interests

After successful development of technologies, systems and applications and their demonstration, the introduction of the operational phase raised new questions:

- Who is to operate the individual applications? Private or public sector?
- Can both sectors operate their applications independently?
- Which actor takes the lead in case of overlaps and competing interests?
- Is there a need to create or modify the legal framework?

The actions of public and private actors follow different objectives. Economic exploitation of privately operated services may lead to conflicts with public policy objectives. For private operators, public objectives are only relevant as far as they support their own interests. It is the task of policy makers to set ”rules” in case of conflicts. This means in this context that policy makers have to establish framework conditions for the establishment and operation of private services:

- Which services are to be set up and operated by public authorities? And by which public authority?
- Which rules and policy objectives shall private operators comply with?
- Which rules and boundaries shall public actors observe in order to enable private actors to plan and invest money?

3.5 Issues for further consideration

Generally it can be stated that the actions of authorities take place in a changed environment. A competitive market is approaching their former "sovereignty" position; it is therefore an urgent need that the roles be redefined to the benefit of all actors. Road authorities from their traditional action fields of planning, construction, operation and maintenance have to enter the new technology area of Telematics. In many administrations the staff has been selected to perform the above mentioned traditional tasks. It is absolutely necessary that administrations face the new situation and establish competence in telematics within their staff.

It is also necessary to draw the attention of Road Authorities to possible impacts of telematics on road design and equipment, traffic flow and capacity. It is necessary to consider aspects of type approval of vehicle telematics equipment as far as requirements and impacts on Road Authorities issues are concerned.

Chapter 4 tries to identify the main interests of the individual applications. Chapter 5 explore possible roles of Road Authorities and related stakeholders.

4. Services, Applications and Tools

ITS offers a wide range of different tools to support the policy objectives of Road Authorities. All tools do not meet all objectives and authorities therefore have to prioritise their effort in areas where most of their objectives are met.

The following tables include a number of already existing telematics services and applications and also some planned services, which might become operational in the near future. The listing is according to ISO, which have divided applications into 32 groups for system architecture purposes. The list show the present conception of ITS and is not necessarily comprehensive, because new technology driven developments are continuously under way and show a high degree of dynamics.

4.1 Impact of various ITS services and applications on policy objectives

Table 4.1 identifies the impacts of various ITS services and applications, as seen by the Telematics Group, on the fulfilment of policy objectives. Possible effects on private sector actor objectives are not listed. Further explanation of services and applications are found in Annex D.

Table 4.1

	Transport policy objectives							Environmental policy objectives	Economic policy objectives		
Service Application	Meet the demands of a mobile society	Meet spec. demands of vulnerable road users	Accessibility to cities and regions	Sustainable mobility	Traffic and transport Efficiency	Fair transport cost allocation	Traffic safety, individual security	Protection of environment	Framework for private services	European competitiveness	European coherence
Traveller Information											
1. Pre-trip information	+	++	++	++	+			+	+	+	
2. On-trip driver information	++	++			+		+	+	+	+	+
3. On-trip public transport information	++	++	++	++					+		
4. Personal information services	+	++	++						++		

5. Route guidance and navigation	++	++	+	+	++			+	++		+
Traffic Management											
6. Transportation planning support	+		+	+	+	+	+	+			+
7. Traffic control	+				++		++	++			+
8. Incident management	++				++		++	++			+
9. Demand management			+	++	++	++		++			
10. Policing/enforcing traffic regulation				+			++	+			+
11. Infrastructure maintenance management	+		+		+		+		+		
Vehicle											
12. Vision enhancement	++	++	+		+		+		++	++	
13. Automated vehicle operation	+	++	+		++		++	++	++	++	+
14. Longitudinal collision avoidance		+					++		++	++	
15. Lateral collision avoidance		+					++		++	++	
16. Safety readiness		+					++		++	++	
17. Pre-crash restraint deployment		+					++		++	++	
Commercial Vehicles											
18. Commercial vehicle pre-clearance	+				++	+	+	+	+		+
19. Comm. vehicle administrative processes	+								+	+	+
20. Automated roadside safety inspection					+		+	+	+	+	+
21. Commercial vehicle on-board safety monitoring							++	+	++	++	
22. Commercial vehicle fleet management	+			+	++	+		+	++	++	
Public Transport											
23. Public transport management	++	++	+	+	++			+	++		
24. Demand responsive public transport	++	++	++	++	+			+	++		
25. Shared transport management	++	+	++	++	+			+	++		
Emergency											
26. Emergency notification & personal security					+		++		++	++	+
27. Emergency vehicle management	+			++	+		++				+
28. Hazardous materials & incident notification				+	+		++	++	+		+
Electronic Payment											
29. Electronic financial transaction	+		+	+	++	++	+	+	++	+	+
Safety											
30. Public travel security	+	+	+	+			++		+		
31. Safety enhancement for vulnerable road users	+	++	+	+			++	+	++	++	+

32. Intelligent junctions					++		++	+	+	+	+

+ = moderate effect, **++** = substantial effect

4.2 Possible Operation of Services and Applications

Table 4.2 gives an overview of possible operators of services as seen by the Telematics Group. The comments include some consideration about the allocation of the application to public or private actors. The allocation is based upon main objectives pursued with the applications, e.g. following primarily traffic policy objectives or private sector objectives. Possible conflicts of interest are pointed out. For a further explanation of services and applications please consult Annex D.

Table 4.2

Service Application	Operated by ***)**	Comments
Traveller Information		
1. Pre-trip information	A, P, PPP	Area of shared responsibility, especially because this service can be used to induce modal shifts
2. On-trip driver information	A, P, PPP	
3. On-trip public transport information	P	
4. Personal information services	P	
5. Route guidance and navigation	P, PPP	Could be an area of shared responsibility if route guidance is viewed as Traffic Management
Traffic Management		
6. Transportation planning support	A	
7. Traffic control	A	
8. Incident management	A	Primarily an area of public interest. There could be a conflict between road administrations, police and rescue service.
9. Demand management	A	
10. Policing/enforcing traffic regulation	A	
11. Infrastructure maintenance management	A	
Vehicle **)		
12. Vision enhancement	P	Areas of private interest. Development towards co-operative driving where there is interaction (apart from friction) between vehicle and infrastructure may alter this. Some rules concerning HMI may be set by public authorities.
13. Automated vehicle operation	P	
14. Longitudinal collision avoidance	P	
15. Lateral collision avoidance	P	
16. Safety readiness	P	
17. Pre-crash restraint deployment	P	
Commercial Vehicles		

18. Commercial vehicle pre-clearance	A,P	Areas of private interest. Some rules e.g. concerning HMI may be set by public authorities.
19. Commercial vehicle administrative processes	P	
20. Automated roadside safety inspection	A,P	
21. Commercial vehicle on-board safety monitoring	P	
22. Commercial vehicle fleet management	P	
Public Transport		
23. Public transport management	P	
24. Demand responsive transport management	A, P	Area of other public authority/private interest.
25. Shared transport management	PPP	
Emergency		
26. Emergency notification and personal security	A, P, PPP	Area of other public authority/private interest.
27. Emergency vehicle management	A, P, PPP	
28. Hazardous materials and incident notification	A, P, PPP	
Electronic Payment		
29. Electronic financial transaction	A	
Safety		
30. Public travel security	A, P, PPP	Area of other public authority/private interest.
31. Safety enhancement for vulnerable road users	A, P	
32. Intelligent junctions	A, P	

Explanations:
***)**
P = Private Sector
PPP = Private-Public Partnership
A = Authorities: Road Authorities; Other Public Authority: e.g. Police

****)** Vehicle related systems might operate vehicle-autonomous, vehicle-interactive and/or roadside supported. This has consequences on liability and responsibility.

4.3 Availability of Tools

All applications need tools for their operation. There is considerable synergy to be gained through the use of common tools and considerable savings to be gained from the reuse of tools. Tools are not easily classified according to applications, as this undermines the idea of interoperable services.

One possible way to classify tools is according to location of installation. This classification has its origin in the US work on system architecture, but is generally applicable:

- *In-vehicle equipment* that measures environment parameters such as road surface condition, range of sight, road geometry, location and speed of neighboured vehicles, etc. In addition they need storage devices of digital road map, data processing, for example, for navigation or distance and speed control, transmitter and receiver for communication with external units and finally input/output (driver-vehicle interface).

- *Roadside equipment* that measures traffic (volume, speed), environmental conditions (esp. weather). In addition they need control units (traffic lights, variable message signs), data transmission from and to other units and display of information for drivers (esp. variable message signs).
- *Central devices / control centres* for system operation, system surveillance, data storage, data processing (open and closed loop operation) and links with other information or control centres.
- *Terminals for private use* (at home, office, public places/information kiosks, portable terminals) for pre-trip information, on-trip information and booking of parking place, seat reservation in public transport, etc.
- *Communication systems* (for communication between vehicles and outside world) such as beacon based short-range communication (infrared, microwave), cellular radio communication (GSM, UMTS, TETRA, LMR), broadcasting (AM, FM, RDS, DAB) and satellite communication.

Road Authorities generally need not be too concerned with technology, but rather with functionality, quality of service, interoperability, etc. Thus the requirements of road authorities are not so much concerned with the specific components as it is with how these components work and what they can do. Many of the requirements of Road Authorities are covered or will be covered by standards provided they participate in the standardisation process and make these requirements known:

- Technical standards, which describe the data sets and protocols to be exchanged between systems,
- Performance standards to be used when testing the proper performance of systems,
- Interface specifications to ensure links to the surroundings,
- System architecture to ensure technical interoperability and maximum utilisation of common data.

These areas are covered further in chapter 6. Additionally, Road Authorities need to be concerned with:

- Organisational interoperability which deals with the interworking of multiple systems under multiple jurisdictions. Thus this is also a question of securing agreements between different operators. This is an area where only little work has been done at the general level. For specific applications however, some work has been undertaken.
- Infrastructure requirements from future transport operations. Most research shows that automated highways operations require co-operation between in-vehicle systems and in-road or roadside systems. These need to communicate, e.g. concerning the reference trajectory to be followed. Road geometry as well as the requirements of the automated systems defines these trajectories. Road geometry does not change rapidly and provisions for future needs may therefore have to be taken soon if automated operation is to have any impact on road traffic. Thus design guidelines may need to be revised.

4.4 Issues for further consideration

A number of immediate conclusions regarding priorities can be drawn from tables 4.1 4.2 and 4.3:

- Traffic information serves many road authority aims but should be operated in a partnership with private industry. There is, therefore, a need for development of relevant models for co-operation in this field.
- Traffic management likewise serves many road authority aims, and is primarily a road authority area of interest. There may, however, be overlaps with other public authorities such as police, etc. which must be dealt with. Thus the primary interest in this area should be technology development and benefit assessment.
- Vehicle technology serves primarily safety aims, and is mainly an area of private interest. Co-operative systems, which assist the driver in a number of tasks, such as lane keeping, will in many cases require/or be improved by e.g. special reflective markings, embedded magnets, etc. Such systems are presently primarily working as prototypes, but several concepts are close to the market. In a longer timespan, the vehicle-infrastructure interaction may demand even more interest from Road Authorities as more advanced systems may require special geometric features to work properly. This issue should be investigated further as a change in design guidelines does not have an immediate effect on the geometric layout of the existing roads. Therefore long term planning of new design features are critical to the long term success of advanced vehicle-infrastructure technology.
- In order to obtain best and synergetic results from services, agreements between actors in the following areas are required:
  - Development of common tools such as data definitions which allows e.g. traffic data to be used by multiple applications.
  - Mutual access to databases to avoid unnecessary duplication of efforts.
  - Improvements of data sources, e.g. floating car data (on-line travel time data)
  - Integration of data from different sources
  - Contracts on strategies

It is recommended that the following applications are considered for development:

- Traffic and road condition monitoring systems have been currently implemented for mainly other purposes than ITS services. The user requirements as set by the services should be used in the development of quality requirements for various types of monitoring information. These quality requirements can then be used as a basis for developing new, innovative monitoring solutions or making the use of existing monitoring solutions more effective.
- Modelling and forecasting tools are needed to make the best use of scarce data. Often data do not describe the present situation as data may be delayed (seconds, minutes or hours). Therefore forecasting or nowcasting models are of great importance and an area where much development work is still needed.
- The use of static monitoring stations may soon be supplemented due to the emerging wide capacity mobile communication systems enabling the extensive use of floating cars as the source of monitoring information. Full use of the emerging potential requires comprehensive R&D efforts concentrated in the collection, management and use of floating car data.

- The efficient use of traffic management systems requires smooth co-operation of the various Road Authorities responsible for the road transport network. In the co-operation, data exchange is a crucial part. The research and development work should build upon the European DATEX activities.
- Additionally Road Authorities should work to ensure that in-car devices are available for all European languages, and not just for major countries, as this is important to create continuity of service throughout Europe.

5. Role of Road Authorities versus Private Investors

In traditional road infrastructure planning, construction and operation there has been an overlap between the responsibility for the different tasks and the control over the tasks. Most Road Authorities have been responsible for road planning and have had the resources to carry out plans within their organisations, or at least on a contract basis. Highway Laboratories and Safety Institutes have the responsibility to carry out research and have, in some countries, their own resources from public funds to do so. Thus traditionally Road Authorities have had the full control over their full range of activities.

The deployment of transport telematics may potentially alter this state of affairs. Most investment projections concerning deployment of transport telematics operates with a significant share of investment coming from the private sector, especially in the area of traffic information related services [ref. The WELL-TIMED study]. With private funds involved as direct investment there will be a requirement from the private sector to control the task in which it invest. This means a potential loss of control for Road Authorities over the areas where these funds are used. If both sides do not accept this transfer of control there will be either no investment in the task or conflict over control of the task.

Road Authorities may well continue to be responsible for planning as well as operation and deployment. As most tasks may include private investment, the Road Authorities can choose to set up clear agreements with private investors and operators concerning the fulfilment of public requirements such as quality of service, continuity of service, content of service, etc. This can either be in the form of a framework of minimum standards to be met by everyone who wants to provide service or in the form of contracts to perform specific tasks.

In any case definition of quality is a key control parameter. Attempts have been made within ISO (TC204, WG2) to set up a group to define quality standards to be used as reference. This effort has recently stopped due to lack of participation. In connection with services that fulfil core Road Authority responsibilities required level of quality is the Road Authority's tool to implement its policies. For peripheral services (services which are not core Road Authority services) the consumers will determine the quality through market forces. Thus Road Authorities need to be able to describe the required level of quality for core services, and need to determine which services are core and which are peripheral. Based on this understanding appropriate areas for public private partnership, outsourcing, etc. can be defined and modes of co-operation can be developed.

Depending on the mode of co-operation between public and private sector there will be a smaller or larger potential for private involvement in the investment in transport telematics. In all cases, however, Road Authorities will be able to uphold the responsibility for planning, deployment and operation but may loose some degree of control. Thus responsibility is no longer a matter of controlling the task but rather of setting the rules of co-operation between public and private sector in such a way that policy objectives are met without excessive investment requirements on the public sector.

An example of the issue is RDS-TMC, which may in some countries depend significantly on traffic data from private sources. Another example is the strong dependence on GPS technology for real-time vehicle location. The development of this system is entirely outside the control of the Road Authorities.

5.1 Issues for further consideration

The new role of Road Authorities will be a role as a very important node in a network of stakeholders, in contrast to the traditional role as top of the hierarchy. Thus Road Authorities need to learn how to influence partners rather than direct partners in order to ensure that policy objectives are met. It is therefore important that policy objectives are formulated explicitly. Two important issues in this context are the development of appropriate modes of co-operation between public and private sector. The other is learning how to express requirements in terms of quality of service, and finding ways to measure the achieved quality of service.

The role of WERD in this context could be to summarise the experience of different Road Authorities in form of “Best Practice” documents. Additionally WERD could be a good counterpart to private stakeholders such as the automotive industry, the communication industry, etc. as these are organised transnationally rather than nationally.

6. Standards

The general objective of standardisation is to ensure the fitness for purpose of products, processes and services. Standards can bring benefits in - mutual understanding - quality - economy - technology transfer and consequently efficiency, safety and environmental protection. Standards are a necessary condition, but not sufficient to guarantee interoperability between systems.

ITS is a large, complex and diverse system. It does not lend itself to the conventional product orientated standardisation process. Rather it follows the models used in IT. It is generally accepted that ITS standards are required to cover the identification and definition of common

- Interfaces; for example road/vehicle communications.
- Databases; for example digital maps.
- Definitions; for example terms used.
- Data Elements; for example traffic messages.

These standards would not specify in detail the equipment and should allow sufficient freedom to encourage development, innovation and competition.

The objectives of standards for ITS is to promote the development and deployment of ITS through the preparation of a coherent set of standards. This development would be at a European level as transport is a pan-european service. Specifically these standards should concentrate on providing compatibility and interoperability both within an application (or service) and between applications. It has always been recognised that the type of standards being prepared for ITS on their own will not achieve interoperability and additional agreements are necessary. A number of these are already in place in the form of MOUs (Memorandum of Understanding) and Concerted Actions.

Standards for ITS are particularly relevant to Road Operators not only because as public authorities they must use the standards in procurement, but also because they offer significant advantages in terms of overall functionality and interoperability. This is particularly important where systems must work together across functional boundaries as for example traffic control systems working with tolling systems for the same road network or area boundaries for example traffic control systems covering an urban area working with the neighbouring motorway control system. Standards can also help Road Authorities bridge the gap between traditional infrastructure based systems with which they are familiar and the in-vehicle systems as the standard will often be a common element.

6.1 ITS Standards Progress

In Europe there is little purely national work being undertaken and most activities are targeted towards European Standards which will be adopted as National Standards. European Standards are prepared by CEN, CENELEC & ETSI with CEN/TC 278 taking the lead and co-ordinating ITS standards in Europe. CEN/TC 278 was formed in 1991 and has an extensive work programme. (Information on CEN/TC 278 can be obtained from their website, which also has links to other standards related sites – http://www.nni.nl/cen/278). ISO/TC 204 was formed after CEN/TC278 and there is a Vienna Agreement between the two committees covering co-operation on standardisation.

CEN/TC 278 is preparing European pre-standards (ENV) rather than European Standards (EN). ENVs are more applicable for the majority of its work. ENVs are particularly appropriate in areas where there is an urgent need for guidance in a field that is rapidly developing. An ENV can be prepared more quickly but has a limited life and does not carry with it the normal standstill requirements at a national level. The first ENVs issued by CEN/TC 278 are now coming up for review.

The EU has agreed and promulgated a strategy and framework for the deployment of RTTT in Europe (ref. High Level Group). This identifies the following five priority areas, each of which has a strong standards element;

- Radio Data System –Traffic Message Channel (RDS-TMC)
- Electronic Fee Collection
- Traffic Data Exchange,
- Human - Machine Interface, and
- System Architecture.

The strategy also calls on the Commission and Member States to promote the acceleration of the standardisation process. To help carry this forward the Commission has issued a further Mandate to support ITS standardisation. The first stage is a review of the present requirements and the ability of present programme to meet these requirements. This will be followed by proposals for a revised programme in line with the identified requirements and the priorities contained in the EU strategy. Input to the review will be wide ranging and all interested parties will be consulted to ensure full acceptance and support before any revised work programme is finally agreed and implemented. The first stage is about to start

The first three priority areas identified by the Commission are particularly relevant for Road Authorities.

RDS-TMC defines protocols and message sets to carry traffic data on the silent RDS channel available across Europe on FM broadcast radio. A European Standard allows a consistent service to be established across Europe that will allow travellers equipped with RDS-TMC sets to receive messages in their own language. The standard essentially enables the service, provides interoperability and sufficiently large equipment numbers to achieve economic production. The standard will also encourage further developments using new transmission media or enhanced services. The existence of RDS-TMC will provide Road Authorities with an effective method of disseminating information about their networks thereby enhancing efficiency, safety and service to drivers. An MOU covering RDS-TMC exists

Standards for electronic fee collection will provide the basic technical interoperability of systems and equipment. This is essential if drivers wish to move between tolling regimes which is likely both at a national and international levels. Clearly these standards, and the accompanying technical developments, are of direct interest to Road Authorities who already toll or are contemplating tolling. To complement the standardisation activities the CARDME (Ref 8) action has been established by the EU. CARDME provides a platform for the exchange of views and the development of policies for toll collection which will lead, in the longer term, to the possibility of Europe-wide interoperability. CARDME has a steering committee comprising representatives of Transport Ministries in Europe. Road Authorities may participate by utilising their national links with Ministries. Alternatively if Road Authorities identified a separate interest and view they might seek separate representation and participation.

Data Exchange defines protocols and messages to exchange data between control centres. This is increasingly important as control centres across boundaries are linked together to provide seamless services to drivers crossing the boundaries and new services are being developed which often involve new control centres. Road Authorities are major operators of control centres and can benefit from the exchange of data between centres. An MOU covering data exchange exists

6.2 Memorandum of Understanding (MOU)

Standards provide a minimum technical level of interoperability and invariably will only be fully established when they have been proven. Often additional agreements are required either to assist the development of standards or to establish additional elements to provide compatibility or interoperability. Two MOUs have been signed by the major European players to help establish the RDS-TMC service and the Exchange of Data across national boundaries. Both of these MOUs have steering committees on which Transport Ministries are represented. International data exchange by its nature is initially concerned with the TERN and much of the activity is being conducted through the Euro-regional projects. Most Road Authorities are involved albeit through the Euro-regional projects, it could be useful if a separate forum also existed where issues common to all Authorities could be discussed.

6.3 System Architecture

A System Architecture is the framework that describes how individual services interact and work together. An architecture does not prescribe standards and protocols rather it identifies where they are needed and what they should contain. Particularly where a family of standards are proposed, such as in ITS, these standards will, inevitably, reflect an underlying System Architecture. Identifying and developing this architecture must assist the standardisation process as it will identify and inform critical developments and help reach the necessary compromises involved in the consensus process used to agree standards. It will also help the individual user, such as road authorities, as it will contribute a better understanding of the wider context.

System Architecture for ITS has been the subject of many studies and much debate. These have covered all aspects from the fundamental need, through issues such as whether the architecture should be local, national, Euro-regional or global, the detail of what should be included and who should prepare and maintain the architecture. The EU sponsored KAREN project, which is led by the Rijskwaaterstaat, aims to develop framework architecture for Europe. Such an architecture will assist the Road Authorities by making sure that their individual systems and developments will fit into the larger traffic and transport system. The KAREN project has acknowledged the important role of Road Authorities and is consulting with DERD members.

6.4 Standards for Road Traffic Equipment

Also relevant to road administration are the standards being prepared by CEN/TC 226 - Road Equipment - and CENELEC BTTF 69/3 -Road Traffic Signal Control Systems - which cover;

- Traffic Signal Controllers
- Detectors
- Variable Message Signs
- Traffic Signal Heads
- Emergency Roadside Telephones

These are very much more product orientated standards. The work has been difficult because of the variety of existing well-established practices throughout Europe and the close relationship between the types of equipments covered by these standards and national traffic regulations. At present final drafts are being prepared for the formal vote stage.

6.5 Issues for further consideration

Good standards will help Road Authorities in the use of ITS. Road Authorities will be required to use the Standards so it is important that the standards properly reflect their needs. Road Authorities need to monitor the standardisation activities and participate appropriately. This also applies to joint activities like the KAREN project and MOUs

The EU mandated action is particularly appropriate as it provides a strategic review of standards for RTTT at a time when there is considerable practical experience of the process and a better understanding of the essential objectives of the standards. The review will provide everyone, including Road Authorities, an opportunity to consider the complete picture and identify changes. It would be sensible to await the outcome of the review before contemplating action but it might be considered if and how Road Authorities may react.

ITS standardisation has suffered from a surfeit of initiatives which has often diverted the limited expert resources. Any action proposed should be through the existing channels and targeted to identified priority areas.

The Road Authorities, or Transport Ministries, are well represented in CEN/TC 278. Up to now they have not acted together as an interest group rather they appear as part of national delegations. They might consider acting together where this is of particular relevant to their interest. In the area of dedicated short range communication, which is considered a priority issue in many countries, and where ENVs have finally been passed, a co-ordinated effort could possibly have stopped a very long fight between different industry groups.

Road Authorities are also represented on the various steering groups established to guide support activities often through their parent Ministries. The dispersed nature of this representation may mean that items of interest and concern to Road Authorities are not identified sufficiently quickly and accurately. Road Authorities should consider how they might work together to ensure they are in touch with relevant developments and have an opportunity to guide and influence.

7. Legal Issues

An increased use of ITS calls for the solution of organisational and legal questions. Without solving the latter questions regarding liability, privacy, integrity, handling of data etc the implementation of ITS might be impeded.

The implementation of road transport telematics applications involves responsibilities and actions by several stakeholders (EU, Member States, Regional/Local Authorities, vehicle manufacturers etc). It seems that a concerted legislative action at EU level is necessary to ensure the safety of applications coming onto the market and to maximise the potential of telematics applications.

So far the primary focus of the EU has been on the Trans-European Road Network, on the implementation of traffic information services and the development of electronic fee collection, but the EU has indeed wide powers to implement road transport telematics applications. There are obligations in the Treaty to provide a high level of protection in the Single market harmonisation process (Art 100a) and to take action on transport safety whenever it can give added value to what can be achieved by Member States individually (Art 75).

The harmonisation of standards is a legal issue as well, which is being dealt with in various international fora, i.a. UN ECE, CEN and ISO. The EU can implement technical standards produced by these organisations, but has to ensure that a high level of protection is given in the harmonisation process. The DGs, III (Industry), VII (Transport), XIII (Telematics), XXIII (Technology) and XXIV (Consumer Policy) are involved in this work.

The above paragraphs contain a brief description of the legal framework concerning the implementation of telematics applications and the international bodies involved in this, especially the EU.

In some countries (eg UK) existing legislative provisions on privacy and data protection seem to be adequate for transport at least for the time being. Other countries have drawn up or are drawing up laws or general codes of practice to protect privacy. The German law establishes the principle that "a driver should be able to pass through a network without anybody being able to trace his movement as long as he respects traffic regulations". Practice shows that people are prepared to accept weaker forms of privacy protection than this (e.g. payment of fees or charges for road use which can identify the individual). An EU project (VERA) is investigating the legal and institutional issues in the area of enforcement.

In this context the difficulty concerning the identification of vehicles or individuals using video cameras or digital image processing, should be mentioned. On the one hand there are legal and privacy problems in the identification of alleged offenders. On the other hand, the storage of information on non-offenders may be an infringement of privacy. The administration costs of pursuing offenders internationally can also be a significant problem.

Other issues that should be dealt with could be the following:

- Who should be considered the owner of data, which have been compiled at the expense of the taxpayers?
- Does the citizen (driver) has the right/any right to "his own data", e.g. data being collected at the administration of a road user charge system? Does the police or other enforcement bodies have full access/any access to these data?

- Who is responsible for the data being correct? Will such a responsibility have any legal consequences, for example as regards damages relating to incorrect or lost data?
- Who has the authority to run service?
- Can efficiency be a legal issue?
- Enforcement of non-payment.
- Who may install equipment at public roads?
- Who may install equipment in vehicles?
- Driver/holder liability in driver assistance systems.
- Cross border video enforcement.

7.1 Issues for further consideration

As there are many more questions than answers at present in the legal issues area a concerted action may seem appropriate. It is therefore suggested that further investigations be made in this field. Further it is suggested to keep the analysis at a pragmatic level as many legal questions can probably be handled within the road sector sufficiently well for the sectors need.

8. Benefits and Costs

ITS systems and equipment do not involve the absolute levels of spend nor the dramatic changes to the environment associated with conventional road building. Although small in comparison to roads the costs are still significant - the EC has estimated that it would cost one billion Euro to equip 20,000 km of motorways and another billion for 85 cities with the necessary transport telematics infrastructure over the next 10 years. The market for in-vehicle equipment could reach 6 billion Euro over the same period. Investments on this scale will require appropriate business cases based on robust assessments of both the costs and benefits.

8.1 Assessment

Many ITS applications will be introduced as commercial services by private sector operators - sometimes on behalf of, or in partnership with, Road Authorities. Where the public sector (Road Authorities) is not involved, investment decisions would be made on normal commercial grounds. Where co-operation is involved the process will be more complex with the mixture of public and commercial methodology and criteria.

Well developed processes exist for the assessment of traditional road schemes. These have been refined to reflect local costs and the criteria used by individual road authorities to justify expenditure and are generally accepted as being accurate providing the input data is correct. However this type of approach is being increasingly questioned in some areas as it often over emphasises the cost savings due to reduced journey times on the new link in comparison to dis-benefits in areas like environmental damage and increases in traffic elsewhere. Equally it is not really appropriate where a road scheme might be compared with alternative solutions involving say public transport where the cost, benefits and investment is more disparate.

The traditional methods developed for assessing road schemes is of limited help when assessing ITS schemes because:

- The large variety of applications
- The range of objectives
- The number or organisations involved with their differing criteria.

Assessing the impacts of ITS can be difficult because they can be widespread, many can only be judged subjectively and those that can be measured often are very small in comparison to the normal variation. Ideally each application or system would be assessed individually but clearly this is not sensible as often the work associated with the detailed evaluation necessary to obtain robust results could be much greater than the benefits. Generic processes, and the associated knowledge and experience, must therefore be developed in a way that is acceptable to those making investment decisions.

A parallel example is the benefit of establishing a road databank. Such a databank is an indispensable part of many different systems all using the same core database. The benefit cost ratio of the database itself is therefore difficult to assess, as the benefits are distributed over a wide range of different applications such as pavement management systems, etc.

There have been examples of good assessments that have produced robust results, many have been in the area of traditional traffic control where the objectives are more easily established and the values for benefits are generally accepted. However, these are often only fully acceptable to the originator of the work because they are related to specific objectives and only applicable in the specific network and traffic conditions tested.

The need to make the results of assessments more acceptable and transferable has already been recognised. Much can be achieved by assembling, classifying and publishing the results of assessments widely. Several organisations are already doing this, for example the Federal Highway Administration reports results from US. (Ref 18 & ??). Developing a common framework so that individual assessments can be compared is equally important. It is essential that this framework includes all the likely impacts even where these cannot be assessed quantitatively. It is also important that the relative merit of each of the criteria used in the assessment process can be adjusted to reflect the priorities of individual Road Authorities. PIARC and Research in the EU Framework Programmes are addressing common frameworks. Many individual countries are also reviewing assessment, for example UK has recently announced, as part of the trunk road review, a new approach to appraisal which aims to reflect the needs of an integrated transport system. This introduces a number of new sub-criteria some of which should be very relevant to ITS (for example the concept of journey time reliability is considered as well as the value of journey time itself).

8.2 Costs

It is mainly the cost of roadside ITS infrastructure that concerns road authorities. Many authorities will be able to accurately predict this as the major costs are often not the ITS equipment itself but the mounting, installation and maintenance, which are very likely to be specific to a country. By working together costs may be lowered, markets expanded, etc.

ITS is different because very often infrastructure will be shared across several applications, for example data collected within one application may be used for a second application. Equally communications will often “piggy back” on services developed by and for others. This can make investment decisions more complex.

8.3 Issues for further consideration

Assessment of the costs and benefits is as important for ITS as for other road investments, however they are often more difficult and costly to obtain accurately. It is important that we capitalise fully from the assessments already completed and those in hand. Road Authorities should ensure exchange of experience and results and should work towards assessment frameworks that would facilitate this. Initially they might consider reviewing existing initiatives with a view to identifying those elements relevant to Road Authorities and determining where common action would help and what form it could take.

9. Vision for the Use of Transport Telematics

The vision presented here is the view of the transport system of say year 2025 as imagined by the Telematics Group. The described vision does not differ decisively from visions presented elsewhere, but is the one generally accepted in the field. The vision doesn't depend on specific technological solutions.

In a 25 years perspective it is expected that the road traffic system will not be a stand-alone system, but has become an integrated part of a complete transport system. The system includes all the transport modes and private as well as public transport. The total transport is co-ordinated and optimised using ITS. As advanced technology has been included in many system components and at different system levels, its implementation has resulted in a distributed component in the total system, an ITS platform. In the ITS based road transport system, Traffic Information Centres (TICs) act as ”system hubs” which manage the information flow between the infrastructure, different types of individual vehicles/road users, public information services etc. The information exchange is enabled by real time accessibility of necessary relevant and updated data of high quality about the road and its condition, the traffic situation, the weather, rules and regulations in force etc. Based on these data the transports of people and goods are adapted to the prevailing and forecasted conditions and the road network utilised in an optimised way. Traffic management has changed its time horizon completely. Traffic management has changed from reacting to incidents and other transport system disturbances, to preventing them on the basis of e.g. advanced systems capable of detecting instances of increased probability for incidents. The prerequisites for the ”entire journey” concept have thereby been realised, meaning that individual trips can be planned in detail and carried out considering space, time and transport mode.

All road user categories have equal and complete accessibility to the transport system of 2025. They can equally easy move in the traffic. Thus, vulnerable road users are made ”visible” by ITS and are thereby included in the system. The information and services asked for by the different users of the transport system, before and during trips, vary. Some may be characterised as public and provided free of charge, while other services have to be paid for with a price based on the actual demand. This situation has opened the door for private service providers as well as for electronics and other equipment suppliers, who have become important actors in the ITS based road traffic system. They produce and provide information, services and equipment (for examples see Annex D) in accordance with functional specifications and data quality criteria set by society and transportation goals. To do so they have to invest own money, but at the same time they profit from people buying the services.

In 2025 the design of the road itself is adapted to the use of ITS. Thus, the road can send data to the TICs and also be ”read” by ITS equipped vehicles. In this way vehicle tracking can be automatically controlled and the drivers can be warned when necessary. Also, the controlling of traffic has become more flexible as mandatory speed and following distance limits as well as ”allowed” vehicle manoeuvres will change according to the conditions at hand. Most vehicles are equipped with several support systems of which some are mandatory. Among the latter are driver monitoring systems preventing people to drive under the influence of alcohol, drugs and illness. Laws and regulations have been modified to fit the new flexibility of the traffic system. The resulting road traffic offers safer and more comfortable travelling for the road users and fewer acute actions required from road administrators. Besides, the assignment of responsibilities between different actors has been changed and clarified.

Role of drivers

The implemented driver supporting ITS functions have been designed to facilitate and support certain sub-tasks of driving. Therefore some sub-tasks have been changed or even removed, while new ones have been added. Electronic communication between infrastructure components and vehicle components has influenced/replaced driver tasks like detection of relevant traffic and roadside information/warnings and interpretation of the conditions at hand. Also, vehicle-to-vehicle interaction like distance keeping has changed from being performed manually by the driver to being performed by more or less automatic ITS systems. The roadside ITS informs, guides and warns all passing road users. Variable Message Sign is used to display temporary warnings, e.g. queue ahead, slippery road, and continuously updated messages about for example detours and speed recommendations together with their reasons. Ramp metering systems keep the motorway traffic uniform, and Motorway Control Systems inform about closed lanes and recommend optimal speed levels in various lanes. In-car ITS systems of different kinds support individual drivers. Support is provided to improve longitudinal (e.g. Intelligent Speed Adaption and Collision Avoidance Systems), lateral (e.g. heading control, lane keeping) and intersection control, to optimise route finding (e.g. Interactive Route Guidance) and to enhance vision (infrared, ultra violet, radar). The in-vehicle ITS are from pure informative systems to completely automatic systems. So the role of the human driver has to a certain extent changed from taking active part to being a passive supervisor. Consequently, the demand on human cognition has increased while the demand on human action has decreased. Preferably, the discrete in-car ITS are combined to an integrated system. For example speed adaptation is supported by combining an Adaptive Cruise Control system operating in motorway and rural environments and a speed limiter operating in urban areas. Likewise, collision avoidance is promoted by warnings presented early followed by automatic emergency braking activated late, if the driver doesn’t act properly. Key-components of the integrated in-car ITS are a common driver-ITS interface, and an ”intelligent” information manager. The manager provide information to the driver from one function at the time, according to a priority strategy, in order not to overload and distract the driver by a number of functions demanding his/her attention and action at the same time.

Roles of road administrators and private service providers

The traditional task of road administrators has been to build and maintain roads and bridges and to furnish the road environment by infrastructure. They have also provided traffic control by information and guidance in the form of ordinary road signs and signals, tools that may be characterised as being ”static”. In the year 2025 different kinds of private service providers have entered the scene. The practical work of collecting traffic data, presenting information to road users as well as building and maintaining roads has to a large extent been transferred to these private actors. Their operational tasks include speed recommendations matched to the actual conditions (sight, friction) and route guidance taking into account road conditions, seasonal variations, traffic volumes, congestion, accidents, road works etc. Besides, the private actors provide data to the databases being the prerequisite for TICs. In this perspective the task of the road administrators is more of the kind of assuring optimal utilisation and safety of the road traffic system by dynamically ”rearranging” it in space and time. Thus, they are heavily involved in creating and maintaining the framework that guarantees the level of safety, efficiency and environmental protection set at the political level. This involves setting the rules for achieving the objectives of road traffic, functioning interfaces, quality assurance, prioritising and timing of activities as well as interaction and task assignment between involved parties rather than carrying out practical work. The latter is performed mainly by the private providers, in accordance with also the administrators’ needs and requirements.

Thus the role and responsibilities of the road administrators have changed from being operational to being institutional, i.e. from capacity providers to capacity optimisers. Typical administrator tasks focus on

- demand management
- strategies for traffic control to utilise the road network in an optimal way
- guaranteeing the availability of required high-quality road and traffic information and an optimal distribution/presentation of it
- guaranteeing the accessibility of roads by co-ordination of for instance road works, obstacle removal etc.

9.1 The change process of implementing ITS

The implementation of ITS in the road traffic system can be described in analogy with a change process in any area. Thus, the successful ITS introduction is the result of considering strategies for a change process in general, such as:

- The starting-point for the change should be based on identified and specified needs and/or problems. Thus, a realistic view of the state before ITS implementation is necessary.
- A ”top level” (management) commitment is necessary.
- Arenas where all the involved actors can meet and exchange ideas and knowledge in a creative atmosphere have to be established.
- The change process must be allowed to take the time needed.
- A change process is costly and may result in a profit drop in the short-term perspective.
- Decisions about profit sharing and responsibilities have to be taken in the initiation phase.
- Dedicated persons are needed, in the beginning to engage more passive actors and later to approach pronounced resisters.
- Practical examples are valuable ingredients in the process.
- Along the change process progress will be mixed with setbacks.
- Information and competence development should take place when needed, something like ”just-in-time” education
- The change should bring challenges and individual development of the involved actors.

When applying change process theories on ITS implementation it is important that it is promoted by political forces clearly expressing transport goals and policies to be reached. The parties involved in changing road traffic have different views of the system to be changed as well as of the system they want, and the track to follow to reach individual goals. This includes their ideas and knowledge about the role and possibilities of ITS. The varying starting-points have to be compiled into a joint view. To take on the managing of ITS implementation the road administrators have to build up internal competence in the ITS field. ITS departments and working groups have to be constituted within their organisations, with the tasks to lead, follow and participate in the implementation process. Leading the ITS implementation, the road administrators have to possess competence including understanding the change as *a (dynamic, and partly unpredictable) process*, understand the change as *a possibility*, see *the individual actors* in the change, and understand the change in its *context*.

Implementing ITS needs different time to mature and be accepted at different levels (se figure below). The ITS experts (mainly external) possess large competence and are familiar with the area and therefore positive and in a front position early. The top management (administrations) and different working groups are the next in building up competence and pushing the change (implementation) forward. The ”middle management” level (realisers) contains the largest number of resistors. The latest to gain enough competence about the consequences of the change and take active part in it are those involved in the traffic as end users.

--------- expert ---

--------- management -----------------------------------

--------- project group ---------------------------

←------- middle management -------------

--------- individual parties --------

10. Conclusions and Recommendations

10.1 Conclusions

1. ITS today offers a wide range of tools to support a wide range of transport policy objectives. Many Road Authority objectives can, to some extent, be met by tools available today. However, there is a need for further development of tools and tailoring of applications to meet policy objectives.

2. ITS is not a substitute for a transport policy. ITS can help optimise traffic and transport systems, but transport policy need to establish the criteria for optimisation.

3. ITS Implementation priorities for Road Authorities should be based on an assessment of user needs and policy objectives to ensure correspondence between requirements and investment plans.

4. Implementation of ITS can in some areas, especially in traveller information, be accelerated and improved through innovative co-operation between the public and the private sector. Such co-operation, however, requires an adaption of the legal framework. In addition it will benefit from development of quality of service guidelines for ITS applications and systems.

5. Standards are being developed for the ITS field in a manner that does not always meet the needs of the road authorities. A joint effort could ensure better representation of common views. Additionally the requirements from legacy systems should be considered.

6. Too few staff is available with proper competence to handle the diverse challenges of research, development, planning, contracting, implementation and operation of ITS systems.

7. There is a great need for more exchange of knowledge and experience in ITS, especially regarding benefit evaluation methods, etc. Projects will always be developed to local needs, but it would benefit everyone if the evaluation was carried out according to agreed guidelines in order to ensure transferability of results.

8. Safety is high on the agenda in most countries and several applications show very promising results in this area. More attention should therefore be devoted to this area.

9. Vulnerable road users have special requirements, which are most often not met by traditional system development. This group needs special attention.

10. Very little is known about the influence of some ITS systems, aiming to take over some of the drivers tasks in controlling his vehicle (e.g. speed, gap, lanekeeping, etc.), on traffic flow and throughput.

11. There are ITS applications, which seek to automate the road, which offer dramatic performance improvements. The requirements of these systems on the road (design, alignment, equipment, maintenance, etc.) are yet unknown, but may be significant.

10.2 Recommendations

1. It is recommended that all road authorities ensure a sufficiently high level of expertise in the ITS field, ideally through an ITS unit in the organisation.
   The rationale behind this recommendation, is that ITS cannot be handled in the same way as traditional road building components. ITS demands a more integrated approach to planning than traditional infrastructure provision. Even where Road Authorities contract design out, there is a need for internal staff to set requirements and evaluate results.
   Additionally ITS units should contribute to a European network, which can:
   - give input to the High Level Group on ITS
   - can co-ordinate viewpoints on standardisation and feed input into WERD SG1
   - can co-ordinate viewpoints on data definitions and feed input into WERD SG5
   - can co-ordinate viewpoints on Trans European Networks and feed input into WERD SG6
   - initiate common projects where such actions are deemed appropriate.

1. It is recommended that traditional highway engineers are introduced to the systems approach to highway design, operation and maintenance.
   The rationale behind this is that ITS tools will allow added emphasis on traffic operations leading to a need for a systems approach to construction and maintenance.

2. It is recommended that road authorities monitor the standardisation activities and, where necessary undertake common measures so that their needs are met. Relevant examples are (the list is not exhaustive):
   - Cross border data exchange
   - RDS-TMC
   - System architecture

   The rationale behind this recommendation is that road authorities should be involved when standardisation is concerned with their business. Action should be taken when the following criteria are met:
   - Standards that deals with user accessibility.
   - Standards that deals with interfaces to other countries.
   - Standards which can be instrumental in providing a multi-vendor situation.

1. It is recommended that road authorities consider co-ordination of viewpoints regarding standardisation between themselves as well as between different stakeholders within the individual countries. In areas such as traffic management the common interests of Road Authorities can complement the interests of global industries.

2. It is recommended that Road Authority implementation strategies for ITS focus on policy and traffic problems and not on technology. To aid this process Road Authorities should make assessments of user needs, to ensure proper use of scarce investment funds.
   The rationale behind this recommendation is that many implementations to date have focused on what we can rather that what we want.

3. It is recommended that a framework for private service in the transport sector be developed for the different areas where partnership is advantageous for both parties.

The rationale behind this recommendation is that investment in traffic information, etc. can be accelerated if private initiative is given a proper framework to work under where they can capitalise on their investments.

4. It is recommended that a task force to study legal issues be created. The task force should focus on legal issues related to public-private-partnership, liability issues, privacy and integrity.
   The rationale behind this recommendation is that large scale implementation cannot be envisioned if these fundamental operational issues are not handled.

5. It is recommended that quality of service indicators are developed as a tool to guide potential partnership negotiations with the private sector or to guide outsourcing of peripheral services.
   The rationale behind this recommendation is that service to some extent is an immaterial product, which can only be gauged through quality of service parameters.

6. It is recommended that Road Authorities review their policy objectives in order to identify which applications are of relevance to them, as highlighted in chapter 3.
   The rationale behind this is that requirements are different, and priority issues should reflect this. Thus Road Authorities called upon to make priorities explicite.

7. It is recommended that Road Authorities exchange experience about tools and implemented systems, impact assessment and evaluation methods for ITS. Depending on the outcome of this it can be expected that this will lead to the definition of common terminology as regards applications, methods and impacts to be measured.
   The rationale is that too many studies are conducted in a way that makes it impossible to transfer results to other sites. Therefore much effort is used less than optimal in this area. Additionally WERD should urge EU to disseminate results of framework projects in a user-friendly way.

8. It is recommended that more specific attention is given to safety related ITS applications. The research on safety related ITS systems have to be promoted by the Road Authorities, as this will not be done in an efficient manner by the market forces.
   The rationale is that safety is a major impact type of ITS. Some ITS systems have the ability to ensure existing safety regulations are complied with, thereby promoting better safety.

9. Effects of ITS on mental load on drivers should be studied in depth.
   The rationale is that it is unclear if ITS systems increase or decrease mental load on drivers. E.g. situations where driving tasks are suddenly reloaded from an ITS system back to the driver or where additional input from other not specifically driving related ITS systems is given to the driver.

10. It is recommended that efforts are being made to meet the special needs of vulnerable road users. Research efforts are required on how the needs of vulnerable road users, such as pedestrians and cyclists, are addressed in an ITS based transport systems. So far, the technological development based on market prospects has concentrated on driver and vehicle-oriented ITS systems.

11. It is recommended that basic research is focused to support the policy objectives related to ITS. This should take account of likely technological development in industry. Basic research on ITS should be given sufficient emphasis in national and European R&D programmes.

12. It is recommended that WERD explores the possibility of co-ordinating ITS development with the automotive industry. Relevant examples are magnetic stripes in the roads, etc.
    The rationale behind this is to take action in stead of waiting for development and then react.

Annex A: Terms of Reference and Committee members

WERD-FEHRL-FERSI 1998-03-19

Draft proposal for

Terms of Reference for Telematics Group

Background

Use of telematics in the road transport sector is of growing importance, and WERD has for some time discussed how to foster the interest of the road authorities in the subject. WERD is anxious to establish which applications of telematics may be of particular interest to them in the road sector, what research results are already available in those areas, and what further research is necessary to meet their overall aim.

In parallel, FEHRL has discussed how it may develop the professional areas of its member institutes to include telematics. Some FEHRL institutes have been engaged in different aspects of the telematics area but no substantial programme of telematics research for road authorities exists today. Similarly, a number of FERSI institutes also have been engaged in telematics and like FEHRL, FERSI wishes to deal more systematically with the subject.

Research in the telematics area is carried out at European level through the 4th framework programme of research. This research is not co-ordinated in a telematics programme that seeks to promote a transport policy. Rather telematics research is carried out as individual projects each of which may be of value to highway administrations but such evaluation has not taken place. Telematics research related to the Common Transport Policy has to some extent been carried out through ERTICO. Use of transport telematics in Europe is being evaluated by the High Level Group under DG VII.

Given the above background WERD, FEHRL and FERSI has agreed to set up a telematics group to undertake an evaluation of common interests in the use of telematics for the road authorities.

Objectives

The Telematics Group (TG) shall

- Evaluate the present European policy development for the use of telematics within the road authorities with a view to describing fields of common interests for road authorities.
- Highlight the knowledge/tools available and/or in use in the above defined fields of common interest

- Describe the need for research and implementation in the above defined fields of common interest

Working Method

The Telematics Group (TG) will meet and initially discuss the present TOR and report to DERD at its meeting on May 11-12 1998 if adjustments need to be made to the TOR

Based on documents initially provided from the High Level Group, from ERTICO and from documents brought forward by the members of the TG, the group will undertake the tasks described in the objectives.

The TG will seek to fulfil the objectives and prepare a report to be presented to DERD at its meeting 26-27 October 1998 and subsequently presented to FEHRL and FERSI.

The TG will comprise 2 persons from WERD, 2 from FEHRL and 2 from FERSI. Mr. Schacke as a liaison between the three organisations will convene the group to its first meeting where a chairman will be elected. It is foreseen that the TG will have 3 meetings, but that much of the work undertaken will be completed outside those meetings.

MEMBERS OF WERD-FEHRL-FERSI-TELEMATICS GROUP – JUNE 1998

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Annex B: Terminology

Background

In any technical area it is always useful, particularly for newcomers, to have ready access to a defined list of the terminology used in the area. This annexe seeks to identify the terminology used in ITS, particularly by reference to already available documents. Perhaps what is more important than absolute accuracy in defining the terms is that they should be accepted and used consistently

It is important to recognise the difference between terminology, which is a description of the special words used in an area and data definitions (data dictionaries) which are the precise and unambiguous description of data used within an IT process. There are several data dictionaries being developed in the ITS field but this is a very specialised area and need not concern the group at present.

Terminology References

Conventionally one might look to the standards organisations to establish a terminology reference. ISO/TC 204, which leads in this area, have produced a list of the 32 fundamental services that comprise ITS as part of their architecture work. This describes these services and also provides some examples but it cannot be considered a terminology reference. ISO has also produced a Glossary but this is a very large document with many thousands of entries. One often echoed comment of the ISO documents in the architecture area is that they have been prepared by Americans and do not fully reflect European developments.

There have also been some terminology initiatives from the EU sponsored research programme but these are not universally. The Nordic Road Association has produced a document;

Nordisk Vegteknisk Forbund, Technical Group No 53, Report No 1: 1997-GB – Road Transport Telematics Terminology.

This is a genuine terminology reference list compiled and presented in the conventional manner. It was prepared with a knowledge of the ISO and European initiatives so does not conflict fundamentally with these. It can also be consulted at the following Website;

http://www.samf.ntnu.no/aaa/nvf/ordbok/

No other multinational terminology documents so well established as the NRA document and is a good basis for a terminology reference.

Abbreviations and acronyms

CEN – European standards committee
CENELEC – European standards committee for electro technical matters
DAB – Digital Audio Broadcast

DERD – Deputy European Road Directors
DRIVE – EU co-financed research program on ITS
ERTICO – European Road Telematics Implementation Co-ordination Organisation
ETSI – European Telecommunication Standards Institute
FEHRL – Forum of European National Highway Research Laboratories
FERSI – Forum of European Road Safety Institutes
GSM – Global System for Mobil communication
HMI – Human Machine Interface
ISO – International Standards Organisation
ITS – Intelligent Transport System
LMR – Land Mobile Radio
MOU – Memorandum Of Understanding
PIARC – International road construction forum
PROMETHEUS – EU co-financed research program on intelligent vehicle technology
RDS-TMC – Radio Data System – Traffic Message Channel
RTTT – Road Traffic and Transport Telematics
TAP – Telematics Application Program
TC204 – Technical Committee 204 (ISO group on ITS)
TC278 – Technical Committee 278 (CEN group on ITS)
TERN – Trans European Road Network
TETRA – TErrestrial Trunked RAdio
TICS – Traffic Information and Control Systems
UMTS – Universal Mobile Telecommunication System
WERD – Western European Road Directors
WFF – WERD/FEHRL/FERSI
WG2 – Working Group 2 (under ISO TC204)

Annex C: List of Reference

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ITS America	http://www.itsa.org
US Dept. of Trans.	http://www.its.dot.gov/
Nordic terminology	http://www.samf.ntnu.no/aaa/nvf/ordbok/
VERTIS	http://www.vertis.or.jp

Annex D: User service definitions

Definitions taken from ISO 14813-1r

1. Pre-trip Information

This service provides single mode, multi-modal and inter-modal transportation information at home, work, hotels, major public locations, such as shopping centres, and on portable terminals.

Pre-trip Information includes shared transport such as public transport by road, rail, air and sea, mass transit, car pooling and other sharing and matching services.

Pre-trip information includes current information on network status, traffic conditions, road and weather information, prevailing traffic regulations and tolls.

2. On-trip Driver Information

This service is provided as :

1. distributed collective information,
2. tailored subscribed information.

On-trip driver (user) Information *includes*:

incidents
park & ride options
parking
prevailing traffic conditions
public transport schedules (timetable and actual)
regulations
roadworks, both planned and emergency
tolls
weather
roadside phones (roadside services, including callboxes)

Service 2 (On-trip Driver Information) and service 3 (On-trip Public Transport Information) are separable but complementary and can both be used in one trip.

3. On-trip Public Transport Information

On-trip Public Transport Information is provided to the traveller once the trip has started. *Examples* of 'on-trip' public transport information *include:*

information terminals at bus stops
information terminals at bus stations, rail stations, car parks
information terminals in major public places
information terminals at transfer points
in-vehicle information displays
portable/personal terminals

The *type of information* provided may *include*:

boarding point information
fare information
interchange possibilities
route choice
time of next service
where to get off

This service is complementary to service 2 (On-trip Driver Information).

4. Personal Information Services

This service provides information either in a pre-trip, or on-trip context. This information is complementary to service 1 (Pre-trip Information) and service 2 (On-trip Driver Information), providing a 'yellow pages' type function. *Examples* of the type of information provided are as follows:

car repair/recovery facilities
filling station location and information
hospital locations and information
hotel locations and availability
restaurant locations and information
booking
general tourist information (e.g. points of interest, parks, hours of operation)
truck stops and maintenance facilities

5. Route Guidance & Navigation

This service provides information on community and/or individual user optimum route options for specified destinations. *Examples include* the following applications:

autonomous navigation, based on historic data regarding road network and public transport information
dynamic route guidance, based on real-time network status and public transport information
dual mode route guidance with the capability of either dynamic, or autonomous modes of operation
multi-modal trip making including interchange possibilities
route and facility guidance services through portable terminal units and roadside equipment (for safety and convenience)

Best route options may be calculated taking account of network and public transport information and may incorporate multi-modal options such as Park and Ride.

This service also includes the provision of route guidance to pedestrians, cyclists and motorcyclists.

6. Transportation Planning Support

This service covers the use of TICS systems to provide data regarding traffic flows and travel demand for transportation planning purposes. *Examples* of such applications based upon TICS data *include* the following:

current traffic flow data from traffic control systems
current utilisation levels from public transport information systems
origin and destination data from route guidance systems
route choice data from route guidance systems
travel demand data from pre-trip information systems

7. Traffic Control

The service covers the management and control of traffic flows through the use of TICS technologies. It *includes* the following:

adaptive traffic signal control
directional variable message signing
implementation of predefined traffic management strategies
integration of inter urban and urban control
ramp metering

route guidance integrated with traffic control
speed control
tidal flow (e.g. directional lane control)

8. Incident Management
This service provides the capability for detecting and responding to various incidents on the transport network. *Examples* of incident management functions *include* the following:
anticipation and prevention
detection and prediction
monitoring
disaster management; such disasters as earthquakes, landslides, inundation or major warfare
post incident management (including disaster/disruption)
response initiation
incident verification
NOTE Disaster management may become a full user service at a later date.

9. Demand Management
This service is the development and implementation of management and control strategies designed to influence the demand for travel.
These strategies influence the overall level of demand for travel at different times of the day and relative demand for different modes of transport, through the management of pricing structures, area access control or zone entry regulations. Demand management functions *include*:
access control
air quality based zone pricing
congestion pricing
high occupancy vehicle facility management
parking pricing
public transport fares management

10. Policing/Enforcing Traffic Regulations
This service covers the application of TICS technologies to the enforcement of traffic laws and regulations. *Examples include* the following:
access control
high occupancy vehicle facility usage
parking regulation enforcement
speed limit enforcement
signal enforcement (e.g. red light violation)
emissions monitoring

11. Infrastructure Maintenance Management
This service covers the application of TICS technologies to the
management of road, communication and computer infrastructure. *Included* in this service *are*:
highway maintenance management,
nature and location from utilities and authorities to TICS control centres
the provision of road works
the use of probe car data to guide timing and location of planned road works and road closures.
highway sign maintenance management

12. Vision Enhancement
The service is the application of TICS technologies to the enhancement of driver perception through the use of in-vehicle equipment.

13. Automated Vehicle Operation
This service is the application of TICS technologies to completely automate the driving process, creating a 'hands off' driving environment. *Examples include* the following:
automatic lane keeping
automatic parking operation
vehicle platooning
very low speed cruise control (inching)

14. Longitudinal Collision Avoidance
Longitudinal collision avoidance includes the use of sensors and control systems to detect potential for collisions either prompting the driver to take action or automatically initiate avoiding action. This includes the application of obstacle detection systems.

15. Lateral Collision Avoidance
Lateral collision avoidance is the use of systems (such as sensors and control systems) to monitor the potential hazards involved in lane keeping, lane changing, entering and leaving high speed roads and overtaking. It can either prompt the driver to take action or automatically initiate collision avoidance manoeuvres.

16. Safety Readiness
Safety readiness is the use of monitoring and warning systems for both private car driver and vehicle. *Examples include* the following:
critical component monitoring
driver alertness monitoring
engine temperature
oil pressure
road condition monitoring

17. Pre-crash Restraint Deployment
This service uses TICS technologies to determine the velocity, mass and direction of vehicle and objects involved in a potential collision and the number, location and major physical characteristics of occupants. A system's use of this data to determine a response strategy *may include* the following elements:
arming and deploying air bags
deploying lateral protection systems
deploying rollbars
tightening seatbelts

18. Commercial Vehicle Pre-clearance
Commercial vehicle pre-clearance allows commercial vehicles, including trucks and buses to have credentials and other documents, safety status and weights checked automatically at normal road

speeds. A principal objective being to effect preclearances with minimal disruption to the vehicle journey and the traffic flow.

19. Commercial Vehicle Administrative Processes
This is complementary to service 18 (Commercial Vehicle Pre-clearance). It enables hauliers and shippers to purchase annual and ad-hoc credentials, using communications and computer technologies.

20. Automated Roadside Safety Inspection
Automated roadside safety inspection is the use of TICS systems to enable roadside access to safety performance records of hauliers, vehicles and drivers. This will enhance existing systems of spot checks by providing inspectors with easy access to current data relevant to the inspection.

21. Commercial Vehicle On-board Safety Monitoring
This service covers the use of on board monitoring systems to oversee the safety status of commercial vehicles, commercial vehicle drivers and cargo during the entire course of the trip. This may *include sensing and collecting data on the following*:
brakes
driver alertness
driving time
lights
shifted cargo
tyres
Warning may be provided to both the driver and/or remote monitoring facilities.

22. Commercial Fleet Management
At a multi-modal level commercial fleet management includes logistics and freight management systems. It also covers the use of Automatic Vehicle Location (AVL) and vehicle-to-control centre communications to provide vehicle location and other status information to the fleet operators despatched. This facilitates the use of dynamic despatching systems to improve the efficiency of the fleet management process. This service includes:
pre-trip information
intermodal terminal conditions

23. Public Transport Management
This service covers the application of TICS technologies to the operation, planning and management of public transport operations. It includes the provision of real time information on vehicle location and status, enabling the identification of departures from schedules and dynamic rescheduling. This also includes the monitoring of public transport vehicle status such as passenger loadings, engine management system functions, tyre pressures. *This service also includes the application of multi modal or super modal scheduling and planning systems.*

24. Demand Responsive Public Transport
This service covers the provision of on-demand transport services to individual travellers. This will provide demand responsive transport services to the user, while enabling transport operators to dispatch and schedule vehicles.
Typically travellers may request service by specifying destination and any special needs such as pram conveyancing, wheel chair lifts, or other special services for the disabled. Vehicles, covering a

corridor, or area, are then despatched to the traveller by a dispatching system. The public transport fleet deployed on this service may include buses, vans and taxis.
This service addresses the needs of commuters by providing a viable shared transport alternative to the single occupancy private car and also addresses the needs of specific groups such as elderly and disabled.

25. Shared Transport Management
Shared transport management provides real-time ride matching services to users at home, office, or other locations.

26. Emergency Notification and Personal Security
This service applies TICS technologies to provide both driver/personal security services and automatic incident notification for private car drivers and goods vehicle drivers. This *may include*:
automatic collision notification
automatic theft warning systems
user initiated distress calls
seat belt tightening
Third party emergency notification
NOTE The lead on standardization for the onboard issues will be agreed between TC204 and TC22.

27. Emergency Vehicle Management
Emergency vehicle management includes the application of fleet management, route guidance and traffic signal priority techniques to the management of emergency vehicles such as fire, police and ambulance.

28. Hazardous Materials & Incident Notification
This service covers the use of TICS technologies to provide authorities with data on the nature, location and condition of hazardous goods cargoes. This facilitates the enforcement of routing instructions and the effective response to any incident involving the load. Data to be provided *may include*:
Routing Data:
route guidance
route enforcement
Incident Data
issuing post-incident instructions to driver
location of vehicle
nature of incident
nature of cargo

29. Electronic Financial Transactions
This service includes the use of electronic, or 'cashless' payment systems for transportation. *Examples* include the following:
Fare collection (e.g. public transport)
Toll collection (e.g. parking)
Payment for services (e.g. yellow page access)

30. Public Travel Security

Public travel security includes the surveillance and monitoring systems for public transport facilities, car parks and on-board public transport vehicles. Systems may be automatic, sending a distress call when specified conditions are encountered or manually initiated. This also covers the use of security systems designed to protect public transport vehicle operators.

31. Safety Enhancements for Vulnerable Road Users

This service covers the application of TICS technologies to the enhancement of safety levels for vulnerable road user groups (particularly elderly or disabled and road maintenance workers). These *groups include*:

motor cyclists
pedal cyclists
pedestrians

Safety enhancement measures *may include* measures such as:

smart pedestrian crossings (e.g. prolonging crossing times for elderly and disabled users).
speed warning systems
vehicle presence detection
automatic advice to drivers by vulnerable road users (e.g. presence of wheel chair)

32. Intelligent Junctions and Links

This service covers the application of TICS technologies to the provision of monitoring and warning systems at junctions (including modal, multi-modal or inter-modal), both signal controlled and priority. *Warnings may include*:

clarification of right of way rules
onboard echo of warning signs
presence of oncoming vehicles
warning of imminent signal phase change