EUROPEAN CONFERENCE OF MINISTERS OF TRANSPORT

Road Transport Informatics

Institutional and Legal Issues

Study drawn up for ECMT and ERTICO by Jean-Pierre CAMUS and Max FORTIN

THE EUROPEAN CONFERENCE OF MINISTERS OF TRANSPORT (ECMT)

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The purposes of the Conference are:

a) to take whatever measures may be necessary to achieve, at general or regional level, the most efficient use and rational development of European inland transport of international importance;

b) to co-ordinate and promote the activities of international organisations concerned with European inland transport, taking into account the work of supranational authorities in this field.

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EUROPEAN ROAD TRANSPORT TELEMATICS IMPLEMENTATION CO-ORDINATION ORGANISATION (ERTICO)

ERTICO (European Road Transport Telematics Implementation Co-ordination Organisation) is a public/private Co-operative Society based in Brussels established on 13th November 1991. Membership comprises at present 36 Organisations’ grouped in five Sectors: Industry, Private or public Infrastructure Operators, Public Authorities, Infrastructure Users, Others. The Organisation is run by a 15 member Supervisory Board, elected by the partnership, and representing the different Sectors. The European Commission and the European Conference of Ministers of Transport are attending the meetings of the Supervisory Board to give advice on those policies of the Community and of the ECMT which affect ERTICO’s objectives and operations.

The object of the Organisation is to encourage, promote and assist with the co-ordination of the implementation of transport telematics in transport infrastructure in Europe. The Services of the Organisation are principally rendered for the account of its partners in general, and of the EC and the ECMT.

The activities of ERTICO, which started effective operation on 1st March 1992 have covered independent studies on the status of transport telematics application in Europe, on automatic debiting systems, on location referencing systems, on traffic data dictionaries and normalised protocol interfaces. In addition ERTICO is collaborating with EC DG XIII on the strategic issues of the ATT Programme (under the CORD Contract), with EC DG VII on the implementation of telematic traffic control on the Trans-European Road Network (under the TELTEN grant), with the ECMT on institutional and legal issues for key transport telematics technologies (the JEEP Project). In collaboration with ITS America (USA) and VERTIS (Japan) ERTICO is organising a series of World Congresses on Applications of Transport Telematics. The first one, “Towards an Intelligent Transport System”, was held in Paris on 30 November-3 December 1994 together with a large public exhibition (more than 130 participants) and had an attendance of more than 2 200 interested actors from all over the world. ERTICO has the status of observer in CEN (Comite Europeen de Normalisation) TC 278 (Road Transport and Traffic Telematics) and a liasion role in CEN TC 224 (Machine readable cards, related device interfaces and operations).

ACEA (Association des Constructeurs Europeens d’Automobiles), AIT/FIA (World Motoring Federations), Alcatel-Alsthom, ASECAP (Association Europeenne des Concessionaires d’Autoroutes a Peage), BMW, Robert Bosch, CARMINAT, Compagnie Generale des Eaux, Daimler-Benz/Intertraffic, UK Department of Transport, Direction General de Trafico, EGT (European Geographic Technologies), Eurotunnel, FIAT Auto, FINTECNA, Ford Motor Company Ltd., France Telecom, Gemplus, IBM Nederland, IRU (International Road Transport Union), Ministere Wallon de 1’Equipment et des Transports, Ministere de I’Equipement, des Transports et du Tourisme, Philips, POLIS, PSA-Peugeot-Citroen, Renault, Rover Group, Rijkwaterstaat, SAAB-Scania Combitech, The Scottish Office, Siemens/EUROSCOUT, SNRA Vagverket, UITP (Union International des Transports Publics), VDA (Verband der Automobilindustrie, Vlaamse Regering, Volvo.

FOREWORD

The European Conference of Ministers of Transport has endeavoured to determine the main lines of the policies called for in order to apply the new information technologies for the provision of road traffic information, and the Council's Annecy Session of 27 May 1994 approved a number of Resolutions concerning the legal, administrative, technical and financial issues arising in connection with interoperable systems in this sphere in Europe.

The Conference's ad hoc TCT Group and ERTJCO asked Mr. Jean-Pierre CAMUS and Mr. Max FORTUN to conduct a survey of authorities responsible for road traffic management and the manufacturers of driver information equipment and, accordingly, they prepared a "tool box" and an explanatory guide whose validity they then established by sending a questionnaire to all ECMT Member countries and members of ERTJCO and by meeting representatives of a number of countries to discuss their replies.

The survey essentially had two aims:

- first, to ensure that the government departments responsible for highways and road traffic were aware of the implications of the new information technologies and associated services;
- secondly, to obtain initial information about the aims and objectives of these departments as regards:
  - their role as central government regulator, and the context envisaged;
  - the direct role that these departments intend to play;
  - co-ordination of the roles of central, local and regional authorities;
  - the partnership between the public and private sectors;
  - legal and financial issues.

The package of documentation given here consists of a general introduction stating the aims of the survey, the "tool box" itself and an "explanatory guide" to enable the specialists in the various particular fields to get a clearer picture of any issues with which they are less familiar.

While it is still too early to draw any conclusions from this work, it can be said that the first objective has been attained in full in that the government departments have been able to adopt a common approach in analysing the main problems to be resolved in order to ensure European co-operation in the development of interoperable systems.

An analysis of the documentation in the light of the responses of all concerned should provide us with the means of determining the concepts, methods and legislation to be adopted for the purpose of developing road traffic information in Europe.

Georges DOBIAS
Chairman, ECMT TCT Group

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OUTLINE INTRODUCTION

The car is the single most important issue currently facing our society. Demand for greater freedom of movement contrasts sharply with the increasing reluctance of the population to tolerate the damage to the environment that such freedom entails. Some way of resolving this conflict therefore needs to be found.

While the most radical way of reducing congestion is simply to increase road infrastructure capacity, the resident population, well aware of the complex interactions between transport supply and demand, are increasingly unwilling to sanction the construction of new infrastructure when the feeling exists that better use could be made of existing facilities.

The introduction of services to drivers such as assisted route planning, in-vehicle information on traffic conditions, and automatic control by the infrastructure operator in the event of difficult driving conditions, provides an important, albeit partial, response to this problem. The development of such services is an issue of fundamental importance to future European policy on both transport and industry.

Manufacturers in Japan and the United States have recently started marketing autonomous in-vehicle driver information systems, some of which are based on satellite communications systems, as well as portable systems which motorists can also use in the home. Unless Europe rapidly sets up and implements a programme to deploy and install such systems, then foreign manufacturers will start to supply European markets with their products in a move which would have the following consequences :

- authorities responsible for transport policy would have absolutely no control over the use of such systems, with all this would imply in terms of the management of traffic flows in economic areas where traffic is close to saturation point;
- with regard to industrial policy, European plant and equipment manufacturers, unlike their competitors, would be deprived of a development base on which to gain experience, with all that this would imply in terms of competitiveness and thus employment.

In view of the above, ECMT and ERTICO felt it necessary to consider the action that would need to be taken at European level to deploy and implement the systems developed under the DRIVE and PROMETHEUS, the first step being to create an appropriate legal and contractual environment.

The aim of the package of documentation presented here is to provide a basis for further action in this area.

This outline introduction briefly summarises the goals, procedures and instruments relating to this initiative. A full description of the above is provided in the attached documentation package consisting of the following :

a Tool Box,
and a Explanatory Guide describing driver information / route guidance systems.

This package, which has been prepared by a team of ERTICO experts, follows on from a series of surveys carried out under the auspices of the ECMT Transport, Computers and Telecommunications Group into the general legal environment for of IT- and telecommunications-based road traffic management and driver information systems. It does not consider the use and operation of Automatic Debiting Systems, nor does it aspire to cover the entire area of TT[1] system applications. The scope of documents in the package is limited to the operation of ground-based vehicle communication systems; there is therefore no discussion of the technical, organisational and economic aspects of the implementation / deployment of the systems and technologies involved.

It emerged in the course of the surveys of ECMT Member countries and the members of ERTICO that approaches to both traffic management and the implications of using information and telecommunications technology for the purposes of such management varied substantially from one country to another.

Objectives

It was clearly essential, before proceeding further, to determine the extent to which the legal and contractual arrangements in force in individual Member States might be harmonised in a way that would promote creation of a single market not only for movements of goods and people, but also for the industrial-scale production of the plant and equipment that would be used both to secure and to enhance such movements.

The objective of the present package, which consists of a :

- Tool Box (basic components of the legal and contractual regime),
- and a Explanatory Guide (to provide users with a technical explanation of how to use the Tool Box),

is to help foster a suitable legal environment for the deployment of RDI services; it does not attempt to dismiss the role of existing legislative and regulatory authorities in EC Member States or ECMT Member countries, nor to disrupt ongoing negotiations between public authorities and service companies. Its sole aim is to help, as far as it is able, the individual parties concerned gain a clearer idea of the new field opened up by the application of information and telecommunications technologies to traffic management.

In view of both the issues at stake and the potential for increased capacities offered by the systems now available, this document sets out to provide a detailed description of the legal and regulatory instruments that need to be put in place, as well as the basic provisions that need to be incorporated into contractual arrangements governing relations between the actors involved in operating systems that are based on technologies whose technical viability has been demonstrated and that are now ready to be marketed commercially.

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[1] In the following we understand as TT the technologies for informatics and telecommunications used in transports and as TT operators service providers using these technologies

Procedure

In accordance with the above objectives, the authors decided to base their analysis on case studies of the development of three ground-to-vehicle communications systems considered by experts to be the most promising of those which are either available now or at a near-market stage in their development[2] (RDS-TMC broadcast sub carrier; GSM digital cellular telephone system; EURO-SCOUT short-range beacon communications system). Despite the use of case studies, however, the analysis still remains highly theoretical in that, to date, only one system[3] (which is not even based on one of the three technologies considered in this study) is currently in commercial operation in the whole of Europe. It was therefore necessary to carry out a simulation, while at the same time submitting a questionnaire to the developers of the various systems as well as the infrastructure operators who would be licensing such systems and/or collaborating with their operators. The simulation concerned the conditions under which the three technical principles on which the respective technologies[4], whereas the operating principle remains the same.) were based would actually be applied in practice. The simulation was based on the findings of the DRIVE programme and on data provided by ERTICO members working in public administrations and industry.

In the course of our investigations, it became clear that no-one at present has a clear overall picture of the conditions under which such systems are both deployed and managed. However, while it is understandable that it is difficult **to** gain a clear picture of the situation at European level (given the differences between countries in terms of their legal systems, geography, etc...), it is somewhat surprising to note that there is no exchange of views between decision-makers, managers, technical staff and legal experts either at national level or within individual companies (or at any rate that no clear strategy would seem to be emerging from any possible internal debate). It was to remedy this situation that we decided to design, and validate by means of questionnaire, a Tool Box which we hope will enable individual actors, whether they are working in government or employed by firms that might wish to operate these new services, to examine the issues more closely and put forward proposals of a more practical nature that might subsequently lead to the formulation of recommendations.

Instruments

As indicated above, the Tool Box is aimed as much at decision-makers, managers, lawyers and technicians working in government departments responsible for traffic management in ECMT Member countries as they are at managers, legal consultants and engineers employed by service companies and industry, and at ERTICO members likely to use or manufacture systems designed to provide drivers with real-time information and route guidance.

The Questionnaire was widely circulated within the ECMT and ERTICO and the replies were used in two ways. First, note was taken of all the corrections suggested by respondents. Second, a synthesis was made of the proposals put forward in replies by identifying points that could be used both to validate the Tool Box and to draw up a coherent proposal for a single market in driver information and route guidance equipment and services at European level which respected the diversity of national approaches by making practical suggestions as to how the principle of subsidiarity might be applied.

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[2] The main characteristics of these systems are described in the attached Explanatory Guide.

[3] Traffic Master in the United Kingdom, which uses a radio-paging system to transmit messages to vehicles.

[4] An alternative exists to each type of technology (e.g. infrared versus ultra-high frequency) transmission system.

We have thus been able to establish a legal and contractual framework which, by providing both public authorities and firms acting as operators and/or suppliers of services with resources they need to manage the technical, marketing and economic risks inherent in the operation of driver information/ route guidance systems, will allow them to commit themselves to the commit themselves to the next stage in deployment.

We suggest that actors use the attached Explanatory Guide in conjunction with the Tool Box in order to gain an insight into the technical, commercial, organization and institutional challenges involved and the areas where gaps still remain. The aim of the Explanatory Guide is to help make the whole situation clearer to the various specialists (public authorities, service and company managers, engineers and technicians) who will be asked to use the Tool Box and to apply their expertise.

In the course of carrying out the surveys it became clear that none of the actors, despite the substantial technical progress they had made, were as yet ready to deploy any of the systems designed to and private sectors, new legislation relating specifically to such systems is of less importance than the acquisition of a certain organizational maturity and financial experience:

	Technology	Organization	Finance
Data acquisition	■	■	■
Data transmission	■	■	■
Data processing	▒	□	▒
Transmission of Information	■	■	□
Editing of Information	▓	▓	□
Formatting of Information	▓	▓	□
Diffusion of Information	▓	□	□

■ Ready for deployment

▒ Undergoing tests

□ At concept stage

The above table summarizing the situation of infrastructure operators needs to be seen in the light of a similar table showing the stage reached by industry in the development of in-car receivers. Since the firms involved in such development are in competition with each other, it is difficult to obtain such information. However, in the light of recent company formations and the various statements made by firms working in this field, it would seem, as shown below, that beacon-based systems are ready to be commercialized and that there is still, as yet, no clear market for the RDS-TMC system. However, although the latter technology is at a more advanced stage of development, the formidable problem of how the service is to be paid for and, in consequence, what it will consist of, still needs to re resolved.

		PRODUCT	MARKETING	MANUFACTURE
RDS-TMC		■		
SOCRATES/GSM				
BEACONS	INFRARED	■	■	
	MICRO WAVES			

■ Ready ☐ in préparation ☐ under study

Moreover, in view of the doubts which remain over the use of the above systems, the public authorities have been reluctant to delegate responsibilities to the private sector. Of the three missions[5] relating to traffic management identified by the MAGIC group :

① ensuring viability,
② management of traffic flows,
③ driver assistance.

only the third is considered to be suitable to be delegated to the private sector, despite the fact that the benefits of concessions have already been demonstrated in a number of European countries (as members of ASECAP - Association des Sociétés Européennes d'Autoroutes à Péage). It is therefore clear that what is needed to promote co-operation between the public and private sectors in efforts to improve the quality and variety of driver services is not so much new legislation as a change in attitudes.

From this standpoint, the Tool Box and Explanatory Guide are designed to show that by using the legal frameworks which already exist it is possible to forge partnerships of the greatest possible benefit to all parties.

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[5] See chapter 3 of the Explanatory Guide.

TOOL BOX

At a time when many transport telematics (TT) systems are passing from the research and development stage to that of experimentation and in come cases commercialisation, the complexity of inserting them into existing institutions is becoming all too apparent. We must not for all that think only of the possible legal obstacles however, but rather analyse the difficulties and find ways of resolving them.

A first version of this document was submitted to the Ministers of Transport of ECMT countries in order to be validated by means of a questionnaire. In addition, surveys were carried out among the public authorities concerned in Germany, the United Kingdom, the Netherlands, France, Sweden and Switzerland. The replies were less complete than we might have hoped, but sufficient to enable us to draw a certain number of conclusions.

There is considerable diversity in the institutional and legal frameworks. At national level in particular, the respective roles of the road and police authorities vary enormously, the two extremes being Spain, where traffic is controlled entirely by the Ministry of the Interior, and Sweden where it is the sole responsibility of the roads administration. In the middle ground we find France with its tripartite management of the road information centres (transport authorities, police, gendarmerie) and the Netherlands with a mixed police / transport database.

Only one country, the United Kingdom, has so far adopted legislation on road information. The role of the territorial authorities also varies enormously and is in fact changing in several countries.

What is clear from the replies and the surveys is that in their diversity these different countries have the legal tools necessary for the implementation of systems and the existence of independent operators. This implementation is nevertheless easier where there is specific legislation and to a less extent where there are already functioning inter ministerial organisations.

It appears in particular that the problems would be greatly simplified if there were a legal definition of road information. In the absence of such a definition, the legal tools linking the actors have to be extremely detailed if they are to be sufficiently watertight.

The value of this “tool box” lies in the fact that through using it the public authorities and would-be operators can assess not only the difficulties, but also the conditions necessary for the implementation of systems. They should be able to find in it the answers to their questions in a form which can be adapted to the traditions of each country. It should therefore be treated as a pragmatic aid to decision making for States, territorial authorities and operators.

This “Tool Box” comprises :

- an Introduction recapitulating the aims and issues dealt with in the light of the recommendations adopted by the Council of Ministers of the ECMT, in particular at the Annecy meeting on 27 may 1994,
- an identification of the relations between actors and the links which unite them : Institutional sphere. The reader is recommended to refer constantly to figures 1 and 2 of the “Tool Box”,
- a series of Contracts, which are the different links uniting the actors, essential tools for specifying the roles and the “rights and obligations” of the different parties.

The “Explanatory Guide” situates these elements by means of more concrete examples of the application of the three main technologies for which there have been case studies, notably by means of functional tables, applications of figure 2 of the “Tool Box”. It is recommended to refer to this figure wherever a matter appears to be imprecise.

By public authorities (the authorities) we mean :

-- the legislative authority or its representatives,
-- the services of the territorial authorities providing a public service and possessing raw data on road traffic.

By public data provider (the provider) we mean :

-- the body to which the different public services send the information they possess on traffic conditions and which redistributes these data to the TT system operator(s). There may in practice not be such a provider.

By TT service operator (the operator) we mean :

-- the supplier of services to the driver who uses a system employing a technology which permits direct communication between the infrastructure (the ground) and the user (the vehicle).

1. Introduction

The expansion of trade and exchanges between European countries and the increasing mobility of people and goods, are major aspects of our society. These trends result in constantly growing road traffic and constantly growing traffic problems. The resulting unreliability of travel and transport is becoming increasingly difficult to accept.

Until very recently, the main response which had been found to resolve these problems was investment in new infrastructures. However, economic constraints, respect for the environment and concern with the disamenities caused by roads and traffic mean that it is no longer possible to go on developing networks as rapidly as in the past. Optimising the utilisation of existing networks, improving their safety and enhancing the quality of service provided are now called for before there can be any further extension.

A new concept is emerging today : traffic management.

Unlike traffic control, which aims only to directly influence the behaviour of each user in the presence of a difficulty, traffic management aims at shifting or modifying traffic flows, sometimes at a considerable distance from the problem area, in order to optimise the management of a road network as a whole.

The concrete actions introduced by a certain number of ECMT member states, together with experiments under way in the context of major projects, have demonstrated the value of such actions. It should also be pointed out that the development of information technologies means that we can already envisage a very significant improvement in the number and quality of the services provided.

This view was confirmed as regards information and guidance systems for drivers by the council of ministers of the ECMT at the meeting in Annecy on 27 may.

The fact is that road information is an essential component of multimodal information which will make it possible to compare the different transport supplies, chose the most advantageous and receive practical information to help complete each stage of the trip under the best conditions. Information needs to be available before the trip (in the home, in offices, in public places, etc...) and on the road.

Such a “consumerist” approach implies a certain transparency and free access to information sources which are often complementary but also sometimes competing. It should contribute to a better balance in the use of the different road and public transport networks available.

Road information is a service for the public intended to give the traveller the information he requires to :

- prepare his trip, chose the route, and select a time to suit his constraints ;
- carry out the journey, stage by stage, in the best conditions;
- avoid difficult situations, announced in advance or in the course of the trip ;

and thus increase both comfort and safety. This service is not necessarily provided solely by the public sector, private enterprises also being able to play a role in this field.

Guidance is a personalised service designed to help the driver to optimise his route in real time, with a minimum of fatigue, driving his vehicle to each chosen point by the best route right to the final destination or the closest free parking space allowing a switch to public transport.

The first objective is to help the driver, but there are also a number of more general objectives :

- better infrastructure management in order to adapt demand to the optimal use of the existing road network capacity and to limit the new road building requirement;
- reduction of the disamenity suffered by drivers and passengers in the case of traffic problems, delays having an immediate impact on the cost of movement and on the competitiveness of European enterprises;
- enhanced safety and less environmental damage.

Guidance and information services should therefore have beneficial effects for drivers, both individually and collectively, and also for society as a whole.

Many of these services require on-board equipment installed in the vehicle itself.

The development of road information services is thus very closely linked with the responsibilities of states and territorial authorities in the fields road network management, motor vehicle safety equipment, environmental protection, and the development of the industries connected with motor vehicles and telecommunications.

Work is already very advanced on certain applications such as those concerned with road information and road management under the CORRIDOR and POLIS projects connected with DRIVE, the speed regulators developed under the PROMETHEUS programme and guidance systems such as CARMINAT and EUROSCOUT, etc. and these cannot be ignored by those responsible for mobility policies.

There are also two factors now modifying the status quo in the field of road information :

- the political will to create trans-european networks at least in the twelve European union member states as provided for in the treaty of Maastricht, a creation which implies greater co-ordination between countries in the fields of operation and information ;
- the appearance of on-board information equipment in vehicles, which, if it is to be usable in all european countries, implies compatible protocols and interfaces to permit the inter-operability of telematics systems.

Inter-operability and standardisation are no doubt not necessary in all cases, but they generally turn out to be essential to promote a service intended for the public, to enhance safety and develop the market, it being understood that the aim cannot be to restrict consumer choice.

Road information is at present delivered in four ways :

- by means of variable signs and signals, and in particular variable message signboards ;
- general national or local radio stations, or specific radio stations dedicated to road information ;
- national and regional press, guides, maps, etc... ;
- by means of telematics, for example by telephone, minitel, microcomputer, television or by specific and coded media permitting targeted and, in the longer term, personalised data.

The information available varies from one country to another and it is difficult to obtain global information covering the whole of an international trip.

Technological advance is affecting the entire information chain : traffic data capture, the instant processing of these data, forecasting models, and transmission methods using different types of terminals, in the home for preparing the trip and on board the vehicle during the trip.

There are various transmission technologies :

- radio, using the RDS-TMC (radio data system / traffic message channel) mode,
- short-distance communications systems (infra-red and micro-waves),
- cellular radio telephone (GSM),
- satellites.

Applications concerning road information and vehicle guidance have been designed and developed on the basis of these technologies under the European Community DRIVE programme and the EUREKA PROMETHEUS programme.

The first applications are being tested in urban (POLIS) and interurban (CORRIDOR) pilot projects intended mainly to demonstrate the technical feasibility.

The standardisation work carried out by the CEN, CENELEC, ETSI and ISO[6] is intended to define the functionalities of the systems and the interfaces, making them compatible to arrive at a set of inter-operable systems. There is however reason to fear that this work will not be completed until after the first systems are installed.

This is why public authorities and would-be operators need to have an instrument for the evaluation of projects with respect to the institutional and legal constraints.

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[6]

CEN	European Committee for Standardisation ;
CENELEC	European Committee for Electronic Standardisation ;
ETSI	European Telecommunication Standards Institute ;
ISO	International Organisation for Standardisation.

The supply of services which is still greater than the supply of equipment or the size of the market may place a locomotive role in the development of these services. They imply the establishment of an effective partnership between the public actors (infrastructure managers, police, gendarmerie, public transport, parking stations, etc...) and the private actors responsible for operating the services. These services are of three types[7] :

a) information connected with the network and traffic ;
b) guiding vehicles according to an optimal route ;
c) broader information connected with the trip.

a) the first category covers information of the following types :

- regulatory, for example one-way, load limits, dimensions of bridges, barriers, bans on heavy vehicles ;
- traffic : saturation, traffic jams, road works, estimated journey time, relief routes and traffic forecasts ;
- safety : accidents, particular arrangements, speed limits ;
- crisis : demonstrations ;
- weather conditions : strong wind, snow, ice.

b) the second category corresponds to an individualised service to help the driver choose his route according to criteria which may vary :

- minimum duration, time of departure or arrival ;
- minimum distance, easy route, ancillary services ;
- minimum cost ;
- minimum as a function of time, cost and constraints ;
- attractiveness of the route from the standpoint of tourism.

c) the third category corresponds to sundry types of information of interest to the driver for his trip :

- alternative or complementary transport modes ;
- parking stations, connections with public transport ;
- terminal services : taxis, hire cars ;
- gas stations, garages, repair services ;
- restaurants, hotels ;
- permanent and updated tourist information.

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[7] The services may be considered from different points of view : from that of their purpose, as here, from that of the point in time when the driver user needs them, and the way in which they are delivered. See the Explanatory Guide for more detail.

The definition and implementation of coherent information and guidance systems in europe thus gives rise to new questions concerning :

-- The organisational aspects implying close partnership between service and infrastructure operators, telecommunications and broadcasting operators, public transport managers, the telecommunications and automotive industries, and the many public authorities which possess the greater part of the information. These actors are not accustomed to working together and they come from both the public and the private sector.

While compatibility is to be sought on the technical level, the objective on the organisational level the objective, notably because of the subsidiarity principle, is not to arrive at a uniform organisation in all countries, but simply to form legal structures which do not constitute an obstacle to the establishment of international operators.

This is why it is necessary in each country to know in advance which services the authorities wish to control very closely, if not take charge of them themselves, and those which can develop freely.

The services can be classified as follows, according to whether the public authority depending on the case and its tradition :

1 - Authority runs the service.

A public authority runes the service, financing it out of its own budget. The private sector in involved only as an equipment supplier.

2 - Authority has the service run.

The running of the service is delegated to a private operator. The relations between the authority and the operator are formalise in a legal framework of a contract with strict specifications.

3 - Authority collaborates with the private sector.

In a more or less pre-established framework (specific legislation, assimilation to existing legislation, etc...) the operator works on this own account but uses public data and/or because it appears that his action will affect traffic management a form of collaboration has to be established and well defined.

4 - Laissez faire approach.

The service in completely independent and cannot perturb the traffic. The operator has total freedom provided that he respects the freedom of the citizens.

- The legal aspects concerning :

    - the electronic equipment on board vehicles, for example screens, and in particular the safety aspects : the drafting of a declaration of principles is a first response in this respect ;
    - the protection of privacy, which could be compromised by driver identification ;
    - public safety ;
    - the transmission of information by radio ;
    - respect of the rules of competition and public markets ;
    - access to information of interest to users and rules for exchanges between managers ;
    - responsibilities and roles of the different actors.

- The financial aspects involved, and in particular :

    - charges for services to drivers ;
    - sales of traffic data between public and private operators and more generally the conditions governing the exchange of information ;
    - division of investment and operating costs between the expenditure necessary to operate the network and the additional expenditure necessary to provide information to drivers ;
    - more generally, all the financial relations between the different public and private parties concerned.

- The technical aspects concerning in particular :

    - standardisation of technical systems, procedures and equipment ;
    - standardised procedures for the exchange of traffic information ;
    - homogeneity of the quality of service offered to clients / users, notably in the presentation of messages ;
    - harmonisation of the services producing and updating information, making it possible to know and compare the possibilities of the networks.

In each TT system it is possible to describe the technical links between actors necessary for its functioning. It will then be necessary for each link to establish its corresponding legal translation which will be the basis for the rights and obligations of each party. The aim of this “tool box” is to bring them out in turn and indicate the necessary minimum which they must contain.

In the first part of what follows it describes the actors and their relations, and in the second the legal expression of these relations, under the generic term of “contracts”.

The technical links are discussed more fully in the explanatory note.

2. Relations between actors

There are five types of possible actors :

A The public actors :

- the legislative or regulatory authority (rule maker) i.e. the public authority responsible for ensuring :
  - public order,
  - the free movement of goods and people,
  - freedom of enterprise and commerce,
  - the safety of citizens.

- the road infrastructure manager, which may be either :
  - a government department ; or
  - a body mandated by a government department.

B The public data provider :

- this public data provider, which remains to be created, is a technical instrument which may be set up under various legal forms depending on the political will in each state to :
  - ensure the consistency and coherence of the data disseminated ;
  - monitor / control the use made of public data.

C The private actors :

- the operator supplying road information and/or route guidance services, which may be either :
  - an off-shoot of the infrastructure manager ; or
  - a specialised and financially autonomous public agency ; or
  - a corporate body subject to private law.

- the driver, who may be :
  - a citizen subject to the laws enacted by the legislator ;
  - a user with regard to the infrastructure manager ;
  - a customer with regard to the service operator.

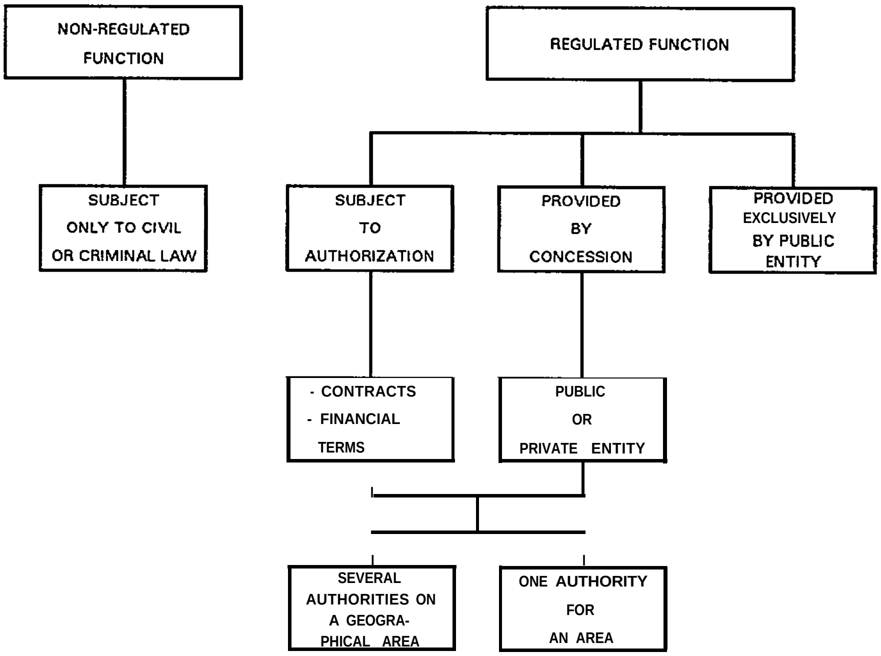
other actors may include suppliers of travel-related services (from the hotel industry, tourist sector, etc...).

The public actors can always, if the situation in the country requires it, take responsibility for a given service. In this case the only problems which arise are the traditional ones of relations between the public authority and the citizen.

2.1. Institutional sphere

The responsibility of each actor must be able to be clearly identified with respect to the actions is has to perform. Certain functions relating to public order need to be covered by specific legislation ; others simply fall into the domain of common law. Since the notion of public order / public service varies both over time and from one area or country to another, law-makers must choose those functions whose performance needs to be made subject to specific legislative or regulatory controls, which in the event will be based on a given definition of road information and the framework for related activities’.

The figure given below describes the conditions under which functions may be performed :



Controls may be applied at three levels :

- EU level,
- national level,
- local (regional or district) level.

These functions all fall within the scope of legislation or regulations relating to the following areas :

- traffic law (highway code, etc...) ;
- broadcasting law ;
- telecommunications law ;
- privacy law.

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[8] The corresponding regulations may be found either in the statute book, as in the United Kingdom, or extrapolated from existing texts on the management of public roads and highways.

While respecting the principle of subsidiarily, the Commission of the European Communities must at the same time ensure that national or local legislation or regulations do not impede the free movement of goods and people and do not jeopardise the safety of drivers (particularly foreign drivers).

Generally speaking the public authorities wish to control the introduction of services insofar as they are connected with traffic management. Figure 3 summarises the degree of control they wish to exercise over the introduction of the functions of an Integrated Road Traffic Management System. These functions are described in chapter 4 of the Explanatory Guide.

2.2. Driver expectations'

As stated above, faced with traffic congestion, a traveller would like assistance in making decisions at various points in his trip :

- Before embarking on a trip, he wants to know which modes are available, how much the use of each mode will cost and how long the relevant trip will take.

- If he decides to travel by car, he would like advice on the route to take on intercity trips, traffic forecasts, as well as information on where to stay both along the route and at his destination.

- Once he is on the road, it is useful for him to have real-time or very short-term forecasts of :

    - traffic conditions and, in the event of worsening conditions, advice on alternative routes,
    - updates on weather forecasts,
    - accident warnings,
    - any other information relevant to the trip, i.e. availability of parking spaces, tourist information, etc.. .

In town, such information must be given in real time and must be detailed enough to provide a credible service. If these conditions are respected then a proper route guidance system can be put in place.

If a transmission system capable of meeting these requirements is installed, it can be used to transmit a whole series of personal or corporate data to the vehicle in movement.

While the desires of users often coincide with the concerns of the public authorities, this does not mean to say that users are necessarily willing to pay for services to which they feel entitled, particularly those relating to safety. A pay system must provide additional services over and above those normally provided as part of conventional road traffic management services.

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9 See also chapter 6, section 5, of the Explanatory Guide.

2.3. Obligations of public authorities and road managers[10]

2.3.1. Obligations of the State

In all countries, the State (in the form of the central government or federal administration) is responsible for traffic legislation and regulations ; the other public authorities only have responsibility in those areas designated by the State.

The State pursues several different types of goal :

1. Traffic regulation is the exercise of sovereign power to meet the vital requirements of the State with regard to the movement of people and goods to supply both the population and industry. As guarantor of such freedom, the State must also ensure respect of the freedom of movement ;

2. Given that the State is considered to be responsible for the personal safety of individuals, it must ensure that road hazards are kept to a minimum by providing the requisite regulatory measures (speed restrictions, mandatory use of seat belts, etc...) and by introducing standards for road infrastructure and related facilities ;

3. Lastly, the State must ensure, without incurring excessive public expenditure, that traffic flows smoothly without the need for any discriminatory measures other than those relating to safety. In meeting this objective, the State may decide to opt for toll systems both to secure funding for new investment and to moderate demand.

In meeting these requirements, the State may avail itself of the police force and other specialised agencies.

It is less common for the State to manage road infrastructure directly. In some countries (Germany, Belgium), the State entrusts the administration of the national highway network to a large regional administration (Land, region) or public entity (Italy). Moreover, even if the State has awarded concessions for the exploitation of toll motor ways, it still retains direct responsibility for a portion of the structural network.

For all the above reasons, the State is virtually obliged to perform all the functions relating to its sovereign status either through its own agents or under the very close supervision of the latter.

This implies a certain minimum of co-operation between the different administrations concerned, at least in the form of a structure for on-going dialogue.

2.3.2. Territorial authorities

While territorial authorities do have regulatory or sovereign powers, in all other respects they exercise the same managerial role as the State. They have traffic flow plans to implement and facilities and infrastructures to operate. In the case of conurbations covering several municipalities, the problem of harmonising decisions may be dealt with by means of specific legislation or a resolute contractual policy.

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[10] See chapter 6 of the Explanatory Guide, in particular section 2.

2.3.3. Means of control available to public authorities

The authorities will undoubtedly exercise direct control over the infrastructure policing, but as pointed out in the introduction they may also contract out other functions less directly related to public order and the justice to third parties.

In descending order of control, the following practices are widespread in Europe :

- while themselves being responsible for the service, authorities make use of firms specialised in a given technique to install, maintain or repair equipment which is used directly by public services and for which they do not employ specialised personnel ;

- provided that no charges are levied on users, and subject to the issuing of a public call for tender, a firm may be entrusted with the task of installing and managing a number of facilities or functions for which it will be paid directly by the public authority as a conventional supplier of services ;

- In cases where charges are levied on users, a number of procedures involving collaboration between the authority and the private sector may be employed[11]:
  - if the authority accepts responsibility for the financial risk involved, and in particular is responsible for setting charges, the relationship is one of a contract for the supply of services. Payment may be based on physical factors, turnover, or any other parameter ;
  - if the authority is responsible solely for setting ceilings on charges and if the firm assumes responsibility for the commercial risk as part of the specification of its services, the relationship is one of the “delegation of public service”, which in many European countries takes the form of a concession ;

- Lastly, unless adoption of one of the highly restrictive frameworks is mandatory, the parties may make use of simple contracts or indeed are free to consider any other kind of arrangement.

2.4. TT (service) system operators”

Public authorities currently have a de facto monopoly of the collection and initial processing of traffic and sometimes weather data. However, they often find it difficult to centralise such data, which are generally disseminated through general radio broadcasting channels. Nonetheless, a few stations set up specifically to broadcast road (motorway) information do exist.

A number of systems using information technologies to provide accurate information on road conditions of the standard required by users are now close to being operational or are in some cases already in service. These are sophisticated systems run by specialist operators.

Taking data generated by public authorities, major transport and tourism organisations, as well as their own data, these operators process them to produce an information package which can be used by drivers.

They usually need to use an intermediary to make contact with drivers ; in most cases, this intermediary is a radio broadcasting or telecommunications system operator.

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[11] See chapter 6, section 6, of the Explanatory Guide.

[12] TT stands for Transport Telematics, or telecommunications and information technologies applied to transport.

2.5. Relations between actors[13]

The production line for the supply of road condition or route guidance information is as follows :

- data collection,
- initial processing[14] to meet the specific requirements of each supplier,
- forwarding of data to the “public data provider”,
- where necessary, validation of data by the public data provider,
- transfer of data to the TT system operator,
- formatting of data by the TT system operator,
- transfer of data to the radio broadcasting” or telecommunications system operator[16], or transmission by the TT system operator’s own facilities[17],
- data received by the end user via an appropriate terminal.

This production chain, which is illustrated schematically in figure 1, offers the advantage of limiting the respective areas of responsibility, in that the prime contractor in each phase is accountable solely for his own activity. It would be advisable, however, to delimit the exact scope of responsibility in the documents, i.e. the “contracts”, governing relations between individual actors.

2.5.1. The public data provider

As part of the survey carried out by the TCT group at ECMT, reference was repeatedly made to the concept of “Public Data Provider”. This term covers a wide variety of practices in that although some countries have highly centralised data collection systems, others may not centralise data at all.

At any rate, the introduction of TT systems, which require public departments to adopt a more coherent policy on the use of data and standard data formats, will undoubtedly lead to greater centralisation of data.

Centralised data collection is one of the comer-stones of any TT system. Centralisation of all traffic data, or at least the bulk of such data, within a given geographical area is an essential condition for operating a TT system. However, there are many information sources and they are not always coherent.

Even at national level, different ministerial departments organise data input according to their own requirements and using their own methods. The same is true of local government and the independent authorities responsible for managing infrastructures.

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[13] See figure 1.

[14] “Raw” data consists of data formatted to meet the requirements of public authorities. Formatted data are data whose format meets the requirements of the TT system operator.

[15] See chapter 5, section 3, of the Explanatory Guide.

[16] See chapter 5, section 4, of the Explanatory Guide.

[17] See chapter 5, section 5, of the Explanatory Guide.

This process is illustrated schematically in figure 2. However, a detailed description is needed of the requirements that it must satisfy.

a) at national level

At least two Ministries are involved in the system :

- the Ministry in charge of the Police force,
- the Ministry responsible for Roads (transport, public works, communications, depending upon the State concerned).

Two others are frequently involved too :

- Defence Ministry (gendarmerie),
- Ministry of Justice.

Each country may establish procedures for pooling the maximum amount of information as a function of its own particular organisation, but permanence is required and therefore very precise conventions, such as the recent Police-Transport agreement in the Netherlands or the Police-Gendarmerie-Transport protocol on road information centres in France, need to be introduced rapidly.

b) at local level

Driver information systems, and route-guidance systems in particular, cover specific geographical areas. The data which in many cases are the property of local government or highway management authorities are essential.

It is therefore a matter of setting up local public data centres and to aggregate the data supplied by the national data centre (where one exists), decentralised government departments, and all autonomous local authorities. Everything will depend, as at national level, on the permanence of the agreements between the public authorities.

It is also possible to envisage bodies of differing status[18] at this level :

1) Purely public status :
A given authority (local government department, municipal department) might be given the task of managing the centre on behalf of the other parties. The authority would therefore sign the same agreement with each of the parties, and would be empowered to deal with partners from the private sector. A management committee would decide upon the contributions and rights of each party.

2) Mandated public service status :
The State and other public authorities could set up a public or private corporation to which they would contribute resources and pay according to services rendered.

3) Purely private status :
A private company could conclude a commercial contract with one or more authorities.

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[18] For further details on relations between the public and private sectors, see chapter 6, section 4, of the Explanatory Guide.

2.5.2. Organic links between the actors in the chain[19]

To simplify our discussion, the following description assumes that a public data provider is already in place (the description is simply of a general nature, details of the application of each technical principle[28] are given in the Explanatory Guide).

This description outlines :

- the flow of data from the provider to the user,

- the links between :
    - the provider and the TT system operator,
    - the TT system operator and other data suppliers,
    - the TT system operator and the operators of telecommunications networks.

This gives us a clear picture of the operational links (flows from the raw data to the final driver information) and the legal links between all actors in the chain. Each legal link has been given a number identifying the category into which it falls ; the nature and scope of the various categories are described below.

If it is desired that both the authorities and the operators should be fully aware of the extent of their commitment, each type of link, referred to for convenience as a "contract"[21] must comprise a number of obligatory clauses aimed not only at setting out the rules governing relations between the parties, but also at providing third parties and end users with the requisite guarantees, ensuring procedural transparency and making it easier to establish liability in the event of a dispute.

The text of these "contracts" is here purely indicative and has to be adapted to the legislation and rules of each country.

It appears that the principal clauses might be :

Purpose of contract :

> The purpose of this clause is to set out the objectives of the two parties in order to explain the rationale behind the more practical provisions made subsequently.

Parties to contract :

> Each party, particularly when the party consists of a group of (public or private) bodies, must specify here the corporate or natural person empowered to enter into a contractual arrangement on behalf of the partner as a whole.

Legal framework :

> The legal framework may vary according to the legal status of the partners and the purpose of the contract : either a unilateral authorisation supplemented by a specification, in the case of dealings with a State ; or, on the contrary, freedom of trade and industry between private operators.

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[19] That is to say links between those who produce raw data, those who process and disseminate such data, and the end user.

[20] See section 3 of chapter 5 of the Explanatory Guide for "RDS-TMC", section 4 for "GSM" and section 5 for "EURO-SCOUT".

[21] Except for the first link, which given that it is unilateral is referred to as an administrative authorisation.

Prior conditions :

In many cases, the agreement of one or more third parties will be required. Such agreement may take the form of public authorisations or the provision of a private network, etc...

Rights and obligations of parties :

This clause is the central part of the contract. It provides details of the services which each party expects to receive.

Financial provisions :

These are the provisions underpinning the rights and obligations of the parties. The problem of whether or not services to the public should be free must be dealt with here. Furthermore, giving the TT system operator access to the "provider's" data will generate added expenditure for various public departments. Considerable attention will need to be paid to this point :

- which costs should be imputed[22] :
  - full,
  - direct,
  - marginal ?

- should users be charged :
  - on a lump sum (subscription),
    itemised basis ?

The choice of lump-sum or itemised invoicing systems must be given very careful consideration :

-- A subscription system may make the operator pay for services which, in the final analysis, he does not require but whose availability will thus be ensured.

-- Itemised billing for services (at first glance) allows the operator to restrict expenditure to those services which he has actually requested, but does not allow the operator to make accurate budget estimates and gives the public data provider the right to discontinue certain services without warning. In addition, it raises the problem of how fixed charges and charges proportional to time should be imputed.

Settlement of disputes :

Given that the legal status of contracts can occasionally prove to be a highly complex issue, it is useful to provide details of the procedure to be used to settle disputes. It would also be helpful to consider the possibility of using simplified procedures (arbitration).

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[22] See chapter 6, section 4.2., of the Explanatory Guide.

Figure 1

Institutional Legal flow framework for ATT systems

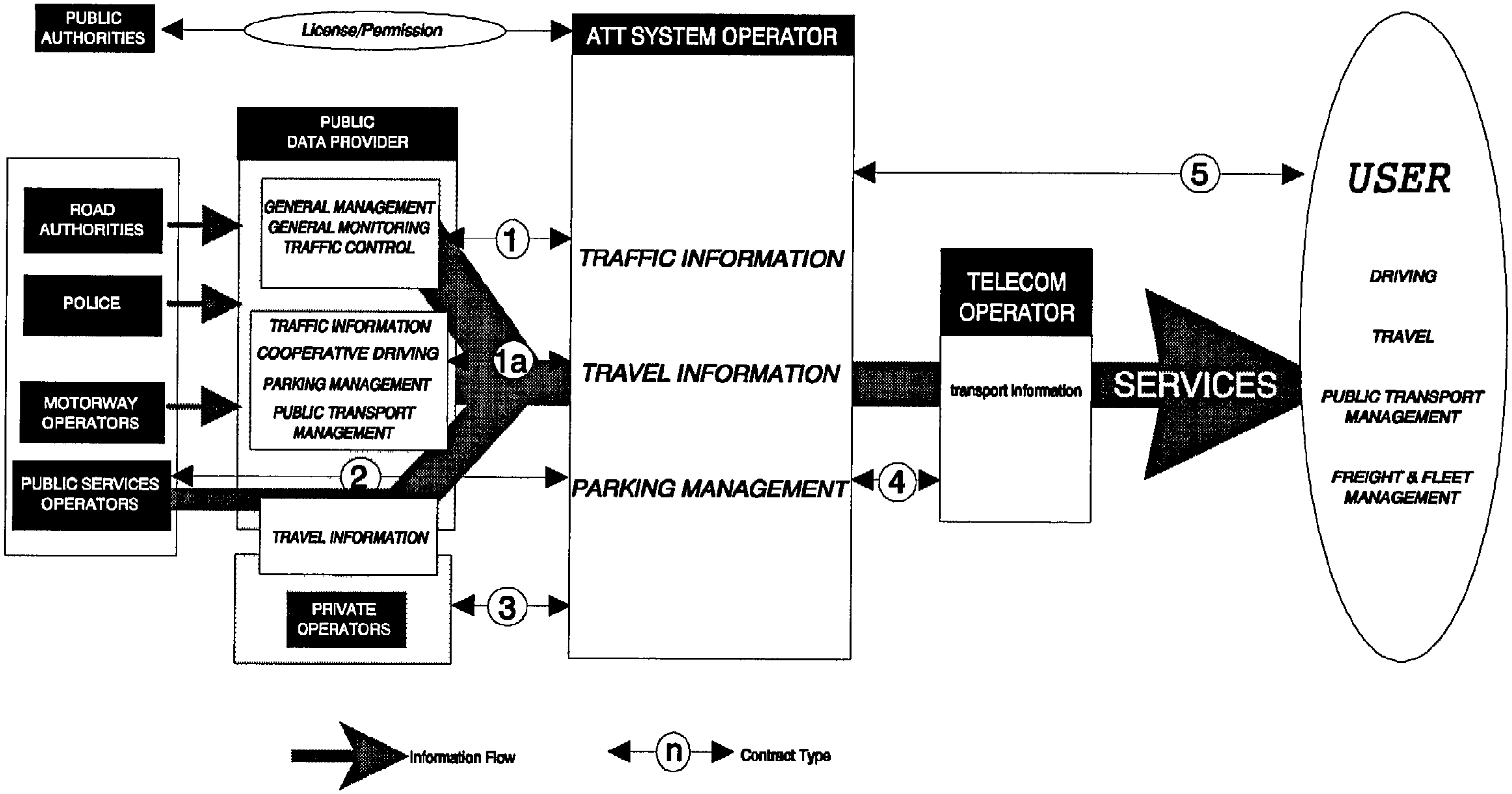

Figure 2

Set up of a public data provider

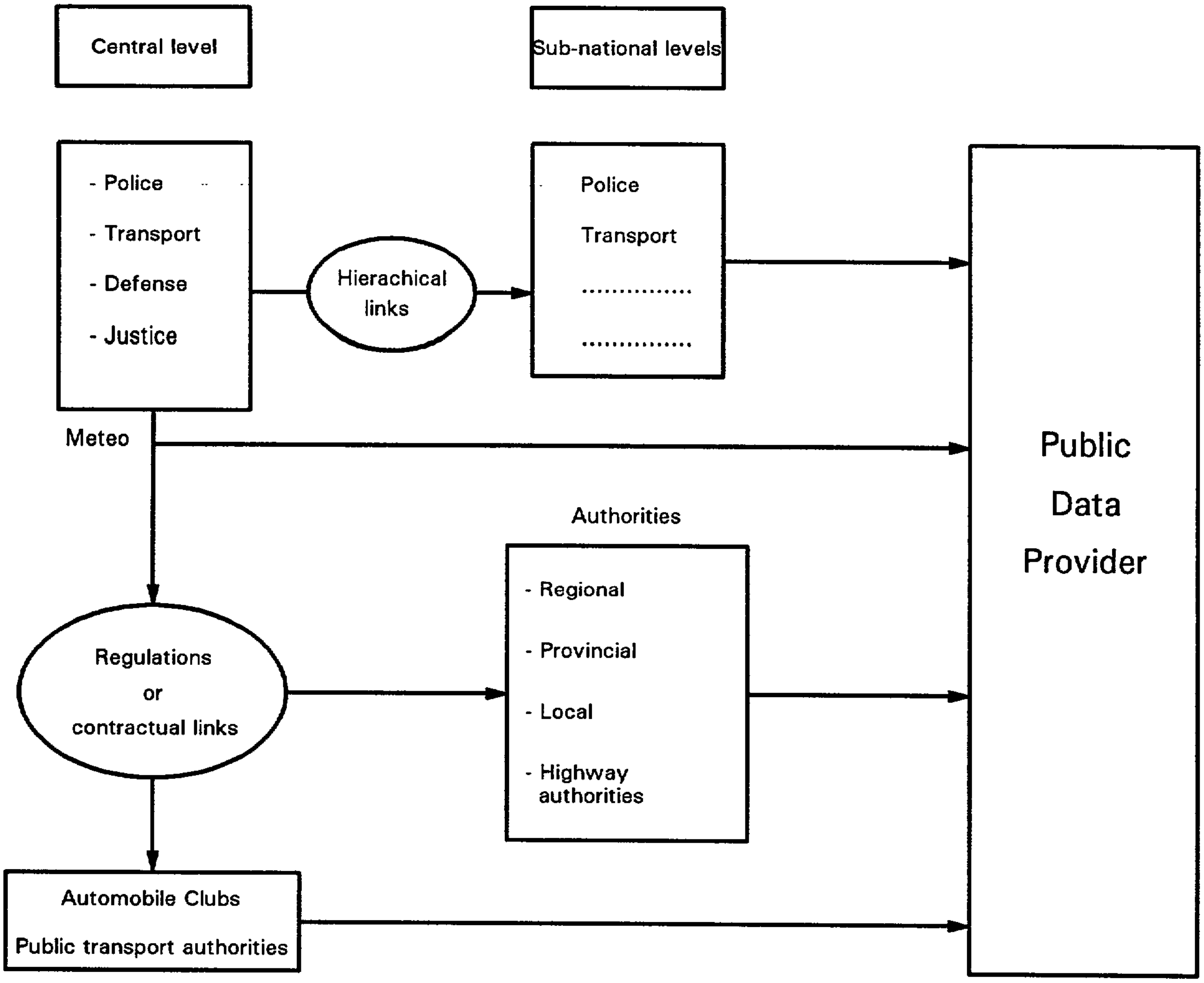

Figure 3

Roles and responsibilities

		REGULATED	PUBLIC OPERATOR	DELEGATEE	PRIVATE OPERATOR	DRIVER	CAR MANUFACTURER
GENERAL MANAGEMENT & LOGISTICS	1.0.0						
Strategic planning	1.1.0	■	▨				
Strategic Management	1.2.0	■	▨				
Forecasting	1.3.0		▨	▨			
General information management	1.4.0	■	▨	▨			
Infrastructure management	1.5.0		▨	▨			
User rescue services management	1.6.0		▨	▨			
Infrastructure services logistics	1.7.0		▨	▨			
Fee collection management	1.8.0		▨	▨			
Policing/Enforcing management	1.9.0	■	▨	▨			
GENERAL INFRASTRUCTURE MONITORING	2.0.0						
Ambient conditions monitoring	2.10		▨	▨			
Road status monitoring	2.2.0		▨	▨			
Events monitoring	2.3.0		▨	▨			
Traffic Monitoring	2.4.0		▨	▨			
VEHICLE CONTROL	3.0.0						
Monitoring Environment & Road	3.1.0	■				▨	▨
Monitoring Driver	3.2.0					▨	▨
Monitoring Vehicle	3.3.0					▨	▨
Vision Enhancement	3.4.0					▨	▨
Collision risk estimation	3.5.0	■				▨	▨
Actuator Control (Dynamic vehicle control)	3.6.0					▨	▨
Dialogue Management	3.7.0	■				▨	▨
COOPERATIVE DRIVING	4.0.0						
Intelligent Manoeuvring & Control	4.1.0	■				▨	▨
Intelligent Cruise Control	4.2.0	■	▨	▨			▨
Intelligent Intersection Control	4.3.0	■				▨	▨
Medium Range Pre-information	4.4.0	■	▨	▨			
Emergency Warning	4.5.0		▨	▨			
TRAFFIC CONTROL	5.0.0						
Section traffic control	5.1.0						
Intersection traffic control	5.2.0						
Network traffic control	5.3.0						
Localised Area Traffic Control	5.4.0	■					
TRAFFIC INFORMATION	6.0.0						
Navigation	6.1.0				▨		
Route computation (guidance)	6 2 0	■	▨	▨		▨	
Route guidance direction	6.3.0	■					▨
Dynamic route information (On trip information)	6.4.0	■	▨	▨			
TRAVEL INFORMATION							
Travel planning	7.1.0				▨		
Statis Route Information	7.2.0				▨		
Personal communications	7.3.0	■	▨	▨		▨	
DEMAND MANAGEMENT	8.0.0						
Demand restraints	8.1.0	■	▨	▨			
Supply control	8.2.0	■	▨	▨	▨		
PARKING MANAGEMENT	9.0.0						
Parking space Management	9.1.0		▨	▨			
Parking guidance	9.2.0		▨	▨			
Parking Reservation & Payment	9.3.0		▨	▨			
On-street parking management	9.4.0	■	▨	▨			
PUBLIC TRANSPORT MANAGEMENT	10.0.0						
Scheduling	10.1.0	■			▨		
Operations management	10.2.0				▨		
Passenger information	10.3.0				▨		
Fare collection	10.4.0				▨		
Maintenance	10.5.0				▨		
FREIGHT & FLEET MANAGEMENT	11.0.0						
Logistics & Freight Management	11.1.0				▨		
Fleet/resource management	11.2.0				▨		
Vehicle/cargo management	11.3.0				▨		
Hazardous goods monitoring	11.4.0	■			▨		

Documents describing the respective legal rights and obligations of the actors involved in supplying data for driver information and route guidance services are referred to generically as "contracts". Depending upon the nature of such contracts, in law they might be termed :

licences,
service contracts,
concessions,
leasing agreements,
public works contracts,
etc...

In what follows we present a typology, based on the position of actors within the data supply chain, correspond to the different types of configuration in which actors may be linked (see figure 1). however, it needs to be borne in mind that the complexity of the links between individual actors is compounded by the fact that the respective roles of the public authorities may be alternative or cumulative[23].

Since the impact of TT systems on road safety and traffic management is an intrinsic feature of their design, they must be covered, at the very least, by an explicit agreement[24].

There are therefore several types of contractual arrangement which might be used to cover the full range of relations between authorities, TT system operators, telecommunications operators and clients / users.

Many countries are hesitating about the need for specific legislation. If legislation is in fact introduced, the minimum configuration is represented by the unilateral "administrative authorisation" issued at national level but which will in most cases need to be supplemented in each of the operator's fields of action by authorisations to operate issued by the local authorities. Where this is not the case, there may still be prior authorisation, but accorded by each competent authority in its particular legislative field.

The most important (as well as the most likely) form of arrangement is one in which the (service) operator of the TT system needs to have access to data generated through the provision of public services. in order to obtain such data, the operator must enter into a contract with the public authorities responsible for managing the relevant services. In return for making data available, the authorities may require the operator to contribute to the public service which they provide. this may lead to exorbitant common law clauses being added to contracts, of the kind that would not be admissible under commercial law. This configuration is examined in "contract n^{o}1" and, where appropriate, "contract n^{0} la".

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[23] That is to say that, depending upon the degree of co-ordination between public authorities working in different domains, the TT system operator may find himself dealing with one public data provider at national level and several authorities at local level with whom he is obliged to deal with individually.

[24] This is the case envisaged under the administrative authorisation.

In order to ensure comprehensive coverage, we have also considered the following contractual frameworks for relations between :

- the TT system operator and other providers (public or private operators) of data which are useful, but not essential, for the provision of driver information and route guidance systems. Since this type of arrangement, referred to as “contract n^{o}2”, does not require the operator to contribute to any public services, it must not contain any exorbitant common law clauses,

- the TT system operator and potential business partners who might be attracted by the operator’s customer base or who might be prepared to supply data that would increase the value added of the basic service. This arrangement is outlined in “contract n^{o}3”,

- the TT system operator and the manager / operator of the telecommunications infrastructure used to broadcast or transmit information to drivers. This arrangement is outlined in “contract n^{o}4”,

- the TT system operator and his client, i.e. the driver using the operator’s service. This arrangement is outlined in “contract n^{o}5”.

Administrative authorisation

This document is intended for the operator of a totally independent system (i.e. one that does not require special access to public data)[25]. It may also be required before any other agreements can be concluded with a public authority.

1. *Purpose of the "contract "*

The purpose of the administrative authorisation is to set out the conditions under which a public authority will authorise the operator of an TT system to carry out his activities.

2. *Parties*

On the one hand, the public authorities :

- at national level, responsible for approving the system (licence). Obtaining this authorisation at national level may be a prerequisite for being able to put a system in place ;
- at local level (operating permit), notably in order to define the network covered and the traffic plan to be respected ;

and on the other hand, the (service) system operator who may be represented[26] :

- at national level, by the holding company which owns the commercial rights to a given technology (patents, licence) and which can apply for a licence on behalf of the operator ;
- at local level, by a local service company.

3. *Legal framework*

Any restriction of freedom of trade and industry of this kind should normally be based either on an interpretation of the laws and regulations governing road traffic and the management of road infrastructure, or upon specific legislation (as is the case in the United Kingdom).

These "contracts" (licences and permits) will be essentially administrative authorisations granted by the authorities in accordance with the legislation in force and may be accompanied by any terms and conditions allowed under such legislation.

4. *Preliminary conditions*

In this case, the operator is responsible for obtaining the requisite authorisations and agreements from existing operators or local authorities to install his telecommunications network or beacons.

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[25] Such as Traffic Master in the United Kingdom, a system which collects its own data and whose operator is under no mandatory obligation to supply such data to a public authority.

[26] This configuration is given simply as an example. We feel, however, that is the arrangement most likely to be adopted in practice in that it minimises the risks associated with TT system operation.

5. *Rights and obligations of the parties*

Some of the obligations incumbent on the operator under contract n°1 may be imposed under either the licensing procedure or the procedure for issuing an operating permit[27]. These obligations correspond to the terms and conditions relating to road safety and traffic management set out in the specifications for system operation. In this particular case, however, the public authorities have virtually no obligations vis-a-vis the operator other than that of respecting the period of validity of any licence or operating permits granted.

It should be specified whether or not the operator is authorized to use his system to broadcast advertising.

6. *Financial conditions*

Financial conditions shall be restricted to any constraints on tariffs (i.e. price ceilings, price changes, etc.. .) which may be imposed by the authorities on TT system operators.

Such conditions may distinguish between the service provided and the sale (or provision) of in-vehicle equipment.

7. *Settlement of disputes*

Disputes arising from application of a “contract” of this nature shall normally be dealt with by an administrative tribunal.

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[27] Logically, they should be covered by specific legislation.

Contract n^{0}1

1. *Purpose of contract*

The purpose of this contract is to specify the conditions under which a public authority or authorities [or public service(s)] will supply the basic data which the TT system operator needs in order to be able to supply his customers with driver information / route guidance services (see contract n^{0}5).

The contract must specify the geographical area to which it applies, as well as the term of the agreement.

2. *Parties to the contract*

The parties are as follows :

On the one hand, the public authorities supplying the data :

- represented by a common public data provider,
- several authorities acting independently :
  - public services (police, infrastructure managers, weather forecasting services, etc...) ;
    local authorities (infrastructure managers, transport co-ordinators, etc...).

(In the event of there being no common "public data provider", there would be as many contracts as there are supplying authorities and operators, which would raise for service operators the problem of ensuring that there is no conflict between their rights and obligations and for the public authorities that of the coherence of the operation of the network).

And on the other hand, the TT system operator, the customer of the data providers (and supplier of information to the user), who may be represented[28] by either :

- a holding company owning the commercial rights to exploit a given technology (patent, licence),
- a local operating company (in which some local authorities might have shares).

3. *Legal framework*

This contract may take one of two forms :

- delegation of a public service,
- commercial contracts with extraordinary clauses subject to common law.

The purpose of the contract will determine jurisdiction in the event of a dispute.

The contract shall generally consist in an Agreement and Specifications.

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[28] See note n^{0}26.

4. *Preliminary conditions*

The means of communication used for data transfers between the public data provider and the TT system operator[29] must be specified, as well as the conditions governing their use. In addition, the following should be specified :

- which party will be responsible for supplying and maintaining the means of communication,
- to whom and by whom transmission frequencies will be assigned, and which party will be accountable to the authorities for their use,
- in cases where the transmission media are managed by third parties, which party will be responsible for relations with such third parties and which clauses of the contracts with those parties (telecommunications operating licence) will affect the current contract,
- the list of authorisations (frequency permits, use of services in the public domain, etc...) issued to the operator, which will determine the date on which the contract enters into force.

In addition, the TT system operator may have to provide proof that the authorisations needed to broadcast driver information to users have actually been granted (or that agreement has been reached in principle).

5. *Rights and obligations of parties*

The rights and obligations set out in the contract must permit :

- the operator to make a legitimate commercial profit[30],
- the public authorities to perform their statutory tasks, in which the operator may be asked to co-operate[31].

a) Rights and obligations of the TT system operator (the client)

The obligations may relate at the same time to the relations of the operator with the user (quality of the service supplied), the obligation to collaborate with the public service under certain circumstances, and the responsibilities that such activities may entail. Restrictions may be imposed on the operator's rights to own and exploit data that he has either collected himself [see contract n^{0}1a] or obtained from the authorities.

The contract specifications must identify all highways situated within the area in which the TT system operator supplies services (major corridors, transit routes, by-passes, feeder roads, etc...), as well as major traffic routes, back-up routes and any other items entering into traffic plans drawn up by the authorities.

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[29] The problem of which facilities will be used by the TT system operator to transmit data to the end user is discussed in contract n^{0}4.

[30] See chapter 6, section 4, of the Explanatory Guide.

[31] See chapter 6, section 2, of the Explanatory Guide.

1) Quality of services supplied to users

The operator may be obliged to :

- refrain from modifying the form and content of data (notably place names and codes assigned to types of accident) supplied to him by the authorities ;
- broadcast free of charge certain messages relating either to safety or to public order, or considered to form part of a minimum service ;
- ensure that data are broadcast at minimum intervals and within a minimum period of time ;
- provide services for a specific period of time (24 hours a day ?) and within a specific geographical area.

2) Ownership and use of data

The operator may be authorised to use data supplied by the public authorities or collected through his own activities to supply other services to third parties (market surveys, sub-contracts with public transport operators, etc.. .) or simply in the performance of the present contract.

3) Responsibilities of the operator

The contract shall specify the extent of the operator's liability should any of his actions (distortion of information, failure to meet specific constraints relating to the maintenance of public order, etc...) lead to a deterioration in traffic conditions. The contract should specify criteria that might be used to assess such deterioration, as well as the sanctions that might be applied to the operator (breach of contract, financial penalties, etc.. ,).

b) Rights and obligations of public authorities (suppliers)

The obligations to be met by public authorities primarily consist in ensuring that the TT system operator is provided with guaranteed access to data of the requisite quality. It is of paramount importance that the public authorities meet these obligations in that the commercial success of the operator's activities will depend on his being able to obtain these data. The scope of such obligations will vary according to whether the operator obtains his data through a common provider (single contract) or directly from each authority (several contracts).

Lastly, one of the major obligations of the public authority will be to respect the specified term of the contract in order to allow the operator enough time to amortise his initial investment and to make a suitable profit.

In contrast, since the authority is generally called upon to provide a public service, it is entitled to ask to be notified of any contracts the TT system operator may enter into with other co-contractors (contracts types 2, 3, 4 and 5), either simply for information purposes or in some cases so that it may give prior approval.

1) Quality of data supplied to the operator

In return for meeting the obligations imposed on him under the contract, the operator is entitled to expect data of the requisite quality. The criteria governing quality shall be :

- format[32],
- frequency of messages[33],
- accuracy[34],

In the case of a single contract, the data provider must obtain guarantees from each of the authorities involved. In the event of separate contracts, it is the operator's responsibility to ensure that the data supplied to him are coherent.

A clause should also be added to release the public authorities from their obligations in the event of work being carried out on the road infrastructure.

0 Ownership of data

The authorities may give the operator exclusive rights to data over a specific period of time and within a specific geographical area ; they may, however, restrict the use that the operator is allowed to make of such data.

6. *Financial conditions*

Should the authorities decide to have the operator pay the public data provider, the relevant contractual provisions must indicate :

-- the amount that the operator must pay for :
  - the formatting of data ;
  - the provision of the additional material and human resources needed to :
    - ensure that data are broadcast at the requisite intervals,
    - ensure the degree of accuracy needed for data to be used on a commercial basis ;

-- whether certain data will be supplied to the operator free of charge, with no obligation for the latter to broadcast them (e.g. safety messages) ;

-- the method to be used to pay for services (subscription versus itemised billing).

Such conditions may also deal with the tariff policy adopted by the operator with regard to users (ceiling on charges, conditions for price variation, etc...), by distinguishing between invoicing for services and invoicing for in-vehicle equipment, as well as any compensation that may be payable by the public authorities (in the event of restrictions being introduced for social reasons, for example).

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[32] i.e. the presentation of data according to precise rules.

[33] i.e. the transmission of messages at regular intervals.

[34] i.e. the guarantee that the data transmitted have been validated.

7. *Settlement of disputes*

The contract should specify :

- whether the authorities reserve the right to impose sanctions unilaterally, and the conditions under which such sanctions may be imposed ;
- the court with jurisdiction in this area (administrative, civil, commercial) ;
- whether provision is made for preliminary arbitration procedures.

Where several distinct public data providers are supplying data to the operator, the use of data supplied by one of these providers may lead to a breach of the operator's obligations with regard to the other authorities. It would be advisable for each contract to provide for recourse to a common arbitration body should the authorities fail to reach agreement on that point beforehand.

Contract n°1a

This contract supplements contract n°1. It is intended for use by service operators **who** collect their own data as part of their normal activities. This is the case in particular of TT systems based on the use of cellular radio telephones[35] and/or radio beacons[36].

1. *Purpose of contract*

The purpose of this contract is to set out the conditions under which the TT system operator is obliged to supply a public authority with data collected in the course of his operations.

2. *Parties to the contract*

While the parties may be the same as those in contract n°1, the roles are reversed in that it is the TT system operator who supplies the data and the public data provider who acts as customer. However, it is possible that in some cases the TT system operator may be required to supply his data directly to the public service responsible for traffic management without going through the intermediary of the public data provider.

3. *Legal framework*

The legal framework is the same as that for contract n°1 in that the data collected will be used to improve the public service.

4. *Preliminary conditions*

In cases where the authority responsible for managing property in the public domain is not the contracting authority, TT system operators installing their own facilities, such as roadside beacons, on public property are responsible for obtaining the necessary authorisations.

5. *Rights and obligations of parties*

The rights and obligations of parties under this contract are effectively the reverse of those laid down in contract n°1 in that the TT system operator acts as a supplier of data and the public authority as the customer of the operator. However, the following supplementary conditions shall apply :

-- property rights to the data collected must be assigned to the TT system operator (Does the latter own the rights or is he a sub-contractor of the authority ?) ;

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[35] For further details, see chapter 5, section 4, of the Explanatory Guide.

[36] For fiuther details, see chapter 5, section 5, of the Explanatory Guide.

- the basic interests of operators must be defined so that they may be safeguarded through :
  - the award of an operating monopoly of limited duration and geographical scope ;
  - restricting the use of data by operators of competing modes of transport / services.

6. *Financial conditions*

Where necessary, the expenditure incurred by the authority using the data with regard to the following should be specified :

- specific formatting,
- any service obligation that might extend the normal period of operation by the operator,
- any access to data that the co-contracting authority might grant to other public services.

7. *Settlement of disputes*

The provisions for the settlement of disputes are comparable to those set out in contract n° 1.

Contract n^{0}2

1. *Purpose of contract*

The purpose of this contract is to define the conditions under which **a** public or private agency managing a given infrastructure or mode of transport shall supply data to a TT system operator. The data in question complement those covered by contract n^0 1. While such data assist in traffic management, they will not be used to help provide a public service.

2. *Parties to the contract*

The parties are as follows :

- On the one hand, a public or private agency supplying data and acting on its own behalf,
- On the other hand, the TT system operator, the customer of the data providers (and supplier of information to users), who may be represented by either :
  - a holding company which owns the commercial rights to a given technology (patents, licence),
  - a local service company (in which some public authorities may have holdings).

3. *Legal framework*

Unlike Contract n^{0}l, the present contract should not impose an obligation of public service on the TT system operator. As a result, the legal framework does not depend on the purpose of the contract, but on the legal status of the parties.

The framework to apply will generally be that outlined in contract n^{0}1 in cases where the data provider is a public body, and that set out in contract n^{0}3 in cases where the data provider is a private organisation.

4. *Preliminary conditions*

The preliminary conditions to be fulfilled are of the same type as those set out in contract n^0 1.

5. *Rights and obligations of parties*

In the present case, the rights and obligations of the parties may be established freely on the basis of commercial negotiations. Each party should state what it expects to obtain from the contract and what it is prepared to supply its partner. The obligations of the operator with regard to the public authorities should be mentioned in the contract to the extent that they have an impact on its performance, particularly with regard to the format and quality of the data as well as attendant property rights.

6. *Financial conditions*

The financial conditions are freely negotiable between the parties. Care should nonetheless be taken to provide clear definitions of the services provided, in that none of the parties are entitled to sell what does not belong to them.

Inasmuch as the parties may decide to exchange information, a barter agreement would be permissible, in which case, the services offered in return must be properly defined. If a bartering system is not agreed upon, the contract must specify the type of payment to be used, i.e. subscription or itemised invoicing.

7. *Settlement of disputes*

The contract should specify :

- the court with jurisdiction, given the nature of the co-contractor supplying data,
- whether or not the parties wish to include an arbitration clause,
- the role of the public authority (partner in a n°1 type contract) within the framework of the arbitration procedure.

Contract n^{0}3

This type of contract might be used for cases in which, for example, rather than purchasing data, the TT system operator broadcasts data (information) on behalf of private partners. The roles would therefore be reversed without changing the legal nature of the contract.

1. *Purpose of contract*

The present contract covers the exchange, purchase or sale of data between the TT system operator and a private partner (hotel chain, tour operator, holiday centre, etc...) which is not directly involved in the management of traffic flows ; the data provide value added for the basic service supplied by the operator, but have no impact on traffic management.

2. *Parties to the contract*

The parties to the contract are as follows :

- on the one hand, the operator of the TT system in his capacity as a buyer, and possibly a vendor, of data,
- on the other hand, a private organisation acting as a vendor, and possibly a buyer, of data.

3. *Legal framework*

Given that no public bodies are party to the contract, and that there are no special clauses governed by common law, this type of contract is covered by normal commercial law (freedom of trade and industry).

4. *Preliminary conditions*

The contract should specify :

- whether the processing and transmission of data are covered by legislation / regulations relating to telecommunications and broadcasting ;
- which authorities are responsible for issuing the relevant authorisations, and which partner is responsible for obtaining such authorisations ;
- whether the use of a public telecommunications networks managed by a third operator is either possible or necessary, and which party will enter into a contract such said operator.

5. *Rights and obligations of parties*

In the present case, the rights and obligations of the parties may be established freely on the basis of commercial negotiations. Each party should state what it expects to obtain from the contract and what it is prepared to supply its partner. The obligations of the operator with regard to the public authorities should be mentioned in the contract to the extent that they have an impact on its performance, particularly with regard to the format and quality of the data as well as attendant property rights.

The format in which each party expects to receive data must be specified in the contract, since compliance with this provision will determine the responsibility of the parties with regard to third parties.

Lastly, the contract should specify which of the partners is responsible for relations with telecommunications operators (who sign contract n°4 ?).

6. *Financial conditions*

The financial conditions are freely negotiable between the parties. Care should nonetheless be taken to provide clear definitions of the services provided, in that none of the parties are entitled to sell what does not belong to them.

Inasmuch as the parties may decide to exchange information, a barter agreement would be permissible, in which case the services offered in return must be properly defined.

If a barter system is not agreed upon, the contract must specify the type of payment to be used, i.e. subscription or itemised invoicing.

7. *Settlement of disputes*

The contract should specify :

- whether or not the parties wish to include an arbitration clause,
- the role of the public authority (partner in a n°1 type contract) within the framework of the arbitration procedure.

Contract n°4

1. *Purpose of the contract*

The purpose of this contract is to set out the conditions under which the operator of a FM radio subcarrier or telecommunications network shall transmit data / information supplied by the TT system operator to the end user.

2. *Parties to the contract*

The parties to the contract are as follows :

- on the one hand, the operator of the FM radio subcarrier or telecommunications network providing a data carrier service ;
- on the other hand, the operator of the client TT system, on behalf of whom the telecommunications operator is broadcasting information.

3. *Legal framework*

Given that no public bodies are party to the contract, and that there are no special clauses governed by common law, this type of contract is covered by normal commercial law (freedom of trade and industry). However, telecommunications operators in some countries may have a special legal status (belong to the public sector, public service obligations) whose potential implications must be taken into account.

4. *Preliminary conditions*

In the case of a TT system based on the use of a cellular telephone network, the contract should specify whether the network operator enjoys a monopoly position on the market and which of the resultant obligations might have an impact on the availability of the network to the ‘IT system operator.

In the case of a TT system based on the use of an FM radio subcarrier broadcasting system, the contract should specify which authority allocates the frequency used, which party should apply for an operating licence (the TT system operator or the FM radio subcarrier network operator), and whether the right to use the radio carrier beam has been granted to the radio broadcaster licensed to the use the frequency (as in Germany) or to the operator of the transmitter (as in France).

5. *Rights and obligations of the parties*

In this case, the rights and obligations of the parties may be freely negotiated under commercial law. The TT system operator should specify the services that he expects to receive, and the broadcasting service operator (radio or telecommunications) should specify what he is prepared to supply to his partner ; a force majeure clause should also be included.

In addition, the contract should specify the obligations of the TT system operator vis-a-vis the public authorities [contracts n^{0}1 and la] with regard to the contents of and intervals between messages, road safety and public order, to the extent that such items have an impact on performance of the contract.

The broadcaster shall be liable solely for his own deficiencies, provided that he has made no changes to the data supplied by the TT system operator.

Lastly, the contract should specify whether the TT system operator or the telecommunications network operator will be responsible for collecting charges from the end user.

6. *Financial conditions*

These conditions may be freely negotiated by the parties to the contract, provided that they comply with the rules on telecommunications tariffs imposed by the public authorities.

The contract should specify which party shall be held responsible for the loss of income in the event of the end user defaulting on payments, and also whether dues / subscriptions will be collected by the telecommunications operator.

7. *Settlement of disputes*

The contract should specify :

- given the nature of the services (wide geographical coverage), whether the court that will have jurisdiction will be that for the area in which the head offices of the TT system operator are located, or that for the area in which the head offices of the supplier of the services is located ;

- whether the parties wish to include an arbitration clause, and the role of the public authority (partner in a n^{0}1 type contract) in the arbitration procedure.

Contract n^{0}5

1. *Purpose of contract*

The purpose of this contract is to set out the conditions under which an TT system operator shall supply a driver information or route guidance service to an end user.

2. *Parties to the contract*

The parties to the contract are as follows :

- on the one hand, the operator of the system supplying the service,
- on the other hand, a user or client, commonly referred to as the “subscriber”, who may be a corporate body or natural person.

The operator of the TT system may be replaced by the telecommunications operator inasmuch as contract n^{0}4 allows the latter to collect money.

3. *Legal framework*

These contracts are subject to the freedom of trade and industry. They may include mandatory clauses in States where the provision of driver information services is a regulated activity.

4. *Preliminary conditions*

Automatic vehicle tracking and toll-debiting procedures must be authorised by the authority responsible for enforcing privacy laws.

5. *Rights and obligations of parties*

a) The operator shall be responsible for installing the facilities needed to provide the service. The contract must accurately list the functions performed by such facilities as well as the level of “quality” promised by the supplier, notably with respect to the reliability over tune of the information provided.
The operator must ensure the continuity of the service. Once the basic features have been defined, additional services may be freely negotiated.
The contract may include clauses relating to the provision of in-vehicle equipment.

b) The subscriber must provide means of identification and must also, where necessary, supply guarantees of payment.

6. *Financial conditions*

Minimum periods shall be specified for financial conditions. Such conditions may take the following forms :

- fixed-term subscription,
- itemised charges,
- a combination of the above two methods.

Failure to pay, subject to the serving of a formal demand, may lead to unilateral cancellation of the contract.

7. *Settlement of disputes*

In the event of failure to reach an amicable agreement, the parties shall agree to refer disputes to the court with local jurisdiction (preferably in the area where the head offices of the operator are located).

EXPLANATORY GUIDE

The use of telecommunications technology in driver information systems

1. Introduction

No-one is in any doubt that technological advances and breakthroughs in R&D alone will not suffice to ensure the rapid and generalised introduction of IT systems and services (Transport Telematics or informatics and telecommunications applications in transport) [9][37]. A better understanding is also needed of a number of “non-technical” prerequisites, of which institutional / legal issues and constraints are among the most important.

It is already clear that the actors involved in the deployment, management and operation of TT systems will need to establish new forms of co-operation which often will cut across traditional boundaries in terms of jurisdiction and/or commercial interest and market presence. Organisations in the public and private sectors will need to co-operate with other organisation from either sector.

Indeed, the need to achieve the institutional “critical mass” needed to realise the full potential of TT systems was one of the main reasons for extending membership of ERTICO to both the public and the private sector. ERTICO aims to do this by drawing on the capabilities of the public sector while at the same time capitalising on the possibilities offered by the private sector.

Further to the adoption in 1990, 1991 and 1993 of a series of Resolutions with regard to transport, computers and telecommunications, the Council of Ministers of the ECMT (European Conference of Ministers of Transport) instructed the Committee of Deputies to investigate the legal and administrative problems arising from the use of computers and telecommunications in the transport sector, which led to a set of recommendations being adopted by the Council of Ministers meeting in Annecy on 27 may 1994.

The introduction of new information technologies for the provision of new services in the transport sector raises numerous administrative and legal issues in such areas as licensing, responsibility, liability, control, confidentiality, safety and funding.

Acting on the Council’s instructions, the ECMT carried out a survey of the situation within individual Member countries based on a questionnaire addressing problems relating to traffic, vehicles, personal privacy and the content of driver information messages.

A report [2] based on the fmdings of the survey was subsequently drawn up in order to draw the attention of Ministers of Transport to institutional deficiencies and identify areas in which Ministers should take action.

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[37] For references, see bibliography.

With the aim of responding to this initiative, ERTICO began work in collaboration with the ECMT on a joint institutional / legal study (Joint ERTICO/ECMT Project - JEEP). On the basis of the information supplied by ECMT Member countries and leading manufacturers of technical systems, a number of operational contractual frameworks were drawn up and brought together in a “Tool Box” which ECMT Member countries, potential operators who are members of ERTICO, and also the DRIVE community, were asked to check by answering and commenting on a questionnaire. The replies made it possible to validate the “Tool Box” and to frame institutional / legal / contractual proposals intended to permit the application of telecommunications and computing technologies to transport operations and management.

This Explanatory Guide provides the different road information professionals, whether working for administrations, concession enterprises or service operators, technical and institutional details which can help them evaluate the what is at stake when drawing up contracts with a view to introducing personalised services for drivers.

1.1. Objectives

The objectives of this Explanatory Guide are to enable users of the Tool Box to :

- identify all the potential actors ;
- identify, with reference to key TT “technological” implementation models, institutional / legal implications and requirements ;
- identify the institutional / legal arrangements that have been proposed or are already in place and to determine whether each individual system / function is :
  (a) subject to specific regulations ; or
  (b) reserved for the sole use of a specific public agency, and if so which one ;
- determine the legal / contractual basis of the relations between individual actors, i.e. public authorities, private companies and road users ;
- assess the influence of existing and projected institutional / legal frameworks on the choice of technology ;
- permit them, depending upon the type of system being developed, to determine their options and identify possible constraints ;

and help authorities with responsibility at national or regional / local level to identify issues they may have to resolve in the future and to indicate ways in which they might be able to do this by adapting their legislative and regulatory framework to the type of system chosen.

1.2. Background [1]

Under the EC DRIVE 1 R&D Programme on Road Transport Informatics (RTI[38]), SECFO has identified a number of key technologies which could be ready for commercial operation in the near future.

A distinction has been drawn between two types of RTI system, depending upon how much development is needed before they can be introduced on a commercial basis :

> Firstly, systems designed to meet specific market needs. Given that such systems have been developed to provide a specific function, whether on not they will actually be introduced will depend solely on their ability to meet market demand at a reasonable price. This category covers the new tools developed for traffic engineering and control, public transport operations, and freight and fleet management.
>
> Secondly, systems which have a wide range of potential applications and which therefore do not provide a specific service. This category of system covers most of the different kinds of information technology used in RTI and can therefore give rise to a wide variety of contractual or legal relations between actors.

Before it is possible to consider drawing up plans for the introduction of systems falling within the second category above, action is required at two levels :

- preparation of a suitable institutional environment :
  - all member states must reach agreement on a plan for the introduction of RTI systems ;
  - a legal framework defining the status of traffic and trip information must be established ;
  - traffic control and information centres tailored to the conditions within individual member countries must be set up in accordance with the legal framework mentioned above ;

- preparation of a suitable technical environment based on :
  - high-density data collection within the network set out in the European Plan ;
  - data bases for the management of all static and dynamic data required for traffic control and information strategies ;
  - a data interchange network ;
  - development of a comprehensive language for driver information ;
  - improvement of current technologies.

This document is primarily concerned with the second category of systems and the aspects relating to the preparation of the institutional environment. Where technical issues are discussed the aim is solely to help clarify this environment.

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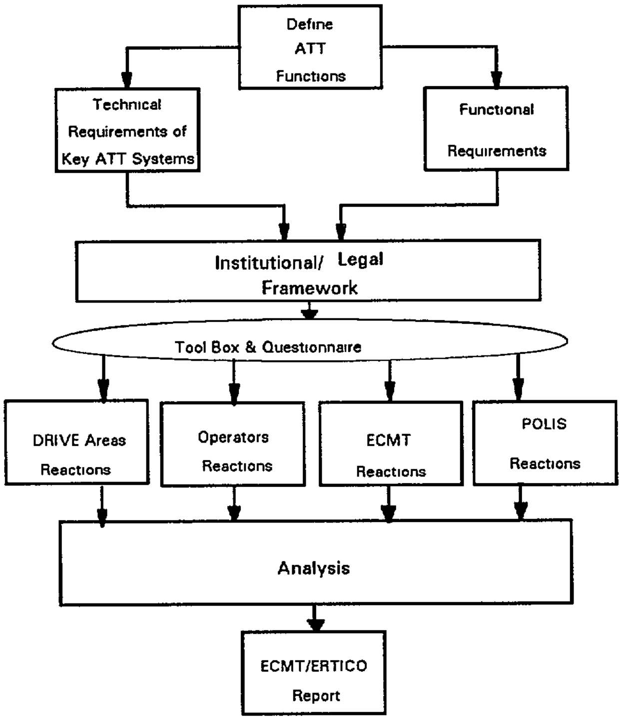
[38] Also referred to as Advanced Transport Telematics (ATT) or Intelligent Vehicle Highway Systems (IVHS). In what follows we use the abbreviation TT (for Transport Telematics).

1.3. Methodology

As shown in figure 1.1., the study can be broadly broken down into the following stages :

Figure 1.1.

Schedule for the Joint ECMT/ERTICO Project on Institutional and Legal Issues



0. Preliminary stage : Identification of TT functions which can be performed by individual systems.

1. Preparation of basic TT "implementation models", based on the following "key" TT technologies :
    broadcast subcarriers ;
    cellular mobile radio ;
    dedicated short-range communications (DSRC) based on the use of beacons.

These models[39] provided the required common bases for the institutional / legal / contractual analysis, and include definitions of the services supported, the information needed to support system operation, the information to be transmitted by the system, and other related aspects. The models will be constructed on the basis of information provided by the relevant suppliers (ERTICO members - Industry Sector).

2. On the basis of the above, institutional / legal / contractual implications and requirements, together with current solutions, have been identified and assembled into a framework. This phase was carried out in close co-operation with the ECMT TCT[40] group.

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[39] See sections 4, 5 and 6 of chapter 5.

[40] Ad hoc Group on Transport, Computers and Telecommunications.

3. The institutional I legal I contractual framework was used to gauge the reactions of the relevant administrative authorities (at both national and regional / local level), and at the same time of operators (of road and/or communications infrastructure) and equipment manufacturers.

4. Lastly, the responses were analysed and incorporated into the Tool Box and this Explanatory Guide, which set out the institutional / legal constraints, assess their influence on the choice of technologies and services to be implemented and identify possible solutions and the need for further action.

1.4. Contents of this guide

While in the Tool Box we propose the basic elements for sound contractual negotiations between the public sector (infrastructure managers) and the private sector (service operators), in the Explanatory Guide we limited ourselves to the technical aspects which shed light on the issues involved in preparation of the institutional environment. Issues relating to preparation of the technical environment are dealt with in more detail by the Task Forces set up by the TCT group, ERTICO, DRIVE and standardisation bodies (CEN, CENELEC, ISO). The main technical issues that will be discussed are as follows :

-- from the standpoint of dynamic infrastructure management :
  - plotting the position of vehicles ;
  - vocabulary of road information and the structure of driver messages ;
  - data exchanges between infrastructure managers ;
  - rules governing the administration of distributed data bases for use in real-time systems.

-- from the standpoint of the commercial operation :
  - standardisation of ground to mobile communications systems ;
  - man-machine interface (driver).

Furthermore, we have limited our discussion to the institutional issues relating to commercial operation of the new services made possible by the development of ground-to-vehicle communications technology. Our analysis does not deal with the management of travel demand nor with the collection of tolls or taxes by means of this new technology, nor with issues relating to personal privacy. Collaboration between public bodies is only dealt with in cases where it is a prerequisite for efficient operation of the TT systems[41] in question. In other words, our analysis is limited to the institutional, contractual and technical issues directly relating to the provision of driver information and route guidance services by actors from the private sector.

The basic document in this analysis is the Tool Box, which this Explanatory Guide accompanies. It is aimed at providing the various actors and professional bodies (authorities, corporate managers, engineers and lawyers) with the information they need to gain a proper understanding of the issues involved in operating TT systems on a commercial basis, and at helping them to formulate their response to TT systems with regard to both the practicalities of such ventures and the potential benefits and feasibility of applying the legal / regulatory and contractual arrangements proposed in the Tool Box.

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[41] The term "TT system” in this document is used to refer to facilities based on a given technology which allow a series of functions to be performed.

Following this introduction, chapter 2 reviews both the issues and risks, based on the main points raised in the report by the ECMT TCT group, that public authorities and private operators must take into consideration. This is followed by a description (chapter 3) of the new problems of road infrastructure management which are raised by the introduction of computer and telecommunications technologies. chapter 4 describes the systems approach as it is gradually emerging from the DRIVE/CORD and PROMETHEUS programmes, and chapter 5 the technical and operational aspects of TT systems based on the principal communications technologies currently available (radio subcarriers, cellular telephony and beacon-based short-range communications systems), set out in a report by ERTICO on the findings of a survey of its Members [3]. Lastly chapter 6 reviews the institutional aspects of TT systems in the form of an analysis of the various types of contract that might be used to formalise relations, and also to spread risks, between the various actors involved.

2. The issues at stake

2.1. Challenges and risks for the community as a whole

The development [2] of new driver information / route guidance technologies means that within a few years drivers will be able to receive direct in-car information on traffic conditions and incident warnings. Display screens and digital road maps will also allow such systems to be used for navigation by making it possible to locate vehicles, plan / optimise journeys and guide vehicles to their destination by offering advice and directions to drivers. Chapter 5 gives a brief description of the route guidance systems based on the three main technologies now being developed.

The use of such technologies is expected to lead to a marked improvement in road safety and traffic fluidity, while at the same time helping to protect the environment by reducing the energy consumption and wastage associated with infrastructure congestion.

These new technologies, in particular the advanced route guidance and driver information systems, are no longer simply a distant prospect. We shall soon be seeing the initial commercial applications, as shown by example of a service which has been operating commercially in the United Kingdom for three years and the recent creation of a traffic information company by German enterprises, projects for the general introduction of remote automated toll-debiting systems, and the route guidance experiments in the development or planning stage in various European cities. Recommendations have already been made to introduce these systems in the relatively near future and detailed plans are now being drawn up.

Given the increasing number of initiatives by electronics manufacturers, car and equipment manufacturers, infrastructure operators and communications firms, there is a very real danger that failure by the public authorities to take swift and co-ordinated action to resolve the administrative and legal problems surrounding these new information systems may well lead to the creation of a patchwork of different systems throughout Europe operating under a variety of institutional arrangements differing radically from one country to another.

Since on-board equipment is sold directly by the manufacturers, it is highly likely that - notwithstanding the standardisation work done by the CEN - the lack of government intervention will mean that the road traffic information disseminated by advanced telematics systems will be confined within national boundaries - owing to incompatible equipment - and the geographical range of such systems will be very limited. The recent example of analogue radiotelephones gives some idea of what might happen in Europe with the new information/guidance services if governments were to decide against ensuring at least basic compatibility, particularly where legal requirements are concerned. Conversely, the example of digital radiotelephones (GSM) shows that a minimum agreement between operators on a common standard permits the rapid development of service supply.

The lack of harmonisation with respect to the various systems is not exclusively an international problem. It may also be a national one. If local initiatives in this sphere - backed to some extent by the manufacturers - are allowed to proliferate with no form of control, a whole series of “islands” may well develop in Europe, each with its own driver information / route guidance system. Since they will be incompatible, these systems are bound to be expensive as well as inefficient.

Given this possibility - together with the fact that it would be inconceivable for vehicles to carry the full range of equipment and aerials needed to ensure that information may be received from any system - it would seem essential for the public authorities to act at European level if the new driver information / route guidance systems developed either nationally or locally within individual States are to be interoperable[42] from both the technical and operational standpoints.

Intervention is warranted on financial grounds in particular if wastage is to be prevented. Governments have already poured large sums of money into programmes such as DRIVE and EUREKA to establish a pan-European system ; all this will have been to no avail if trial operations are allowed to develop almost everywhere and do not have Europe-wide scope.

The financial implications are considerable. The pan-European market for on-board equipment alone is estimated at ECU 5 billion up to the year 2000 and ECU 50 billion by 2020. The market for infrastructure computer equipment over the next 20 years is estimated at ECU 8 billion for motorways and ECU 4 billion for urban roads. The services in operation after the year 2000 are thus expected to generate an annual turnover of some ECU 30 billion.

Another risk involved in any extreme compartmentalisation of information systems in European countries is that the cost of the equipment might well remain very high because industry would be unable to mass-produce products under such conditions. European manufacturers would have to compete with imports from other countries which, like the United States and Japan, have managed to develop systems on a huge scale.

The potential adverse consequences of developing incompatible route guidance / driver information systems within Europe are so great that the Commission of the European Union devoted several passages to the issue in two of its recent White Papers on “The Future Development of the Common Transport Policy” and “The growth initiative” of December 1993. Given the need to ensure the interconnection of intermodal systems and the interoperability of mobile equipment, in the first of these documents the Commission unhesitatingly assigns priority to technical harmonisation in the telematics sector. It makes the following points: “appropriate compatible information systems must be developed . . action may be needed to ensure that (traffic management) systems are compatible . . . Technical harmonisation, essential to the interoperability of systems throughout the Community and affecting the output of its equipment industries, necessarily requires action . . . It makes sense to find new common solutions and develop common specifications through co-operation at Community and even broader European levels. Risks can be shared and economies of scale are likely to be achieved if assistance is given to the development of new systems requiring heavy “up-front” investment. The industrial implications of such activities are accordingly considerable . . . Compatibility, interconnection and interoperability should be key criteria.”

To obviate these risks, it would therefore be advisable to endeavour to ensure that route guidance / driver information systems in Europe are interoperable and that the legal and administrative problems connected with the introduction of these systems are resolved consistently.

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[42] See chapter 4 for an attempt to define interoperability.

2.2. Challenges and risks for firms and TT system operators

The introduction of TT systems used to supply new services to drivers does entail some degree of risk for the firms which intend to operate them.

Apart from the purely commercial risks that all firms face in seeking to gain entry to a given market, there are four other risks, all related with one another, which are particularly critical in the case of TT systems and which are examined below. Furthermore, the nature of these risks is such that the systems themselves should not be considered to be mutually independent in that :

- if the first system introduced onto the market proves to be a failure, the resultant general loss of credibility may completely jeopardise the chances of success of competing systems ;
- if the first system introduced on the market proves to be a success, it may pave the way for other systems by allowing greater differentiation as the volume of the market grows ;
- if the market reaches maturity, the most likely candidate for success will be a Universal Vehicle Information System (UVIS)[43] combining a variety of different technologies.

2.2.1. The technical risk

The technical risk is directly related to the development potential of the technology concerned as compared with that of competing technologies.

Consequently, any one of the three of the main technological principles[44] may ultimately prove to be successful :

Radio sub carrier technology may be able to :

- increase its potential capacity through the introduction of Digital Audio Broadcasting (DAB) ;
- improve the quality of its geographical coverage by using different transmitters, each dedicated to a given area within each regional unit.

Cellular radio telephony offers the possibility of :

- greater capacity ;
- plotting the position of vehicles through triangulation, thus allowing tailored information to be transmitted to individual vehicles.

Beacon-based systems offer the possibility of :

- increasing geographical coverage through a broadening of the service base ;
- at the same time, finer geographical coverage.

2.2.2. *The marketing risk*

This risk is directly linked to the "mix"[45] of services that can be provided by means of the technology considered, as well as the novelty of such services ; it would therefore be fair to say that :

- the use of radio sub carriers is an extension to the radio broadcasting service ;

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[43] See chapter 4.

[44] See chapter 5.

[45] That is to say various functions put together into a marketable “package”.

dynamic guidance systems are either an extension to the service provided by digital cellular networks or, as in the case of beacon-based systems, completely new kinds of service.

In the first two cases, channels for distributing information already exist ; in the third case, channels will need to be found. Each of the two alternatives therefore has both advantages and disadvantages, depending upon the interest that existing distributors[46] take in the new services provided.

2.2.3. The economic risk

This risk is directly related to the dependency of the operator on other actors in the value-added chain of which he is part, i.e. the operational risk, and obviously to the size of the capital investment that will need to be made to gain entry to the "business", i.e. the capital risk[47].

2.2.4. The risk of obsolescence

This risk can perhaps be viewed as an amalgam of the previous three types of risk and consists in the fact that the system installed might rapidly become obsolescent. For a firm, this would raise the threat of being unable to recover the initial capital investment (economic risk) before a new technology (technical risk) is introduced, thus making it impossible for the firm to achieve its market share objective because new customers simply turn to the new and more comprehensive supply of services (marketing risk).

2.2.5. The political risk

Lastly there is a risk which we might tend to forget to take into consideration in our advanced democracies - the political risk. It is however very present in the minds of service operators insofar as the payback time on the investment in systems installed will in a certain number of cases be longer than the lifetime of a municipal government. The fact is that a change in the political majority of a local authority which is the partner of a "public data provider" could lead to a decision which threatens the financial equilibrium of the private operator. Such a situation is all the more worrying as it is not improbable and, since it does not really constitute a unilateral breach of contract (to the extent that other local authorities respect their engagements) the resolution of the difficulty threatens to be particularly difficult.

These considerations regarding the risks run by operators are central to the debate on legal and institutional aspects of driver information / route guidance systems. The way in which operators cover themselves against such risks will play a determining role in the development of information technologies in the transport sector.

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[46] Information can be supplied through a variety of complementary channels. In addition, a distinction needs to be made between the installation of equipment and the sale of subscriptions and/or cards providing access to the service.

[47] The TT service operator will wish to cover this risk through an exclusivity clause and longer contract periods.

2.3. The problems to be resolved

The first step in promoting the development of interoperable systems in Europe is to consider the institutional framework in which these systems are to operate, so as to identify possible stumbling blocks. These fall into two categories. First, there may be legislation that prohibits or unduly restricts specific actions or procedures which are nevertheless required in order to use the new guidance techniques. Second, the lack of regulations may on the contrary mean that, because the legal concepts are inadequately defined, partnerships cannot be set up with anyone outside the existing system in which the public authorities have a say everywhere, whether it be in road traffic management or telecommunications.

ECMT surveys were carried out in 1992 and 1994 to take stock of the situation in the various Member countries. They show that the chief obstacles to the harmonious development of driver information / route guidance systems in Europe at present are of either an institutional / legal or technical nature.

2.3.1. Institutional and/or legal obstacles

- The first legal obstacle concerns the lack of common definitions, since some terms apparently vary in meaning from country to country. Moreover, certain legal concepts crucial to the development of the new systems are vague or have not been defined at all. Examples include route guidance and road traffic information, whose legal content is rarely defined in detail in any existing legislation.

- The second obstacle concerns administrative dysfunctions, which are quite substantial in many cases but have no impact on the fundamental balance of powers, a case in point being the fragmentation of responsibility for traffic and information within central government. Departments dealing with these matters - often with very little co-ordination - include road traffic departments (road authorities and the police), telecommunications authorities, radio and television authorities and those safeguarding personal privacy. Most in need of harmonisation are the services responsible for traffic, so the central government could have a simple approach to dealings with the many public authorities with powers to regulate traffic.

- The third institutional obstacle is more sensitive in that it concerns the balance of powers among autonomous public authorities and affects certain traditional freedoms. Although information systems might be used in all kinds of geographical areas, two main categories are likely to account for the greatest share of the market, namely major traffic corridors and daily traffic in major urban areas.

Major traffic corridors generally consist of national highways and motorways. These come under central government authority, even in countries like Germany or Belgium which delegate responsibility to the major decentralised authorities (e.g. Land, Province). All that is required, therefore is to determine which government department is to be in charge of the system and then to give it the powers it needs to introduce it, including the power to enter into contracts with the private sector. A serious problem may arise, however, if the routes needed to operate the main network on a satisfactory basis are administered by other authorities. It is apparently impossible, except under exceptional circumstances, for the government of any country to force an authority to participate in a scheme of this kind.

The problem arising in urban areas, particularly large cities, is even more complex. France has a vast number of communes, but the largest urban area of all, Greater London (UK), has 33 local councils, each of which acts as a road transport authority, together with the Ministry of Transport which is in charge of the area's 340 km of major roads. The situation is the same in every city with over one million inhabitants.

A study of the situation in each country clearly shows that road transport authorities everywhere are free to authorise or prohibit the installation of fixed roadside equipment (beacons or terminals) in their area of jurisdiction, to choose which roads are to be included in the system and to communicate any information they have compiled at their own expense. It is also clear that if all these authorities enter into an agreement, there is nothing to prevent one of them from withdrawing, thereby jeopardising the future of the whole scheme. This problem can only be overcome by legislation or by very carefully worded contracts which lay down requirements for the choice of network, co-operation among authorities (including withdrawal from a joint scheme) and basic specifications.

- The last of these legal / institutional dificulties concerns relations between public authorities and operators. Road traffic information is a sphere in which there is not always a clear distinction between special prerogatives and economic activity, and this may prevent open competition. It is not easy to see how operators can be given total freedom if at least a minimum level of service is to be provided and if the problem of responsibility / liability is to be resolved, since no real solution has been found so far owing to the uncertainty of the present situation. To ensure that the regulatory powers are clearly separated from the industrial activity, the legal relationship between public authorities and operators must be defined in precise terms and rules established to determine the way in which responsibility / liability is to be allocated among all the actors contributing to the information chain.

2.3.2. Technical obstacles

Even if choices have been made as to operating areas, roads to be included in the system and the allocation of responsibilities and powers to enter into contracts, the problem has not necessarily been resolved. The various systems have to be compatible throughout Europe.

Compatibility[48] is a problem that concerns both infrastructure and vehicles. There are no really clear ideas on the best way of achieving it.

Most countries feel that it would be premature to draw up detailed regulations on purely technical matters. They would prefer to establish a legal framework to monitor initiatives without too much prior regulation, and therefore recommend that a simple "code of practice" be drawn up for on-board equipment and its use.

It might appear desirable to seek a single technical architecture for all traffic management and personalised driver information systems in Europe. However, this would in fact be neither realistic (it is very likely that at best the technologies would be obsolete and at the worst foreign supply would have satisfied the needs before agreement had been reached), nor desirable (we would rapidly be obliged to choose between a common system of acceptable cost but with limited potential and not satisfying demand, and a common system satisfying demand but economically unmanageable because of its complexity).

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[48] See chapter 4 for an attempt to define compatibility.

It nevertheless appears necessary that the four technical preconditions outlined above be fulfilled by road infrastructure managers:

- a common vehicle tracking system,
- a common data dictionary and message structure,
- a common data exchange protocol,
- a coherent distributed databank management system wherever real-time management is necessary.

Indeed, it is the creation of this kind of technical environment which will provide the requisite basis at European level for significant economies of scale to be achieved with regard to both the development of digital cards for users of services and the manufacturing and marketing of m-vehicle equipment.

A common vehicle position monitoring system is needed to allow the same system to be used for vehicle tracking and navigation from one country to another. CEN TC 278 WG7 is currently investigating this area and is working towards achieving a compromise between the two systems proposed for Europe, namely :

- GDF (Geographical Data File) ;
- RDS/TMC tracking code.

The above systems still need to be harmonised with systems that infrastructure managers have developed for their own requirements (construction work and maintenance).

A common data dictionary and message structure are needed to allow information conveyed by the system in digital form to be translated into the language used by the driver (synthesised voice data or alphanumeric messages). This area is to be addressed by CEN TC 278 WG8. There are currently two message lists (one drawn up by the European Broadcasting Union, and the ALERT-C list approved by ECMT in May 1991) and 4 data dictionaries already under development.

A joint administrative structure for managing databases is needed to ensure that data can be exchanged between infrastructure managers and TT system operators under real-time conditions. In its most basic form such a structure might take the form of an organisational template which would allow the interconnection (distributed databases) of different systems. Much progress still remains to be made if this objective, which to date seems to have received somewhat cursory attention, is to be achieved.

A common data exchange protocol is needed to operate shared databases utilising distributed data. A protocol of this kind has been developed under the STRADA programme.

Meeting the above conditions will also help to ensure the transparency of the different systems as far as the driver is concerned.

It should be noted, however, that the introduction and deployment of these shared instruments may make it necessary for existing tools to be either scrapped or at best redesigned (geographical data systems, road information data banks, transmission networks). Such a development would have significant financial implications, which raises the question of whether it might not be better to develop interfaces (bridges) that would allow the systems currently most commonly in use to communicate with each other. Falling computer prices and recent advances in software engineering would seem to indicate that this option should be given further consideration.

There are also other conditions which need to be addressed and met directly by industry (i.e. are firms prepared to agree amongst themselves to lay the foundations for a vast market, or would they prefer to segment the market in order to reduce competition ?), namely :

- standardisation of ground-to-vehicle communications (so that the same in-vehicle equipment can be used throughout the European network), which is not the same thing as the standardisation of services (which depends upon agreement being reached between the operators of systems) ;
- standardisation of man-machine interfaces, not only for safety reasons but also, and above all, to make the equipment easier to use.

As indicated in chapter 1, the above considerations are merely mentioned in passing in the present document, which is more concerned with those institutional aspects which have a direct impact on the commercial development of driver information and route guidance services supplied by TT system operators. Considerations relating to automatic toll charging are also only mentioned in passing.

2.4. Solutions

If we are to ensure that driver information / route guidance systems are interoperable, it will clearly be necessary to make technical choices, but these do not - initially at least - come within the province of Ministers of Transport, who must await the findings of the specialised studies now in hand such as those being carried out under the DRIVE programme. No proposals will therefore be put to the Council of Ministers regarding specific action in this area.

As matters now stand, however, Ministers of Transport will have to take decisions on a number of basic requirements to be met by the systems developed with a view of ensuring that they are interoperable and overcoming the legal an administrative obstacles to this. While specific legislation would make it possible to clarify the legal environment, this does not appear indispensable insofar as the Ministers have jointly agreed on the definition of the essential requirements which had to appear in the contracts governed by existing laws (except in certain cases like the legal definitions of road information and the associated services which appear necessary).

These requirements relate to :

2.4.1. Establishment of a common definition of route guidance and driver information

Some countries have already attempted to produce precise definitions of these terms, which must be defined in law before new systems providing route guidance and driver information services can be introduced. The UK Road Transport Act (1989) contains an explicit definition of road traffic information systems. Similarly, draft legislation concerning road use and road traffic information now under consideration in France gives a definition of road traffic information. Both texts also indicate the legal conditions (contracts, agreements, licences) governing the activities of operators.

To ensure that systems are interoperable within Europe, the Council of Ministers adopted, on 27 May 1993, a resolution to promote work to establish a common legal definition of route guidance and road traffic information and on 27 May 1994 a global resolution on the applications of the new information and telecommunications technologies in the transport sector. It would also be advisable to submit for official approval at international level a single multilingual glossary based on work done or still in hand in various fora (DRIVE, CEN, PIARC, etc...).

2.4.2. Co-operation among the services concerned

In each country, the first step should be to set up a permanent forum for the various government services involved, including road traffic authorities (highway managers and police), telecommunications, radio and television authorities, the authority responsible for safeguarding personal privacy, etc...

Each country should also introduce legislation or a contractual system governing road traffic, driver information and route guidance, and relations between central and local government and among the various local authorities concerned. If the geographical scope of the new guidance / information systems is to be broadened, effective co-operation is called for among the authorities concerned. However, there is at present no means of obliging a local authority to grant an operating permit - or even to provide information - if it does not wish to do so. A change of attitude or a refusal on the part of a single local authority can throw the future of any scheme into question. The problem is particularly acute for non-autonomous guidance systems which need to make some use of public property, since existing legislation does not usually make provision for a local authority to be obliged to accept the installation of fixed roadside equipment (e.g. beacons or terminals) or to make its network available. While the problem does not really arise in major traffic corridors where the highways are the property of central government, it is of crucial importance in built-up areas administered by more than one local authority. Wherever there is more than one authority running an information / guidance system (several municipalities, for example), the system should provide for decisions to be made by qualified majority in order to force recalcitrant authorities to participate in the system without the need for central government intervention.

At international level, means of co-operation should be developed among the various public authorities with responsibility in this sphere. This is essential if driver information / route guidance systems are to be interoperable.

It is therefore necessary for relations between the various public authorities involved in route guidance and driver information systems to be clearly defined in law. Any legal arrangements set up to achieve this at national level should in particular set out the means of co-operation among :

- the various central government services involved ;
- the various public authorities concerned (national, regional, provincial, local, etc...).

At international level, the EU and the ECMT should request that means of co-operation be rapidly developed, through international regulations if necessary, among the public authorities concerned to ensure that information systems, and hence networks, are interoperable. To facilitate such co-operation, they should first promote exchanges of information with regard to the bodies, and the respective responsibilities of such bodies, involved in driver information and route guidance at national level.

2.4.3. Definition of services to be provided

Road safety requirements in particular will make it very difficult for government authorities to avoid specifying what is required as the minimum basic service to be supplied by information / guidance systems run by private and public operators.

Specifications for the range of services to be provided should relate to kinds of service and to their level and quality.

As regards the various kinds of service, a distinction should be made between what is covered by traffic management - the only area to come under government authority - and what concerns route or traffic information.

As for service quality, the legal instruments used (contracts, agreements, licences, permits, etc...) and the specifications laid down by public authorities to govern the activities of operators of new information systems will necessarily include requirements relating to standards of service, message format and frequency, multilingual presentation, possible monitoring of information, etc. . To ensure that systems are interoperable, comparable requirements should be adopted in each country.

The Council of Ministers decided to promote the establishment of common criteria for determining the basic services to be provided by route guidance / driver information systems. The criteria should relate to both the kinds of service and the quality of the information disseminated in this way.

2.4.4. Allocation of powers and responsibilities

The introduction of route guidance systems calls for a whole chain of activities relating to the production and dissemination of information[49] activities which involve public authorities, operators (public or private) and users, and which call for specific rules, particularly with regard to service quality, so that the breakdown of responsibilities is clearly established. These rules should be drawn up under at least some degree of government control. It is up to the public authorities to organise the allocation of powers and the delegation of public service activities required for the operation of route guidance / driver information systems.

Within the process of producing and disseminating information there is a hard core of activities that clearly fall within the category of public service, since the public authorities are responsible for traffic and safety in every country.

All information / route guidance systems are based on the gathering and transmission of quality-controlled data, most of which can only be produced by a public service. In some cases, public-service responsibilities may be delegated, provided that there are contractual rules setting out operators' rights and obligations, particularly with regard to data collection, the quality of transmission / dissemination, frequency of transmission and the quality of the information itself.

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[49] See the Tool Box, figure 1 and chapter 4 figures below.

One particular problem that the contractual rules must resolve is that of recovering the cost of data collection. As a general rule, data are compiled by public authorities. It would seem appropriate for governments to set out in these rules the pricing arrangements for data transmitted to operators, data that will subsequently be incorporated in the services sold by these operators to users. Where appropriate, the rules should also make quite clear the extent to which those who compile the information may retain some control over the form in which it is disseminated.

Similarly, it would seem essential that the contractual arrangements should make provision for control of the data to revert to the public authorities so that, in the event of an emergency, for instance, they can decide what information may be disclosed. A basic set of common, internationally applicable rules is required to establish these contractual arrangements ; here, too, if systems are to be interoperable throughout Europe, it is necessary for governments to allocate responsibilities. Common rules have to be established for gathering, exchanging and transmitting data, since, as matters now stand in many countries, there is no standard procedure for data gathering, information is processed according to individual needs, and messages likewise differ in form. In the longer term, it would therefore seem that international regulations might be required in certain cases to govern the relations between public authorities and the operators of road traffic information systems.

The time has now come to promote the establishment of common rules for compiling, exchanging and transmitting traffic data so as to ensure that driver information / route guidance systems in Europe are interoperable, and to encourage work to establish at least basic international rules governing relations between the public authorities and operators of the new information systems, and to determine common rules for the allocation of responsibilities among all the participants in the information chain.

2.4.5. Protection of personal privacy

A major problem in connection with the use of telematics in the new route guidance / driver information systems is associated with vehicle identification. One particularly sensitive aspect is that of safeguarding personal privacy when using traffic regulation systems in which all vehicles in a given area can be identified and monitored. Potential violations of the freedom of the individual are a key problem in the debate on automated data-transmission systems. Vehicle monitoring can certainly be seen as an intrusion into the private life of drivers.

Furthermore, when automated data transmissions systems are associated with automatic debiting systems, the question inevitably arises of the right to institute legal proceedings. If a driver goes through an automated toll collection system without paying, for instance, is the operator legally entitled to photograph the vehicle and its registration plate in order to prosecute the driver for non-payment of the toll ? New legislation or regulations should therefore be introduced to resolve these issues since they might otherwise impose serious constraints on the new route guidance / driver information systems - an eloquent example being the automated urban toll system introduced in Hong Kong some years ago which failed for precisely that reason.

Technical means of overcoming these difficulties are being developed and, with a view to ensuring that transport systems are interoperable, a consensus should rapidly be sought at European level on such sensitive issues as the automatic identification of vehicles, automatic police controls, on-board recording devices, etc.. .

Since it is essential to safeguard personal privacy, the Council of Ministers may wish to commission legal studies concerning confidentiality with a view to establishing a basic body of common legislation to ensure such privacy and the right to institute legal proceedings.

2.5. Actions to be taken

As regards technical standardisation, efforts should be concentrated on :

- on-board equipment which can be used throughout Europe. This implies :
  1. a common vehicle tracking system,
  2. a common data dictionary and message structure,
  3. ground-vehicle communications protocols accepted by all ;

- traffic management systems adapted to each situation but capable of communicating with one another to guarantee continuity of service. Depending on the desired degree of interoperability this implies :
  4. accepted common procedures (for minimum cooperation),
  5. a common data exchange protocol,
  6. a coherent distributed databank management system (for the integration of operations).

For the best economic efficiency it may be necessary to satisfy all six criteria, but this should suffice if it is accepted that continuity of service does not mean uniformity of the services supplied[50].

In practical terms, there is clearly a fairly urgent need now to be able to test in the field the solutions proposed to ensure that the route guidance / driver information systems developed in Europe are interoperable, the aim being to see whether, in practice, the systems meet the basic requirements set out above.

In order to provide a practical and progressive response to the legal and administrative problems arising in connection with the introduction of the new driver information / route guidance services, it is of the utmost importance to give support to the experiments scheduled to start this year on a few international routes in the trans-European network, as defined in particular by the European Union or the UN/ECE.

The lack of previous work in this area makes it necessary to have some kind of preliminary institutional / legal framework to use as a basis for future work. This is the aim of the Tool Box associated with this Guide. The next stage will be to carry out full-scale field trials which will then be assessed with a view to developing Europe-wide means of ensuring that systems are interoperable. The final stage will consist in drawing up a master plan for road traffic information.

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[50] In fact there is often confusion between continuity of service (receiving road information everywhere), transparency of the on-board system (being able to use it anywhere where a service exists), network interconnection (being able to go anywhere) and system interoperability (the way in which operators of a given type of service cooperate to achieve these objectives). This by no means obliges service suppliers to give the same information throughout the territory and to all have the same method of management, criteria 4, 5 and 6 being applied as a function of the degree of cooperation necessary.

3. A new approach to road infrastructure management”

All the missions of the public authorities and their relations with private service providers are described, from the institutional standpoint, in chapter 6 below, which also identifies the different actors likely to participate in public service missions and supply services to the end user. The Tool Box proposes aids to facilitate the management of relations between these actors.

In this chapter we deal more particularly with the technical aspects of the public service missions, the conditions under which action will be taken and the new technical framework within which the information and telecommunications technologies described in chapter 5 will be implemented to supply personalised services to the user in real time. We also examine what makes the content of these missions evolve under pressure from two sources, the users, who want more personalised services and are not prepared to wait any longer, and technical innovation, which provides the tools that make it possible to respond to user needs. A new approach is therefore required to meet the new public service challenges represented by :

- individualisation,

and

- real-time.

3.1. User needs

The needs of the final user can be split into two segments according to whether they are connected with :

-- the object of the trip : mobility,

-- the conditions of the trip : convenience[52]

The user’s needs change over time and depend on where they are expressed (country, region, etc...) as a function of the economic and social level to which he is accustomed and his personal characteristics.

The first need to satisfy is that for the free availability of an infrastructure or a transport system which facilitates the mobility of goods and persons, a mobility which was difficult or even impossible to permit earlier. Once these facilities have existed for a certain time the user begins to ask for more, such as guaranteed availability of the infrastructure or the system, greater ease of travel, improved safety and more comfort.

The level of satisfaction of these needs (for products and/or services), very closely linked to the supply comprised of the installations, services and their operations, will give the measure of how good the available mobility is in terms of quality (convenience, safety and comfort).

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[51] This chapter is based largely on work carried out by ERTICO for the TELTEN project in the framework of the MAGIC working party set up by the Commission of the European Union.

[52] "Commodite" in French.

3.1.1. Mobility : accessibility and availability

Mobility can be regarded as the combination of accessibility, permitting people to have the maximum of contacts with the minimum of effort, and the availability of transport installations permitting travellers to go anywhere, any time. Mobility can be measured by the number of trips per person per day and the number of kilometres covered.

3.1.1.1. Accessibility

Accessibility applies to the proximity of one economic and/or social activity with respect to another and may be measured by the distance, road density per square kilometre, transport time and transport cost. Accessibility is thus a function of both the spatial distribution of activities and the transport system serving them.

Greater accessibility is achieved by building new roads permitting more places than before to be reached. Road signs and signals help to improve accessibility.

3.1.1.2. Availability

Availability refers to the ease with which individuals can travel. An available transport mode is one which permits people to travel in all freedom because the duration and cost of the trip are modest and there are many options open for making it. Availability can be measured indirectly by means of car ownership rates, the length of public transport lines per square kilometre or the cost per kilometre travelled.

Improved availability can be achieved either by increasing the road capacity or by improved the management of existing roads.

3.1.2. Convenience : comfort and safety

Accessibility and availability are directly connected with the concept of transport, but now drivers when they are on the road or motorway (and particularly when it is a toll motorway) want a good average speed in fluid traffic flow conditions and access to assistance services as well as the provision of rest areas and catering facilities.

3.1.2.1. Comfort

Comfort may be understood as the individual need par excellence. As stated above, it appears once the basic needs for mobility have been satisfied. Comfort comprises the travel conditions which make it easy and enjoyable for the driver. These conditions may include trip preparation, traffic conditions, the attractiveness of the countryside along the route, the availability of roadside services such as restaurants and rest areas, and lastly the possibility of booking a hotel.

3.1.2.2. Safety

Safety is the most complex field and it has two dimensions :

- the individual dimension of the driver's sensation during the trip, which is directly connected with the concept of comfort,
- the collective dimension of the social cost of accidents and deaths.

The two dimensions are not independent. If the design of the road gives the driver an impression of comfort he may increase his speed and travel more dangerously. On the other hand, comfort reduces stress and from this standpoint reduces the probability of accident.

3.1.3. Individual and collective needs

The collective need is the aggregate of a set of individual needs, including those of people who are not road users. Hence the expression of this need is manifested on the one hand by demands for the global improvement of transport system efficiency, while on the other hand it is also the expression of those who suffer from the environmental impact of road infrastructures and call for the limitation of their use and oppose the construction of new ones. This second aspect of collective need may be interpreted as a constraint / limitation imposed on the road transport system, whereas the first is directly connected with the raison d'etre of this system and must be understood as an objective by infrastructure managers.

3.2. A new approach for new needs

It is therefore necessary to take a fresh look at the public service missions connected with infrastructure use in the light of these tendencies. However, the operating conditions of roads and motorways are particularly dependent on the nature of the traffic and the environment (geographical, climatic, economic) of the particular infrastructure.

The organisation of services thus needs to be rethought as a function of :

- the missions of infrastructure managers,
- operating conditions,

with a view to increasing the provision of personalised services for drivers under competitive economic conditions.

Infrastructure managers originally managed road to satisfy collective needs. Their obligation was to make roads in good repair available to users. However, they have recently come to be faced with two parallel evolutions :

- First, the growing number of situations in which it is necessary to manage traffic in real time in order to be able to control congestion as effectively as possible (obligation to intervene in the case of incident to make the situation evolve favourably, whereas before it was simply necessary to repair the damage),

- Second, the transition from a transport concept to a service concept, which means considering the driver not only as a citizen, but also as a client, which implies more individualised relations between the managers and the driver users[53].

In what follows we examine, in the light of these changes, the missions of infrastructure managers and the conditions in which they operate, so that the actors (public authorities, infrastructure managers, TT system service operators) can well understand the functions they will have to share.

3.2.1. The missions

The missions of infrastructure managers may be summed up very simply : “to serve the greatest number of users and provide them with the best level of service they may desire”. In order to fulfil their mission, managers must on the one hand provide an infrastructure all of whose permanent characteristics (geometry, pavement, etc.. .) make it possible to carry different traffics[54], and on the other provide all the installations, services and structures essential for operating the infrastructure and meeting the travel assistance needs expressed by users[55]. Under the pressure of both the evolution in traffic conditions (demand) and the available technologies (resources), this leads to the identification of three missions, with their corresponding services, which have to be fulfilled by infrastructure managers in order to satisfy users’ needs :

- two missions to guarantee mobility :
  - ensure that the road is in good repair (1)
  - manage traffic flows (2)

and

- one mission :
  - assist drivers (3)

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[53] It may be considered that the user is the client of a public service. The difference with respect to a client for a private service is that in certain exceptional service management conditions his personal interest has to be subordinated to the general interest ; but in normal circumstances he should be treated as a client, something which is unfortunately all too often forgotten (see chapter 6).

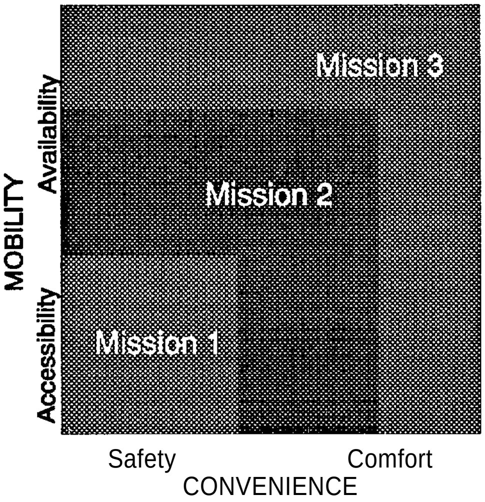
[54] At European level, the START group is bringing answers to these questions.

[55] At European level, the MAGIC group is bringing answers to these questions.

These missions have a collective dimension (very marked in the case of the first two) and an individual one (very marked in the case of the thud), and the growing importance of this second dimension is the new condition to with public services have to adapt. The contribution of the three missions to satisfying the individual needs of drivers is shown schematically in figure 3.1.

Figure 3.1.

The missions of infrastructure managers



As we are using a systems approach, it would appear useful here to look at the situation from two standpoints :

The external standpoint considers the system's contribution to (impact on) its environment. This contribution is imposed by the world outside the system. From the standpoint of infrastructure managers it can be considered a constraint defined by social demand, the main components of which are road safety, environmental protection and efficiency (preventing or reducing congestion) ;

The internal standpoint considers the way in which the system fulfils its mission. This mission is defined by the demand for services addressed to the system. From the standpoint of infrastructure managers it can be considered as the objective to be achieved, i.e. ensuring mobility (the physical and economic accessibility and availability of infrastructures) under the most convenient conditions (safety and individual comfort) and making the best use of the resources available.

Safety is thus a permanent and dual element in the system. Integrating it in a specific mission (for example "mission (1), ensuring road quality and safety") appears to give it weight, but it is in fact a reductive approach and we prefer to make it on the one hand a collective and external requirement, and on the other an internal individual service objective.

Lastly, while a few years ago infrastructure managers had only one mission, that of keeping the road open and safe by ensuring its quality, they now also have to manage traffic and assist drivers. This third mission is in fact an amalgam of the two others insofar as on the one hand traffic management is intended to improve the efficiency of existing infrastructures and on the other it helps improve the driver's comfort by improving fluidity and informing him of traffic conditions. Lastly, the traffic flow management mission provides the raw data and information necessary for the production of personalised services such as dynamic guidance.

3.2.1.1. Ensuring mobility and convenience from the collective standpoint)

a) Ensuring road quality

Ensuring road quality (mission (1) consists of maintaining infrastructures and keeping communications open regardless of events (incidents / accidents or adverse weather conditions). This mission is the longest standing for infrastructure managers and to fulfil it they have traditionally been organised on a territorial basis.

Ensuring road quality involves three type of task for infrastructure managers :

- "administrative" management for the award of contracts and concessions for road advertising and installations. It is of great importance because it gives control over visibility and safety conditions along the roads for which they are responsible ;

- management of road works to repair when necessary and to forestall as far as possible any event having negative consequences for road holding. It is of great importance because it has an impact on traffic and hence on service quality. For proper maintenance, i.e. for proper care of the carriageway, safety barriers, sign boards, emergency telephones, toll booths, etc..., it is necessary to determine :
    - the place where action is required,
    - the best time to act,
    - the method,
    - the cost ;

- management of incidents, to channel traffic and clear the road when necessary and to keep to a minimum the resulting reduction in capacity. It is important because it has an impact on the traffic conditions and safety. To be able to take proper actions it is necessary to plan :
    - the organisation of emergency services,
    - methods and resources,
    - access for these resources to reach the scene.

For these tasks the road infrastructure managers need to be organised on a territorial basis in such a way that each manager has a perfect knowledge of the section of road for which he is responsible so as to be able to take action as quickly as possible.

b) Managing traffic flows

Managing traffic flows (mission (2)) through demand management and traffic control: this a new mission for infrastructure managers, but follows on from the first. From this standpoint it will be necessary to proceed to the introduction of new operational structures on the basis of networks, which will imply several levels of coordination and cooperation between infrastructure managers and with private operators.

This mission is the vital link between :

- the collective standpoint : i.e. the number of vehicles which use the road in a given period of time,
- the individual standpoint : i.e. the journey time (or average speed) and comfort and safety, which are directly linked with the volume of traffic (stress).

In order to fulfil this mission, infrastructure managers need to have installations which enable them to manage flows, in particular in critical cases where traffic conditions are bad or where intervention in the case of accident is difficult. By means of traffic flow management they seek to prevent (anticipation) or react to (adaptation) the following types of event[56] :

- congestion :
    - recurrent (inadequate capacity),
    - foreseeable episodic (holiday departures),
    - random (particular event) ;

- accidents :
    - statistically predictable,
    - unforeseeable ;

- phenomena :
    - weather conditions,
    - disasters :
        - natural,
        - industrial ;

- capacity reductions :
    - road works,
    - restrictions :
        - cycle races,
        - official visits.

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[56] These events are influenced by the operating conditions (see 3.2.2. below).

With regard to the use of road information disseminated by the infrastructure manager to accomplish this mission, a distinction should be made between :

obligation : when the road infrastructure is particularly affected and measures have to be taken by the managers and followed (obeyed) by drivers,

recommendation : when difficulties are expected and the managers try to divert in advance some of those drivers who have the choice between several alternatives,

information : when operations are normal the managers inform users that this is the case and thus enable them to choose the best route.

For this mission the infrastructure managers will use real-time information systems and will have to organise themselves into a network to be capable of reacting in the shortest possible time and thus able to manage demand and control the traffic. This means trying to achieve the most flexible infrastructure use possible, which requires an integrated telematics system, the size and characteristics of which will depend on the situation to be managed.

3.2.1.2. Assistance (from the individual standpoint)

Assisting drivers (mission (3)) with their trips means giving them information on the traffic volumes and conditions they are likely to encounter on the one hand, and providing them with a certain number of services during the journey on the other (assistance in the case of accident, catering facilities, etc...). This mission is not entirely new, but now has a considerable potential for development through the introduction of personalised services[57] made possible by the appearance of information technologies and on-board systems. This will lead to the appearance of new forms of organisation based on a new type of relationship of cooperation and coordination between the public sector (which has the raw data) and the private sector (which will use these data to supply personalised services to drivers).

In this field the managers have to operate appropriate assistance installations and systems. The services may concern :

During the trip : information (which may serve both to regulate traffic or at least control it and to improve driver comfort), assistance (both mechanical and medical) safety measures (guidance in the case of bad weather and danger),

- During stops : services for vehicles (fuel, mechanical assistance) and for people (restaurants, telephones, toilets, etc.. .).

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[57] There are several ways of classifying these services : see below.

In particular, when we speak of information services provided by the manager they can be classified by the place in which they are useful and by when or where the information is supplied to the user :

- Pre-trip services are provided at home, before departure. The service required is trip preparation and optimisation after having taken a certain number of decisions :
  - to make the trip ;
  - when it should be made ;
  - using which transport mode ;
  - by what route.
- On-trip services are provided along the road and in the vehicle. The service required is to facilitate decisions to help reduce journey time and improve comfort and safety through the provision of information about :
  - short and medium-term traffic conditions and trends ;
  - probable journey time ;
  - location of road works ;
  - accidents ;
  - traffic problems ;
  - possible deviations ;
  - parking facilities.
- Travel services are provided everywhere (at home, on the road or at the destination) and at all tunes (before, during and after the trip) to let the user know what possibilities are open when he reaches the destination :
  - tourist information ;
  - hotels ;
  - other services (garage, parking, etc...).

For the infrastructure manager (and obviously also for the authorities responsible for traffic management, whether concessionaires or not) these services should be divided into two categories :

- Services directly connected with the “management“ of the trip (i.e. mobility) and also with user safety and traffic management, including in particular the quality of traffic flows and the corresponding information,

- Services making it possible to improve convenience (comfort and safety) and bringing value-added to the trip, such as mobile telephones to stay in touch with other people during the trip and information on tourist facilities, as well as emergency services. They vary according to the country and the authorities responsible.

The implementation of services connected with this mission (3) will require complex organisational structures involving close cooperation between partners with public service objectives (authorities and infrastructure managers) and partners with profit objectives. Relations will no longer be one-way or bilateral, but will require the creation of networks of actors and the making of arrangements to ensure the coherence and safety of the services supplied to users. It will be necessary to create a "public data provider" for this purpose in most cases, given the number and variety of the actors. The public authorities will have to establish contractual relationships with one another and with the private partners[58].

3.2.2. Operating conditions

Infrastructure managers are constrained by the traffic conditions on a particular section of road ; they have virtually no way of acting on the characteristics of this traffic, the social environment (habitat, etc...) or the climate, and it is their obligation to provide the best service under these conditions.

Relying simply on the traditional definition of types of infrastructure such as motorway, expressway and road, or a purely territorial view based on the legal and/or administrative structures to serve as a basis for reflection on the organisation of the public service missions connected with traffic management and road information, or for negotiations to create a local company to supply personalised services to drivers, is not enough because the technical characteristics and operating conditions are constantly varying, independently of these criteria. It is therefore necessary to seek a way of integrating different infrastructures through what is common to them with a view to achieving coherence in the economy of operations for the manager or operator and the readability of routes for the user.

From this standpoint it must not be forgotten that around the biggest conurbations intercity traffic accounts for scarcely 5% of the total, but this traffic must not get caught in traffic jams. This means that on a given infrastructure different types of traffic have to be managed simultaneously, and that sometimes decisions have to be made to give priority to one or the other.

3.2.2. I. Classification criteria

To classify a network in a pertinent fashion it is necessary to find as objective a method as possible for identifying the "HOW" and "WHY" of what is supplied to users by managers, in terms of installations, services and the management methods used to supply them.

The operating environment of a road infrastructure is characterised by the type of infrastructure (motorway, road, urban freeway, etc...), the types of traffic and the types of environment. It is also influenced by the existing operating methods.

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[58] It is these relations and the "Public data provider" which are described in the Tool Box.

It is possible to identify key points directly connected with the operating conditions, as in the following table :

	Key points	Operating conditions
Infrastructure	Infrastructure and Land use	Zone (access roads) Nodes (converging roads) Network (alternative roads) Corridor (parallel roads) Axis (a single road)
Traffic	**Flow** and Capacity	Congestion Fluidity
Environnement	Use and Infrastructure	Mixed use (pedestrians, level crossings) Dedicated use
Operating methods	Maintenance, clearing and Infrastructure	Safety Fluidity

3.2.2.2. *Type of infrastructure*

Road infrastructures are combined into a system or network of roads to permit mobility. The challenge involved in arriving at a given level of quality of service (LOQOS)[59] is that of being able to organise these combinations in such a way that the user/driver can have a homogenous perception of them (no surprises) right throughout the trip.

These infrastructures may bear different names according to whether they are built in an urban environment or not :

INTERCITY	URBAN
Motorway	Urban expressway
Highway	Avenue, boulevard
Main road	Road
Feeder road	Service road

From the standpoint of the structured operation of roads, we may consider different systems / networks ranging from the French motorways belonging to TERN (Trans-European Road Network), the management of which should in the longer term be by collaboration between operators at European level, to local networks whose operation should in cases be through cooperation in real time between neighbouring operators, whether or not they belong to the same country (for example the Channel Tunnel or the tunnel under Mont Blanc).

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[59] The Level of quality of service is defined by MAGIC.

These combinations of infrastructures (associations) into systems / networks may be summarised as follows :

Category 1 axes : Roads and motorways in rural areas linking two towns or two economic centres ;

Category 2 corridors : Combination of motorways or major roads with parallel roads which can be used to distribute the traffic in certain circumstances ;

Category 3 networks : Combination of motorways or major roads in dense zones where it is possible to have the choice between several routes ;

Category 4 nodes : Towns or economic zones where several roads and motorways converge, or where a network can have an interface with other transport modes ;

Category 5 zones : Zones in a rural or urban environment where the roads permit access to the final destination (feeder roads and streets).

3.2.2.3. Traffic parameters

Several types of parameters influence the composition / structure of traffic. The most important are :

- type of user,
- type of vehicle,
- flow (number of vehicles using a section).

a) The user

Through his driving behaviour, and according to whether or not he habitually uses a given infrastructure, the user has a great influence on traffic conditions and hence on operating conditions.

There are different types of user, ranging from the person living in the suburbs making frequent, but short trips (averaging 3 trips a day, including shopping, of less than 10 kilometres) to the truck driver carrying goods from the North of Europe to the South. These users obviously have different behaviours and different perceptions of the level of quality of service (LOQOS) which they expect the infrastructure manager to provide them with. They may be classified simply as a function of the length and frequency of trips and their professional category. This is important for evaluating the real capacity of an infrastructure, because it has been observed that the presence of many regular (commuter) drivers over a given route can improve the capacity by about 10% (from 2000 to 2200 vehicles per hour).

A new driver category has appeared over the past 10 years, affluent retired people travelling for tourism and pleasure. They have an impact on the general volume of trips but do not generally increase the traffic difficulties at peak hours because they do not drive in the same places at the same time as people going to or from work.

b) The vehicle

The composition of traffic as a function of the different types of vehicle has a great influence on both the infrastructure capacity and the driving conditions (such as safety and comfort). Trucks in particular have a great influence not only on capacity, but also on safety insofar as when they are involved in accidents the risk of deaths is higher.

c) The flow

The volume of traffic has a direct influence on the traffic conditions. It is described by a concept well known to road engineers, the level of service (LOS) of the Highway Capacity Manual (HCM).

The variables used are :

- average speed,
- hourly flow,
- density (occupation rate).

This definition of level of service and the relative efficiency which corresponds to it are given for a “point” on a motorway at a given time. But the characteristics of a road vary over time and space when those of the traffic vary over time. This is extremely important for managing traffic and the associated services, which will be evaluated by the perception the users / drivers have of the level of quality of service (LOQOS) over the route concerned. As a result, the concept of level of service (LOS) needs to be seen from these two standpoints :

- Level of service (LOS) as a function of space :

  The maximum possible capacity of a road infrastructure varies with the geometric characteristics : the width of the carriageway, the hard shoulders, the reference speed and the characteristics of the routing (plan and profile). In other words the level of service for a given traffic structure (constant number of vehicles and constant percentage of trucks) will vary along the different sections of a system of motorways. This is the key problem when it comes to achieving a certain minimum of homogeneity of journey speeds for trips through Europe or through a country.

  Particular attention has to be paid to urban zones where the definition of level of service may be different (especially if we consider a network with crossroads rather than flyovers).

- Level of service (LOS) as a function of time :

  Traffic varies over the year, during the week and during the day. As a result it is virtually impossible to consider a constant level of service for a given section of road / motorway. These variations as a function of time depend on a certain number of parameters, such as :

  - population density and size of the zone served by the road,
  - the local economy (industry, agriculture, tourism, etc.. .),
  - geographical location (industrial corridor, transit route, etc...).

- The particular case of congestion :

  It is with congestion that there comes a demand either to build new infrastructures or to make better use of existing ones. It is therefore in congested zones or on congested axes that users will increasingly demand services corresponding to mission (3). Infrastructure managers and service operators will therefore be well advised to have a very good knowledge of the conditions under which congestion arises to be able to judge when and how these can be provided.

  Congestion always means :

  - too much traffic,
  - queues of vehicles,
  - wasted time, extending the journey time, and hence leading to,
  - unpredictable journey times.

  Congestion, i.e. interruption of the smooth flow of traffic, is increasing on European roads. It is in urban areas, where roads are linked together by intersections to form a network, that serious congestion problems are found, with the network being blocked over substantial areas.

  In practice, traffic managers identify three cases of congestion :

  - the first case, defined as “pre-congestion situation” is characterised by the deterioration of flow conditions, though they can still be managed by the majority of users. In this case the slowing of traffic does not create jams so long as traffic demand does not increase. If traffic stops this becomes a parallel jam,

  - the second case, defined as “parallel traffic jam” is characterised by flow conditions being completely deteriorated by traffic demand, and tailbacks get longer,

  - the third case, defined as “series traffic jam” is characterised by the “flooding” of traffic blocking the upstream area and completed freezing the whole of a network.

Three types of congestion can be identified :

- chronic congestion can easily be kept under control because it is predictable. There are evaluation methods and traffic management models for exercising such control,
- occasional congestion is not predictable but can be easily anticipated insofar as it is generally connected with special events the time and place of which is known in advance, so that appropriate measures can be planned,
- random congestion can neither be predicted nor anticipated. The appearance and extent of the congestion are random. It is generally due to accidents, incidents or weather conditions. Only the operator's experience makes it possible to anticipate the resources which should be used in the case of intervention.

Since certain motorways and roads, notably in urban areas, are becoming increasingly congested, a new approach is necessary to take this congestion into account in the management of corridors and networks.

d) Typology of traffic conditions

Taking account of the capacity has led road engineers to dimension roads and motorways for the 30th hour (the 30th most heavily trafficked hour of the year) predicted for the end of the project's lifetime (generally the 30th year). It is necessary for traffic management too to consider the best measures to introduce to favour traffic flows, as a function of the day, week and year considered. The following table shows the effects on the definition of the level of service for average traffic over the year and makes it possible to establish a typology of traffic conditions which will have a predominant influence on the operating conditions :

Type of traffic	**Average level of service**	**Peak factor**	**Level of service at the peak**
Metropolitan	**D**	**2.4**	**E/F**
Urban	C	**3**	**D**
Intercity	B	**3, 5**	**D**
Rural	A	**4**	**D**
Tourist	**A**	**7**	**D**

It is thus possible to take account of the fact that while on a tourist road the peak is seen about ten times during the year, in a big conurbation the peak appears twice a day.

3.2.2.4. General environment

Geography (economy, climate, topography) has a great influence on infrastructure operating conditions. All these characteristics affect traffic insofar as they influence the practical capacity of a given road, but they also have an effect on the organisation of the operations introduced by the infrastructure manager.

a) The economy

The economy can be characterised by the population density to the extent that this conditions the demands made on the manager. The denser the area, the more the traffic is a complex combination of a great variety of demands for trips ranging from commuting to international haulage.

From the services marketing standpoint (level of quality of service : LOQOS) if we take into account a combination between economic activity and population density (which are not independent parameters) based on a user potential and the complexity of implementation (political factors, multimodality, real time, etc.. .), the human environment of the TERN may be classified as follows :

rural areas :	population density is low and the services are planned to satisfy very particular needs,
towns :	these are medium-sized towns which constitute a type of environment in which the transport problems are not very complex, but where their impact on the quality of life is a politically sensitive issue,
urban centres :	with high population density and having to cope with complex transport problems for which the information technologies may help find solutions,
urban peripheries :	big suburban areas around the big towns or linking two big urban centres and in which, although the general characteristics of the trafiic are comparable with that found in urban centres, the problems are not so complex,
conurbations :	these constitute the most complex environment of all, because they contain both urban centres and peripheries without it being possible to separate them from the standpoint of traffic management because there is no open space (open road) between them. It is in this type of environment that the introduction of information technologies finds its biggest field of application.

It should also be pointed out that intermediate types of environment are frequently found, combining for example rural features with those of the industrial centre (single industry towns generating substantial traffic), with an average population density which in some cases has a precise area of influence. As regards traffic management they may be considered as intermediate between towns and urban centres.

This leads us to classify the operating conditions directly as a function of the type of infrastructure. Given the structure of the traffic, the more complex the operation conditions will be, the lower the proportion of international and intercity traffic to be taken into account.

b) The climate

The climate has an important impact on driving conditions on the one hand and infrastructure management on the other. The main parameters to be taken into account are :

- snow, for clearing,
- fog,
- ice,
- rain and the probability of flooding.

c) The topography

For the design of roads, a distinction is generally made between four types of relief : flat, hilly, mountainous and very mountainous. It is obvious that these types of relief are often associated with certain types of climatic environment and may also be connected with human environments. They equally obviously have a direct impact on the geometric characteristics of roads and motorways (reference speed, width of carriageway, etc...) and on the effect of heavy vehicles on capacity.

3.2.2.5. Operating methods

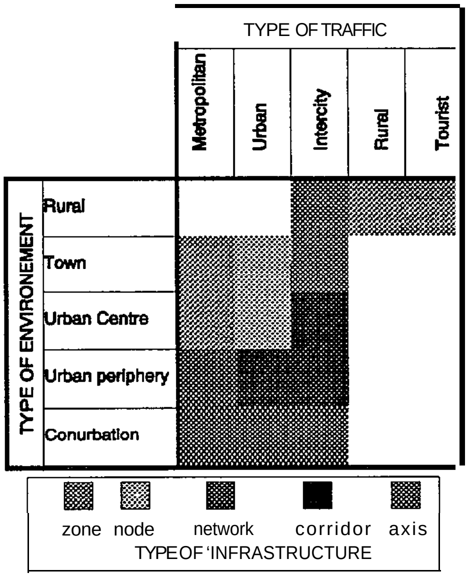
The operating methods may have an influence on the service supplied to the user. The organisation of maintenance and repair or the clearing of snow may have an impact on the capacity and hence on the level of quality of service (LOQOS). Over a long period infrastructure managers were more concerned with cost and ease of intervention more than anything else, but today’s traffic levels are such that this way of thinking has to go, and we are now increasingly seeing repair schemes in which the cost of the special operating measures is higher than that of the road works proper.

3.2.2.6. Classification of operating conditions

Lastly, what has been said above can be summed up in the following table, where a correspondence (the intensity and pertinence of which will vary as a function of actual conditions) is proposed between type of traffic, economic (geographical) environment and type of infrastructure, bearing in mind that the choice of the type of infrastructure is the first response by the authorities to traffic demand in a given environment.

Figure 3.2.

OPERATING CONDITIONS



It is only to optimise the use of these infrastructures that their managers undertake operational measures and envisage contracting out certain services associated with them.

On the basis of the above it was possible, in the context of MAGIC, to propose a classification of infrastructure operating conditions from the standpoint of the managers. This classification is based on the typology of infrastructures by associating with it the operational methods chosen as a function of the traffic and the environment.

Class 0 : Applies to European roads and motorways which have been taken into account in the Master Plan with a view to regional development, in particular for the peripheral countries. In this case the action to be taken must have the objective of harmonising the geometric characteristics and road signs and signals throughout Europe. A minimum of operational measures should be concerned with installation quality and infrastructure. The main factor influencing organisation will be the climate.

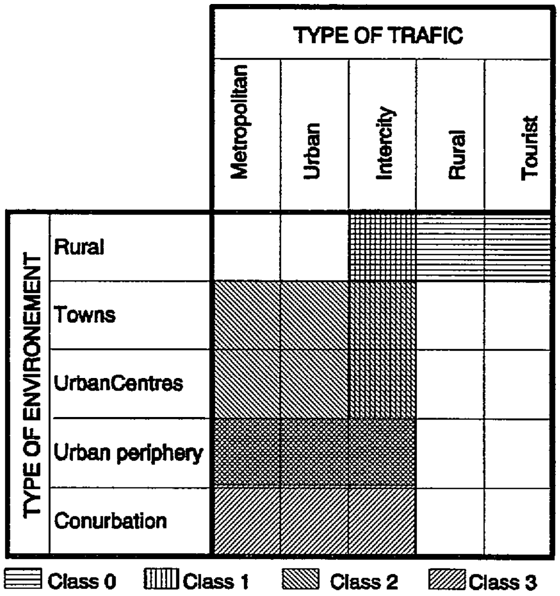
Class 1 : Comprises the axes on which there is considerable international traffic, both for freight and for summer migrations in particular. The probability of perturbations is relatively low and it is not necessary to provide for the use of alternative parallel routes to relieve traffic in the case of difficulties, or else they are not possible because of the lack of infrastructures. In this case operation will be based on information and advice to the driver with a good level of organisation to be able to intervene rapidly in the case of incident.

Class 2 : Comprises the corridors which carry a traffic comparable to that found on the axes, but with intercity traffic in addition. In this case there are parallel roads and in some cases there may be a second motorway. Perturbations appear and these infrastructures have to be managed in a coherent fashion in order to balance the flows so as to obtain the best efficiency for the manager and the best convenience for the greatest number of users. On a corridor, maintenance and repair can be undertaken only when the global level of traffic is less than the capacity of one or other of the corridor carriageways.

Class 3 : Comprises the networks which are the infrastructures which may be used to access different places by different routes in a homogenous economic area. In the urban peripheries the sections of the network may be limited and with no alternative between one node and another[60]. In the big conurbations each segment will have an alternative with a local infrastructure. It is then a matter of a network of corridors. These infrastructures are generally subject to perturbations and the operation of such networks requires permanent monitoring and real-time management in order to be able to counter the negative effects of these perturbations.

Figure 3.3.

OPERATING CLASSES



TYPE OF ENVIRONEMENT		TYPE OF TRAFIC				
		Metropolitan	Urban	Intercity	Rural	Tourist
	Rural			▤▥	▤	▤
	Towns	▧	▧	▥▧		
	UrbanCentres	▧	▧	▥▧		
	Urban periphery	▧▨	▧▨	▧▨		
	Conurbation	▨	▨	▨		

▤ Class 0 ▥ Class 1 ▧ Class 2 ▨ Class 3

It is not recommended to go into any more detail on these classes because the variety of human, climatic and topographical environments would lead to too great a number of categories which would rapidly make understanding of the level of quality of service (LOQOS) offered to the user impossible for him. As a result it is assumed that these characteristics will be taken into account in a professional way by the managers in charge of operating the corresponding infrastructures.

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[60] **See the definition of "node" in 3.2.2.2.**

3.2.3. Levels of quality of service

The task is to implement new levels of service standards, and the corresponding measures, which in the longer term will encourage an approach which will permit the programming of network development in terms of services while not forgetting the local traffic management problems. It is therefore necessary to select the best ways of weighting the levels of service on the different homogenous sections such as axes, corridors and networks, taking congestion into account and endeavouring to provide the best conditions for mobility.

The concept of the readability of a route was launched a few years ago in France. The aim was to concentrate more on achieving the homogeneity of geometric characteristics, the natural environment, and police and directional signs and signals. This idea was taken up by the Commission of the European Union in the work of the Motorway Working Group and extended to the operating conditions under the new term “level of quality of service” (LOQOS). Taking into account what has been said regarding the parameters influencing operating conditions, it is necessary above all to find a way of making the actions taken by the different operators clear and understandable to the user. It is therefore necessary to :

- weight the operating conditions to reduce the differences between different infrastructures,
- aggregate the different infrastructures to respond to the variety of operating conditions,

3.2.3.1. Weighing the operating conditions

This needs to be done from two standpoints :

- that of the homogenous trip for a national or trans-European trip (transport, business or pleasure) :
  - the individual standpoint ;
- that of homogenous local use of existing infrastructures :
  - the collective standpoint.

3.2.3.2. Aggregating the operating conditions

Two different concepts can then be used to justify and guide the aggregation of the levels of service :

- The first is the concept of the type of trip, where the level of service may reasonably be aggregated to reflect the common traffic conditions and trip lengths (commuting, weekend, freight transport, etc., .) :
  - demand.
- The second is the concept of route, where level of service may reasonably be aggregated between different roads, corridors or networks :
  - supply.

3.3. User services

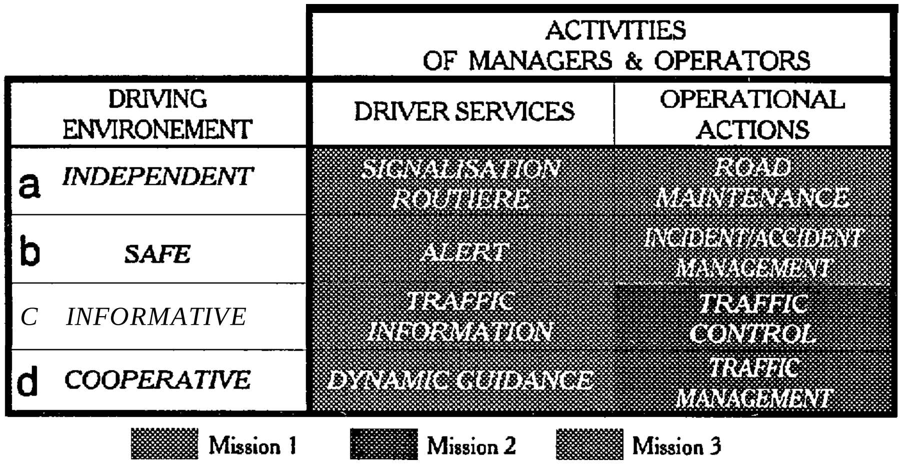
3.3.1. *A coherent framework for action*

Investment and organisation need to be dimensioned so as to use the available financial resources as efficiently as possible. As a result there cannot be uniform provision over the whole of a network without regard to the operating conditions. On the other hand, the driver should be able to rely on a certain minimum level of service wherever he goes, which implies a certain minimum of coherence in signs and signals, emergency services, information and ancillary services.

Four types of relations between the infrastructure manager and the driver can be identified, depending on the trip conditions. Each of the four corresponds to a set of public service actions to be performed by the infrastructure manager and the provision of certain driver services delegated to private operators in the context of mission (3).

Figure 3.4.

Missions et services



	ACTIVITIES OF MANAGERS & OPERATORS	
DRIVING ENVIRONEMENT	DRIVER SERVICES	OPERATIONAL ACTIONS
a INDEPENDENT	SIGNALISATION ROUTIERE	ROAD MAINTENANCE
b SAFE	ALERT	INCIDENT/ACCIDENT MANAGEMENT
C INFORMATIVE	TRAFFIC INFORMATION	TRAFFIC CONTROL
d COOPERATIVE	DYNAMIC GUIDANCE	TRAFFIC MANAGEMENT

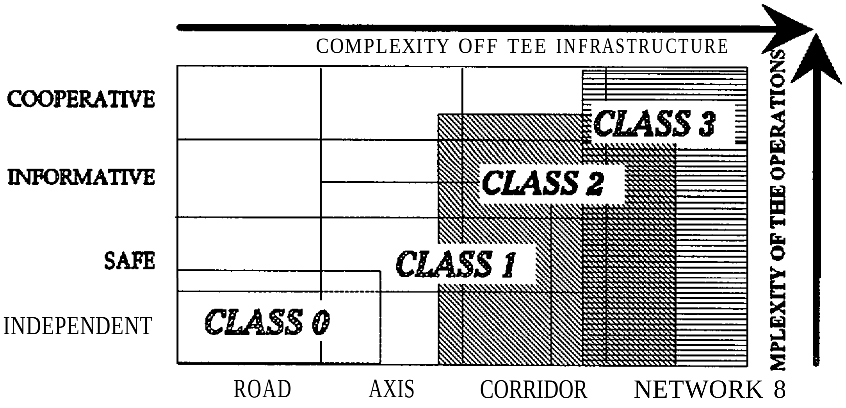
▨ Mission 1 ▨ Mission 2 ▨ Mission 3

Independent :	means that the driver receives no direct aid from the infrastructure manager,
Safe :	means that the driver may receive advice on the action to take in the case of a serious event,
Informative :	means that the driver directly receives information on traffic conditions during the trip,
Cooperative :	means that the driver continuously receives real-time information which enables him to optimise his route and the manager to optimise the use of the infrastructure.

These types of relations are not alternative but cumulative as one passes from one level of service to another (it is difficult to imagine dynamic guidance without signs and signals). It is therefore possible to arrive at a coherent typology of operating conditions, types of infrastructure and driving environment proposed to the driver, on the basis of which the actors (authorities for the operational actions and operators for the driver services) will be able to define their respective objectives and reciprocal obligations :

Figure 3.5.

Principes de gestion



This shows that mission (3), assistance to drivers, can be fulfilled effectively only if missions (1) and (2) are fulfilled correctly. What is more, it is obvious that, without considering the control by the public authorities for the reasons discussed in chapter 6, close co-operation between those responsible for ensuring infrastructure quality and managing flows and those who provide personalised services for drivers is a necessary condition for the provision of these services.

3.3.2. Service provision

These user services, essentially connected with mission CD, are in principle subject to the laws of the market. However, in the fields of traffic management and road information the situation is more complex than it appears at first sight :

- the information disseminated may have an impact on the performance of a public service and hence the missions of collective interest,
- the total cost of production of the information may out of all proportion to what the user is prepared to pay to have it.

3.3.2.1. User wishes

User services may be summarised as follows :

Trip preparation	- information about the trip.
Aid during the trip	- navigation, - traffic information, - dynamic guidance.
Other services	- emergency assistance, - comfort, - tourist information.

User wishes have not yet been well evaluated except as regards emergency assistance and comfort facilities as provided by motorway operators. On the other hand, demand studies on “information” services are few and far between, and remain confidential where they do exist. It is however virtually certain that :

- First, they will be increasingly demanded by users as mobile communications develop (people will not understand why they cannot also be used to provide information on traffic conditions),

- Second, travel assistance services cannot be supplied without the operators making the raw data on traffic conditions available, the cost of the collecting this data being too high to be covered by user charges only.

All the participants in the management of an infrastructure therefore need to get together and organise themselves to be able to satisfy the needs of both users and the private operators who wish to provide services. It will be necessary in particular to determine who is the best placed to fulfil a particular mission or provide a particular service, the impact of these services on the collective interest missions, and the sharing of the financial risk between the different actors.

3.3.2.2. Services offered

Along roads and motorways drivers should be able to find restaurants, emergency telephones, etc... However, these installations are not provided at the same kind of interval everywhere, which depends on the authorities to whom the infrastructure belongs. It might be a good thing to identify routes (on the basis of socio-economic criteria) on which a certain minimum of coherence is important because of the nature of the traffic using them. The arrival of information technologies in transport introduces new possibilities for informing users both along the road and in the vehicle.

a) Roadside services

For a top quality trip it will be necessary to make available to the driver not only adequate information, but also services such as :

-- Convenience facilities at reasonable intervals :
  - rest areas,
  - filling stations,
  - restaurants,
  - hotels.

-- Safety facilities :
  - emergency telephones,
  - rescue and repair services.

-- Tourist information centres.

The management of some of these services can be entrusted to private operators under specific conditions (generally concessions) on motorways, while on other roads the convenience services are subject to the normal regulations governing land use and commercial activities.

b) On-board services

The on-board services which can be supplied to the driver consist of all the information which he could obtain via roadside equipment plus individualised services such as dynamic guidance. It is obvious that the availability on board of services already available at the roadside will bring a significant improvement of driver comfort.

Whereas up to now services have been introduced from the collective standpoint (i.e. the same information for all drivers at the same time) the introduction of transport telematics will make it possible to introduce personalised services. These are of four types :

Independent navigation[61] :	The driver has on-board equipment (a digitalised map and a computer to read it) which tells him where he is and which is the best route ;
Traffic information :	The driver receives information (via an RDS/TMC receiver, for example) concerning traffic conditions on the section of road he is using ;
Dynamic road guidance :	The driver has on-board equipment which enables him to find the best route in real time, taking traffic conditions into account. This service is a combination of the above two ;

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[61] Here the term "navigation" is limited to finding the right way. It seems that the term is being increasingly used to cover all the activities connected with travel assistance. As a result it could be replaced here by "static road guidance".

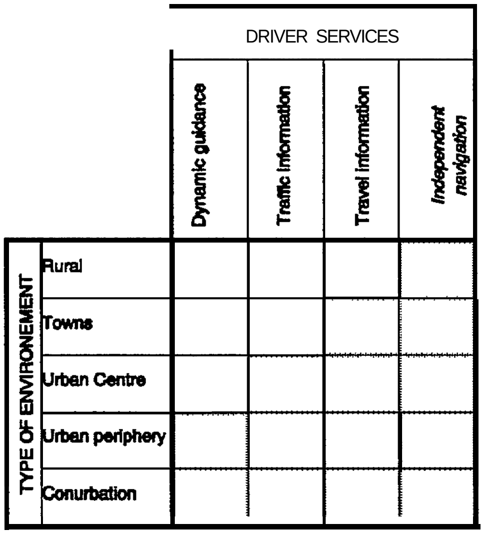
Travel information :	The driver has on-board equipment through which he has access to information concerning parking conditions, accommodation, public transport and other services.

Navigation services can be completely independent of the infrastructure managers, where as traffic information depends on the willingness of the infrastructure managers to provide this information to drivers via a service operator. Dynamic information will generally require cooperation between the infrastructure manager and the service operator. The degree of cooperation will depend on the technologies used. The introduction of telematics in road transport thus crosses a new frontier and will have an impact on traffic management and hence on the definition and evaluation of the corresponding user services.

For obvious economic reasons these services will not be made available to drivers in all circumstances. As a first approach the segmentation shown in figure 3.6. appears justified.

Figure 3.6.

Service market segmentation



		DRIVER SERVICES			
		Dynamic guidance	Traffic information	Travel information	*Independent navigation*
TYPE OF ENVIRONEMENT	Rural				
	Towns				
	Urban Centre				
	Urban periphery				
	Conurbation				

The provision of these personalised services should generally be left to private sector initiative, but since some of them will have an impact on operating conditions, rules for cooperation between infrastructure managers and service operators need to be devised. The existing legal framework is sufficiently rich to permit this without anything more than perhaps certain adaptations.

4. The systems approach

4.1. The concept of system

The ultimate aim of the DRIVE and PROMETHEUS programmes in Europe, the IVHS[62] programme in the United States and the VICS[63]/UTMS[64] programmes in Japan, is to "sell" the concept of an integrated road transport system based on information and telecommunications technology as the way in which to enhance the performance of existing transport infrastructure (and particularly road infrastructure) in terms of not only safety, but also protection of the environment and efficiency. This represents a considerable technological and conceptual leap forward in that it implies a shift from reactive / anticipatory style of road system management (new infrastructure is built once the capacity of existing infrastructure proves inadequate) to a proactive, dynamic style of management (in which better use is made of existing capacity), thus prompting traffic engineers to convert themselves into real-time systems engineers. It is hardly surprising, therefore, that no standard set of design concepts or consensus on terminology has as yet emerged. The result has been one of confusion, which is exacerbated in Europe by differences in terms of both language and national practices. This situation is compounded by the feeling of helplessness which afflicts both policy-makers and traffic planners faced with rising levels of traffic and widespread congestion. Against such a background, TT systems may be seen as a cure-all capable of remedying all problems at one stroke. They have all the requisite attributes of a panacea in that :

- they are "systems",
- they are based on the use of "information",
- they provide a platform for the introduction of new "services",

in the United States, for example, IVHS is seen by the federal government not only as an answer to the country's transport problems, but also as a means of reviving economic growth and a potential new market for a converted defence industry. The "information highways" are becoming the new frontier in the United States as in Europe with sometimes a certain confusion in people's minds with "real" highways and the application of these technologies to their management.

The optimism and expectations aroused by such systems may well give way to disillusionment, whose impact would be all the more damaging in that it could either prevent or delay the introduction of instruments that are indispensable in a modern State intent upon optimising the movement of goods and people (for both private and public transport). We therefore felt it necessary to clarify certain points, not in order to "impose" a given terminology, but simply to be sure of being properly understood. We shall, in particular, explain precisely what we mean by the term "Integrated Road Transport System".

4.1.1. Lack of standard terminology

Road information and traffic management know-how has not as yet been adequately formalised either in Europe or in the rest of the developed world. The technological tools (TT systems), too, are still at a prototype stage ; and systems and their applications (i.e. the functions they are designed to perform) are still frequently contused.

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[62] Intelligent Vehicle /Highway Systems.

[63] Vehicle Information and Communications Systems programme set up by the Ministry of Communications.

[64] Universal Traffic Management system set up by the National Police Agency.

There therefore exists a host of terms for the same basic concept : ATT (Advanced / Applied Transport Telematics), RTI (Road Transport Informatics) in Europe[65], MIS in the United States and VICS or UTMS in Japan. Conversely, the same term may have very different meanings depending upon whether it is used by industry or simply within the transport sector ; the same is true of the terms "system architecture" and "interoperability".

The other sources of confusion stem from :

-- subsicliarity (method of decision-making),
-- flexibility (capacity to choose different methods),
-- compatibility (capacity to work simultaneously without mutual interference),
-- interchangeability (possibility of having several suppliers for a given component).

The principle of subsidiarity recognises the right of each to decide for himself the way in which he produces his services and how he uses those supplied to him. Flexibility allows each partner to choose the most appropriate method of producing his services. Compatibility is what allows products, processes and services to be used together under certain conditions to satisfy the requirements expressed and without mutual interference. Lastly, interchangeability is the capacity of a product, process or service to replace another to satisfy the same requirements.

In what follows we endeavour to clarify the concepts of system, interoperability and compatibility.

4. 1.2. The system

4. I. 2.1. The general system (principles of representation)

One of the first sources of difficulty lies in the concept of "system". In the broad sense it is an organisation as a whole, in the restricted sense it is a technical device processing material, energy or information. It is agreed that a system is made up of a set of interconnected sub-systems to perform functions in order to achieve an objective. Any sophisticated system can be broken down into three sub-systems (functions) of a permanent nature :

- a production system (the system which produces the product or service),
- a decision system (the system which defines the objectives and validates the results),
- an information and control system (the intermediary system through which the orders are transmitted to the operating system and information on the production transmitted to the decision system.

Thus for the production of personalised services for drivers, the production of information (collection and transmission) is done by the production system, monitoring the availability of the equipment used is done by the information (control) system of the organisation and the choices of the services to supply to drivers and the day-to-day choices on the nature and frequency of transmission are made by the decision system.

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[65] Attempts to bring order to this area would seem to be turning TT systems into a multimodal concept (applicable to all modes of transport).

Each of these sub-systems is itself built up in the same way to fulfil its obligations. Thus in an enterprise the Accounts Department is the information system for the whole, but it has its own decision system (the financial director), production system (the accounting services) and information system (auditing service).

4. I. 2.2. Levels of control (standpoints)

In a system it is also possible to distinguish levels of the control function each having their own logic (standpoint). A distinction is generally made between :

- the prospective level, which fits into a logic of changing the system to respond to a radical change in the environment,
- the strategic level, which fits into a logic of anticipation and evolution in parallel with the environment,
- the management level, which fits into an organisational logic of forecasting, planning and control of the realisation of the objectives,
- the operation level, which fits into a logic of planning and executing the production system tasks,
- the physical level which fits into a logic of processing the material, energy or information with which the system is concerned.

Each of these levels, when it is taken into consideration, must be analysed from the corresponding standpoint by considering all the sub-systems of the general system. Thus the analysis of the methods of production of personalised services for drivers is based on this logic of strategic levels : the logic of the management and operation levels from the standpoint of the relations between the actors, and the logic of the physical level from the standpoint of introducing informatics and telecommunications technologies.

The strategic aspect has been discussed in chapter 3, which gives indications on user needs, the missions of infrastructure managers and the personalised services which could be supplied to drivers, this chapter (chapter 4) concerns more particularly the operation level, chapter 5 the technical level and chapter 6 and the Tool Box the management level.

4.1.2.3. The structure

In any sophisticated system we find :

- those who do the work operations centre,
- those who supervise the work : management hierarchy,
- those who standardise the work : technical structure,
- those who help do the work : logistical support,
- those who coordination the whole : strategic summit.

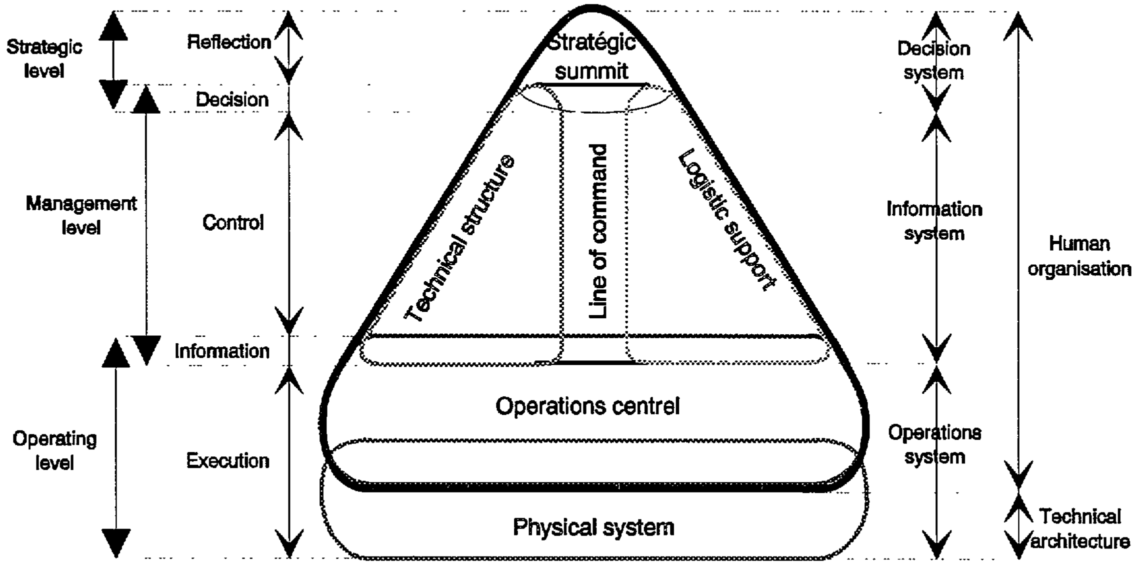
The operations centre is the vital part of the organisation because it "manufactures" what is wanted by the environment (the clients). The strategic summit is there to ensure that the mission is fulfilled as efficiently as possible. The hierarchy is the line of command between the strategic summit and the operatives. The technical structure prepares the tools and rationalises the organisation of work. Lastly, the logistical support structure is there to "free" the operatives from tasks which are not directly connected with production but are necessary for it.

4.1.2.4. Relations between logic, function and structure

The following schematic diagram shows how the different logics of a system are connected with its basic functions and its organisation. The diagram is very greatly simplified and it must be borne in mind that each sub-system has its own decision, information and operation systems in order to be able to correctly perform the tasks assigned to it, whether they are concerned with strategic planning or the production of services.

Figure 4.1.

Basic parameters of a system



4.1.2.5. The networks

The different sub-systems are interconnected by networks which contribute to the organisation of the general system (transport, communications, information, etc. networks). These networks perform no processing, but simply conduct the flows from one component of the system to another, and the definition of their interoperability is not that of the military[66] ; they do not exchange goods or services with one another, but are the channels through which exchanges are made. The communications networks are the basis for information flows and in a complex organisation it is the interoperability of the information systems of different entities which permits the whole to operate.

4.1.2.6. The architecture

The architecture of a system is the conceptual framework which enables us to describe how the components (sub-systems) of a system interact to achieve the objectives of the system[67]. For some commentators it is an evolutive framework in which the management organisation of new services will fit, while for others it is the definition of the structure of the technical system which will be manufactured and installed.

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[66] See 4.1.2.7. below.

[67] Definition given by IVHS.

The whole art of managing complexity lies in knowing what level of detail one must descend to in the analysis of a system in order to get away from mere generalities, and at what level one must stop in order to remain comprehensible. As a system can be analysed from different standpoints (logic levels) it is essential to define at the outset which one has been chosen.

4.1.3. Interoperability

This problem of the standpoint (logic level) arises again with the definition of the interoperability of systems. There is an initial source of confusion between :

- the interoperability of systems,

and

- the interoperability of networks.

In fact the interoperability of systems (capacity to work together) consists of mutually obtaining and accepting services and using the services thus exchanged to work efficiently in concert, while the interoperability of networks consists of permitting the exchange of goods, information and services without the passage from one network to another being an obstacle or hindrance to these exchanges.

Thus the interoperability of the European road / motorway networks will mean among other things the continuity of personalised information services being supplied to the driver regardless of who manages the network. But to supply these personalised information services it is necessary to have :

- interoperability of the service production systems set up by different operators to assure the continuity of these services between the areas “managed” by different operators ;

- interoperability of the information systems and the telecommunications systems for the exchange of data.

To try to clarify this aspect we use the three levels of interoperability of the information and communication systems taken into account by the military. They distinguish between :

- operational interoperability (which corresponds in fact to the strategic logic level of the system), which is generally a common approach to objectives and requirements connected with the exchange of information and a coherent philosophy regarding the use of this information and the establishment of links. It implies identity of significance (a common vocabulary) and of processing (same method of validating the information). This is the basis for agreement between operators and precedes the other forms of interoperability ;

- procedural interoperability (which in fact corresponds to the system management logic level), which is the adoption, for different types of equipment which have to communicate with one another, of a common presentation format, the same operating and data delivery procedures, and a common definition down to bit level of the information exchanged ;

- technical interoperability (which corresponds in fact to the system operation logic level), i.e. the ability of hardware items to communicate with one another, either through interconnection (mechanism permitting communication), or by interfunctioning through the supply of identical, equivalent or different services whose implementation implies varying degrees of cooperation (concerted operation) and mutual aid (sharing of resources).

There are several methods of ensuring the interoperability of an information system :

- exchange of information, which results in the establishment of links which may be of variable capacity but which on the one hand do not permit the precision and speed required for real time, and on the other require human intervention in the exchange process,
- remote terminals, which permit the staff of one operator to directly access the information produced by another without having to contribute to its production,
- bridges between computer systems to permit computers to exchange information via an interface,
- direct links between computer systems, which consists of eliminating the bridges (costly to develop) through choosing standards and implementation profiles for systems which are identical from the outset.

It is the highest stages of interoperability which imply mutual aid and cooperation. They require not only interconnection but also complete compatibility between the components of the different systems to be able to exchange identical services. As a result, while it is difficult to imagine the interoperability of information systems without interconnection (the possibility of exchanging information is the very minimum) the technical investment required to achieve it will vary as a function of the nature (real-time) and volume of the data exchanged.

	Operational interoperability	Procedural interoperability	Technical interoperability			
			Interconnection	Interfunctioning		
				Different service	Equivalent service	Identical service
Exchange of information		CONCERTATION				
Remote terminals						
Bridges between systems						
Links between systems					COOPERATION	

It is therefore necessary to consider what information is to be exchanged and the conditions of this exchange before embarking on the implementation of an interoperable system which has the objective of cooperation (interfunctioning of identical services) as defined above. In the case of personalised information services to the driver the "public data provider" will not only have the management function of ensuring the coherence of the data exchanged, but also the technical function of bridge between the information systems of the different actors.

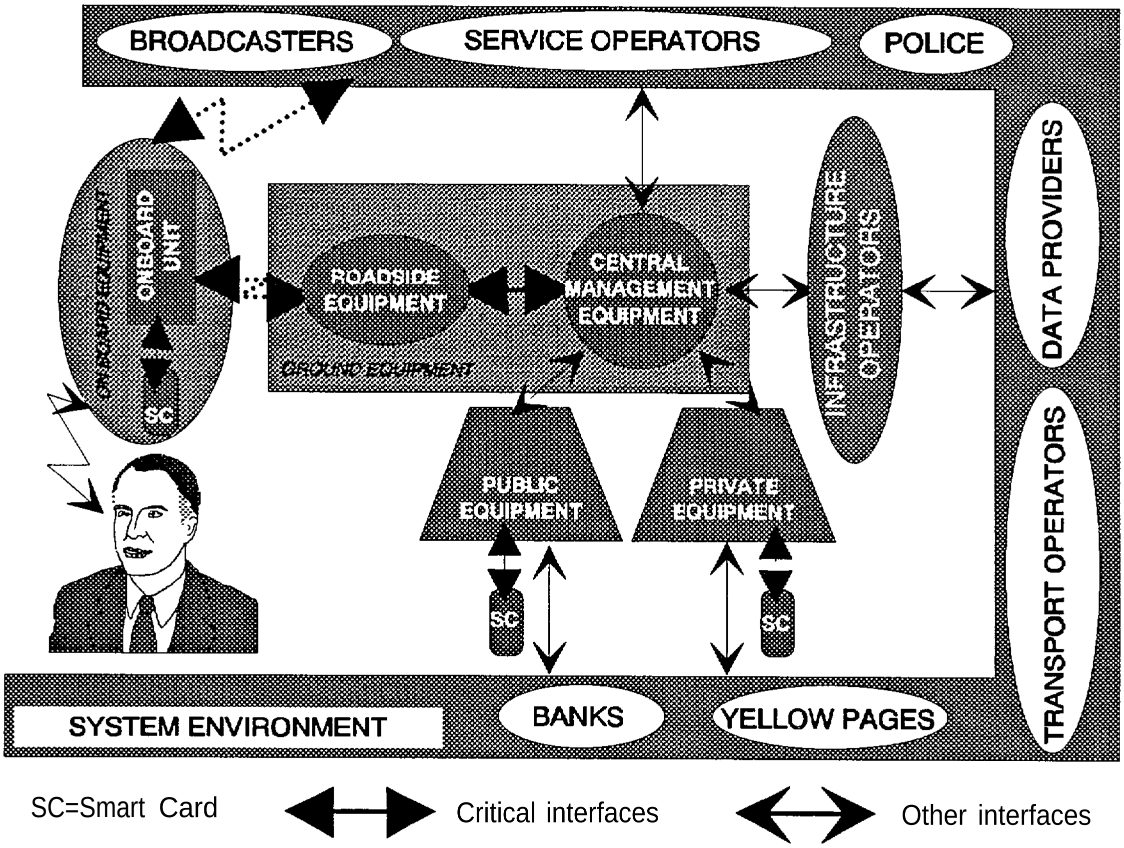
4.1.4. Compatibility

It is obvious that the tasks / functions which have to be performed in real time are those which are critical and require a physical interoperability of cooperation (concerted operations) or even mutual aid (sharing of resources). The choice between direct links and bridges will be made taking into account the cost of developing a new system for the whole of the communications and that of developing the different bridges where they are necessary. This second alternative allows existing systems to be retained and/or new ones to be developed without calling the general organisation into question (flexibility).

The existence and definition of interfaces between the components of the system results from the choices made regarding the system architecture. Today the general framework of the road management system we are heading towards may be summed up as shown in figure 4.2. This architecture is equally applicable to automatic toll charging, traffic management, traffic information management and value-added services.

Figure 4.2.

General architecture



The interfaces have to be designed in such a way that the growing industrial return in terms of economies of scale (mass production) and field of use (variety of services provided using a given item of equipment) will be exploited to the maximum without it being necessary to oblige actors to become part of a single organisation either for the provision of the service or for the management of receipts.

The fact is that using the combination transponder (economies of scale) and smart card (economy of field) makes it possible to achieve this objective by making the sub-systems transparent to the user. It is such considerations which make it possible to identify in CASH[68] the interfaces[69] which have to be compatible with all the components of the system which they link, i.e. the communication links between:

on-board equipment and ground equipment,
on-board equipment and the smart card,
public and private equipment and the smart card.

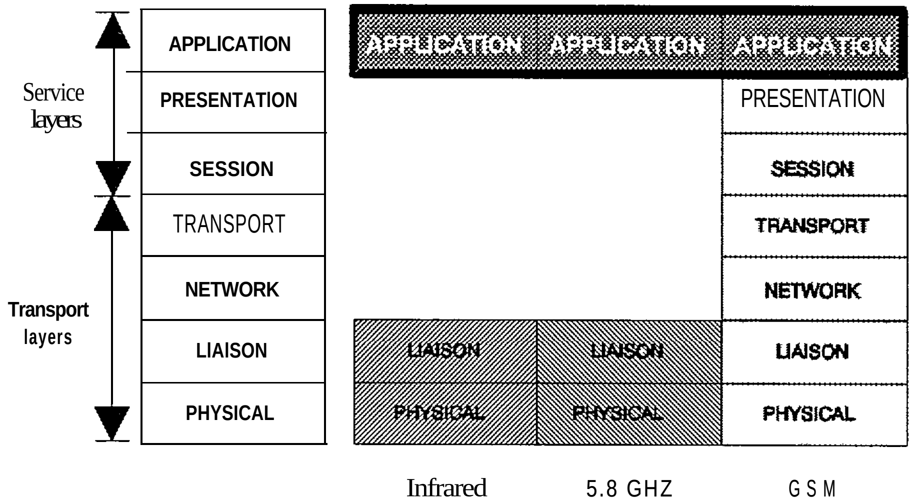
This compatibility will be complete if it is achieved at three levels :

- the physical interface connected with the compatibility of physical characteristics between neighbouring components (geometry, nature of the surfaces in contact, frequencies, mutual influence due to proximity, etc...) (IS0 I),

- the functional interface connected with the compatibility of the mechanical, electronic and electrical connections between components (ISO 2-6),

- the logical (software) interface connected with the compatibility of the software of the various components (ISO 7).

For the ground-vehicle interface corresponding to each of the three technical principles described in chapter 5, we have :



The same work is to be done for the other two interfaces.

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[68] CASH is a DRIVE project concerned with the functional specificities of automatic toll charging, but its conclusions concerning the compatibility of interfaces are valid for the system as a whole.

[69] To which should be added an interface between the system and the driver on board the vehicle (information on the transactions), which is important for both the acceptability of the system and road safety.

4.2. The Integrated Road Transport System (IRTS)

This concept first emerged as a result of studies carried out under the DRIVE 1 programme. Now, with the preparation of the European Union's 4th R&D Framework Programme, it is incorporated into a broader concept of integrated transport system that encompasses not only road transport, but also all land-based transport modes as well as the interface with air transport. This broadening of the initial objectives, which in the process have become increasingly complex, has not been accompanied, as yet, by any clarification of the original concept[70]. There is still a great deal of confusion, therefore, between the technical means used to process and transmit information, the internal information system needed to manage a transport system, and the production system which supplies information to the user. The aim of the third type of system is to meet a need ; the aim of the second is to provide the organisation needed to check that users' needs are properly met ; the first system, however, is simply a technical resource whose components, such as transmission cables, may be utilised by the other two to perform their functions. Furthermore, the various standpoints that have been taken into account in describing this system vary according to the actors involved and without the latter realising that the resulting contradictions are merely superficial and simply reflect the variety of individual approaches on the part of : professional carriers, firms manufacturing in-vehicle or telecommunications equipment, public works enterprises and transport system users, all of whom have their own idea of what the work of the infrastructure operator should be (and vice versa).

This is why we have decided to propose our own definition of IRTS[71] from the standpoint of the infrastructure manager responsible for maintaining traffic flows, that can apply to the implementation of systems based on the three technical principles outlined in chapter 5 of this document.

In this respect :

- the aim / objective of the system is to ensure mobility (freedom for motorists to go where and when they want) and convenience (comfort and safety) ;
- the function of the system is to manage road traffic as efficiently as possible ;

  while at the same time minimising the environmental impact (pollution and land use)
- the system is organised according to functional area, i.e. the type of trip and the geographical area served (obviously the single most important component of this organisation is the road infrastructure itself) ;

the system will evolve, through additions to the network and capacity increases in response to environmental pressure, into an integrated system in which the interfaces between different modes will enhance the overall performance.

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[70] Despite the lack of consensus on the conceptual and technical bases for systems, planners seem to be caught up in a headlong rush to introduce new concepts that are ever broader and vaguer than their predecessors (although more readily acceptable to various pressure groups such as road hauliers, environmentalists, users, etc...).

[71] Our aim is to distinguish IRTS from the term "Road Traffic Management System" with regard to 'IT applications, a distinction that we feel needs to be made in that the IRTS is designed to manage not only traffic flows but also the infrastructure (construction and maintenance) and the interfaces between the latter and the environment, attributes that are completely disregarded in programmes such as DRIVE, IVHS, etc...).

4.2.1. The dynamics of the system

There are two ways in which planning authorities can ensure mobility : they can either build new roads or improve their management of existing traffic flows. Up until now, the planners have always opted for the first alternative. It is only recently that, as the amount of land available for development has diminished, traffic levels have begun to have a serious impact on the quality of life of those living in the vicinity of road infrastructure[72] and that information technology now offers a means of optimising the use made of infrastructure by allowing managers to improve both the spatial and temporal distribution of traffic flows. To achieve this objective requires significantly lower system response times and real-time management of traffic flows, or in other words new system dynamics.

4.2.1.1. The long-term dynamic

Historically, growth in demand for transport has always elicited the slowest response (and the least constrained in terms of schedules) from planners. Over the past thirty years, for example, three different sources of congestion, requiring different types of response from traffic management authorities, may be seen to have been at work :

Cause of congestion	Response time	System response	Type of action
Bottleneck	5 years	Increased capacity	Anticipation
Migration	5 months	Temporal distribution	Adaptation
Incident	5 minutes	Temporal and spatial distribution	Control

Traffic flows in Europe are currently affected by all three types of congestion. Throughout the European road network, well-known bottlenecks exist which can only be remedied through investment in infrastructure. There are also periods of holiday departures and predictable temporary congestion ; and lastly there are areas where traffic flows are close to saturation point and where the smallest incident will immediately lead to congestion.

For many years, given the relative availability of land and the lack of concern over environmental issues, the main response of planners to all of the above problems was simply to increase capacity.

Indeed, it will always be necessary to increase capacity and to extend the network in order to meet growth in demand for transport. However, before resorting to such solutions (which will become increasingly expensive), it will become all the more necessary to improve the return on existing capacity by optimising the use made of it both temporally and spatially.

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[72] It is worth remembering, however, that throughout the world there are still many thousands of villagers desperately hoping that the planners will drive a road straight through the centre of their village, since for them a road is a lifeline.

4.2.1.2. The short-term dynamic

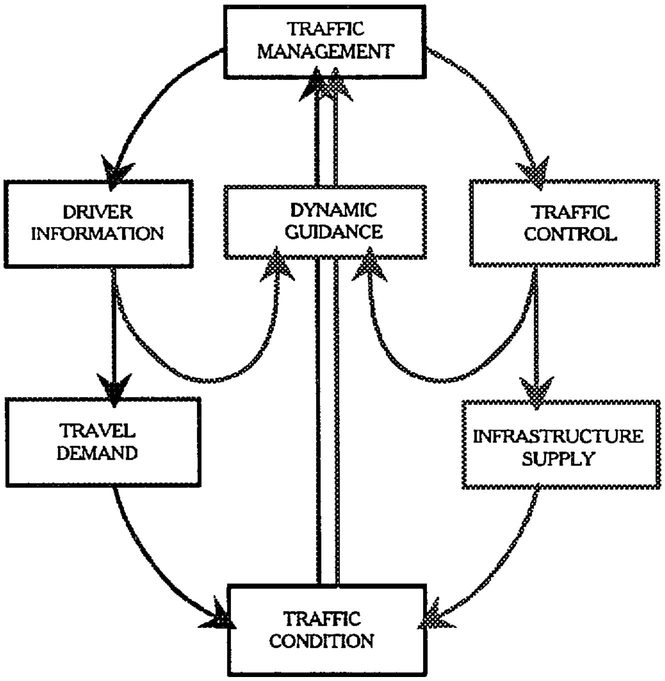
A system-based approach aimed at the dynamic management of road infrastructure is therefore essential. Such an approach must combine the three types of response identified above :

anticipation : to increase capacity (new infrastructure),
reduce demand (regional development),
adaptation : to spread demand (over time, by mode, by route),
control : to improve effkiency (making better use of existing infrastructure).

The prime area of application for information and telecommunications technologies clearly lies in control and adaptation and will permit the introduction of dynamic guidance services for drivers :

Figure 4.3.

Traffic management dynamics



Until now, all the areas of application that have been identified above have functioned as independent systems, each with its own means of collecting data. Thus the same stretch of carriageway, for example, may be equipped with one set of traffic counting devices installed by the engineers in charge of road-building (to obtain estimates of traffic volumes on which to base investment programmes), another set for traffk light controls, and a third for managing seasonal traffic peaks. On the other hand, according to local circumstances, there may only be counting systems covering one or two of these areas installed. However, any plans to introduce real-time traffic management and dynamic route guidance for drivers would require all functional areas (functional systems) to be interactive, as indicated below, which would therefore mean installing real-time communications systems.

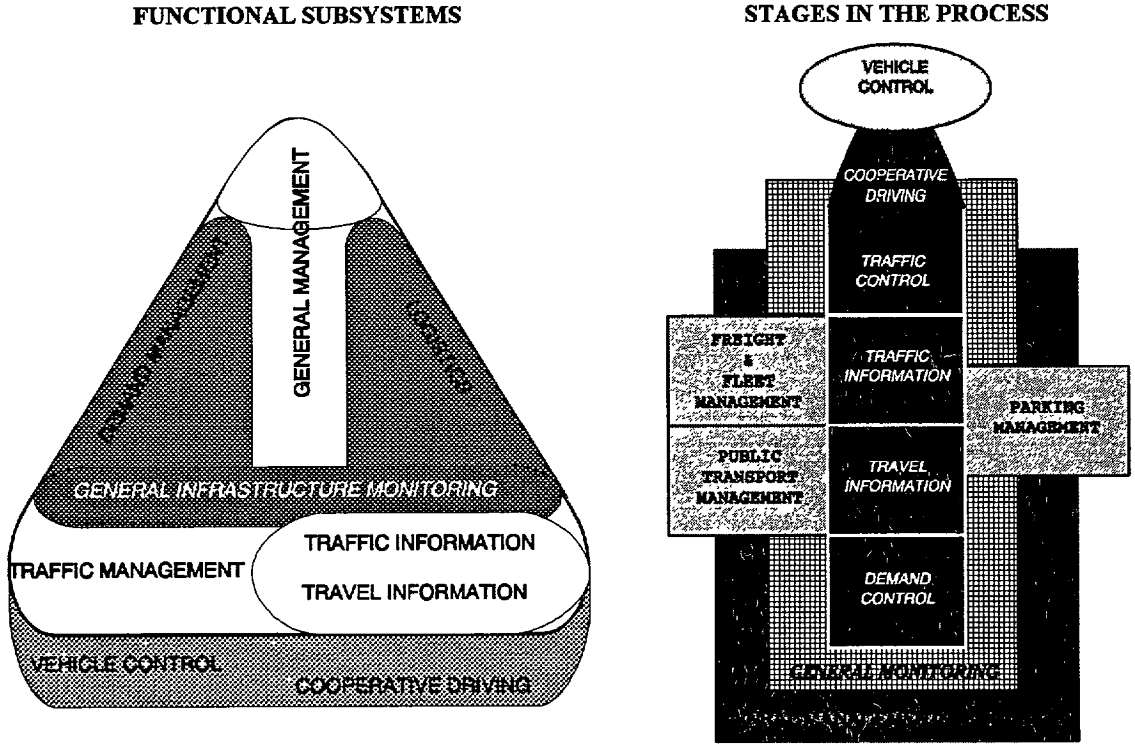
Such real-time "links" are provided by systems based on the use of information and telecommunications technologies. These new technological resources make it possible to deploy integrated systems for the management of both road traffic and interfaces with other modes of transport.

However, an appropriate regulatory and contractual environment is needed if this possibility is to become reality, and in particular an environment that will guarantee that the systems (applications) eventually introduced are interoperable throughout the European area. Indeed, in most cases, the critical size of operations for such systems is measured in terms of a continent and not at the level of individual countries.

4.2.2. The complete system

To have an overall vision of the system (we are taking the level of operating logic here) we must take into account not only the dynamic functions of operational management outlined above, but also functions relating to the management of professional road users (public transport and freight movements), logistic functions (general management), system monitoring, and the final function of parking space management. This provides the following breakdown, where the function may be regarded as either functional sub-systems or as stages in the travel process[73].

Figure 4.4.



FUNCTIONAL SUBSYSTEMS

STAGES IN THE PROCESS

4.2.2.1. Driver aid operational functions

These are the functions which are directly connected with driving. They are also the most recent. They were developed under the PROMETHEUS programme and important research is being carried out in the United States with the longer-term aim of arriving at the "Automated Highway System".

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[73] A complete list of functions is given at the end of the chapter in a series of tables showing the missions to which they contribute and their impact.

Vehicle control :

Existing systems, like ABS, or systems about to be introduced, such as anti-collision systems, will make it possible, with systems monitoring the state of the vehicle, its trajectory and the driver's vigilance, first of all to assist the driver to drive more safely, and later to take over the driving operations.

Co-operative driving :

In the future, cars will have their own on-board computers which will not only fulfil several functions, but will also be able to exchange information between one another so that the driving system is informed of any manoeuvre by the preceding or following vehicle.

4.2.2.2. Traffic management and services operational functions

These functions are those which directly concern the responsibility of the infrastructure managers and by means of which they fulfil their missions and that of the private operators who provide personalised services to drivers. They are broken down according to the response time given to the user for his decisions. The aim of this breakdown is to clarify the presentation of the actions of infrastructure managers and the services provided by operators, but it must be borne in mind that there is no discontinuity between actions and services. However, this presentation has the advantage of making it clear how and why the decisions taken in the context of one function constitute information for the performance of the other.

Traffic control :

Through traffic control the infrastructure manager takes measures to regulate flows to ensure the best collective use of the infrastructure. This can range from the simple traffic light to the introduction of adaptive traffic light coordination systems in large conurbations. In this case the user's choice is limited to abandoning his trip or continuing, depending on the state of the traffic.

Traffic information (information supplied to drivers on the road) :

This informs the driver during the trip on the different traffic situations or reductions in infrastructure capacity he is likely to meet with. The user has already chosen his transport mode but he is given the opportunity to optimise its spatial use by being able to choose between several routes and thus minimise the journey time.

Travel information :

This gives the user the options open to him when preparing the journey. The information supplied should enable him to choose between several transport modes and above all to choose his route and time of departure.

Demand management :

This influences transport demand through incentives or restrictions or through charging for infrastructure use. Up to now this type of management could only be through anticipation, but the arrival of TT technologies will permit management by real-time adaptation.

Parking management :

This optimises the use of parking places and avoids drivers having to waste too much time looking for a space (it is estimated that in a given district of a town 30% of the drivers are in transit and 30% are looking for a parking spot).

4.2.2.3. Functions relating to user management:

These functions are those which a transport professional has to perform to fulfil his task. They therefore do not concern the infrastructure manager in the first place. However, the improved quality of traffic management will have a considerable impact, notably on the efficiency of public transport. What is more, professional carriers will be the first users of information and communications technologies to improve their own efficiency. Lastly, these technologies will permit cooperation (interoperability) with the sharing of resources between transport professionals and infrastructure managers.

Public transport management :

Here it is a matter of giving public transport operators the tools for improving the regularity of service and passenger information. TT will also make it possible to permanently track vehicles and improve safety in difficult urban areas.

Freight and fleet management :

Road hauliers will be given tools for optimising the use of their truck fleet thanks to better information on the availability of loads and on traffic conditions, enabling them to optimise trips. Furthermore, TT will permit the real-time monitoring of consignments of dangerous goods and thus improve the possibilities for intervention in the case of accident or disaster.

4.2.2.4. Basic functions

These are the general management functions found in any organisation. They correspond to the tasks of the decision and information systems and logistical support. Though not directly connected with the production of the system they are essential to its functioning.

General infrastructure management :

To efficiently perform all the above functions the infrastructure managers obviously need to be able to forecast traffic trends, define a management policy and maintain the infrastructures, tasks which correspond to mission (1) as defined in chapter 3 and the logistical support required for missions 6 and (3).

General infrastructure monitoring :

This involves an information system in the operations logic of the road traffic management system. These functions are essential for knowing what is happening and being able to take traffic control decisions and keep drivers informed. At present each function has its own monitoring system, but the sharing of resources between systems made possible by TT should permit substantial savings and ensure the integrity of the system and the interoperability of the sub-systems.

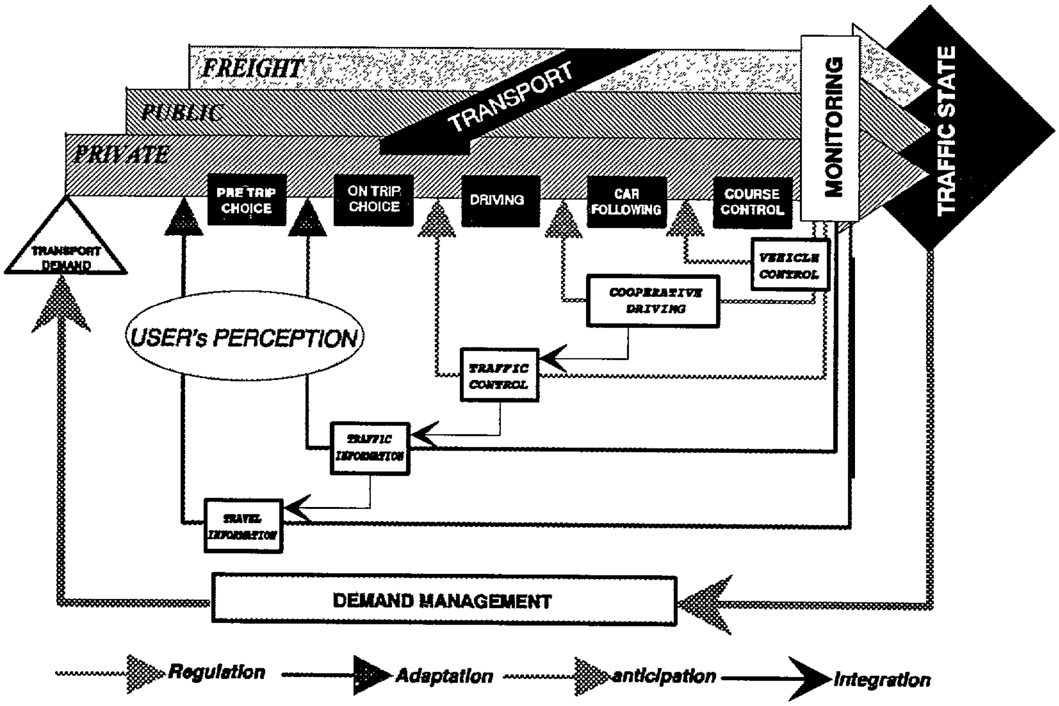
4.2.3. The integrated system

The different functions described above are generally performed separately. In particular, until very recently the information used for traffic control and the decisions taken in this respect were not used to give real-time traffic information. It was the arrival of the new information and communications technologies which made it possible to connect the functional sub-systems of control and information and thus bring about partial integration of the system (the ARIAM/BEVE1 project in Germany is no doubt the most developed example at present).

The following figure is a schematic diagram of the information flows in a future integrated system in which the connection of the functions of vehicle control, cooperative driving and traffic control are integrated in the automatic highway and where the traffic control, traffic information, travel information and demand management are integrated in a real-time collective travel management system.

Figure 4.5.

Information flows



4.2.4. System efficiency

It is not enough simply to install new technical facilities. Planners must first determine whether they are capable of delivering the services expected, and secondly whether the organisational structures into which they are to be incorporated are capable of functioning properly. Thus, even though they are not germane to the present document, it is worth recalling the criteria used to assess the utility of TT systems as well as the environment that such systems need in order to function efficiently.

In other words, the potential benefits in each functional area (functional system) may be viewed from two different standpoints :

1. Ultimate contribution of system (criteria for assessing utility) :

   Utility has two aspects : effectiveness (i.e. the system provides the services expected) and efficiency (i.e. the resources used to meet the initial objectives) :

   a) effectiveness : impact on the environment in terms of :
      - congestion,
      - accidents,
      - pollution,
      - driver comfort,
      - driver safety ;

   b) efficiency : performance in terms of :
      - cost (fuel consumption),
      - amortisation of investment in infrastructure and mobile equipment,
      - travel time.

   The Table given in the Annex lists these contributions according to different types of environment.

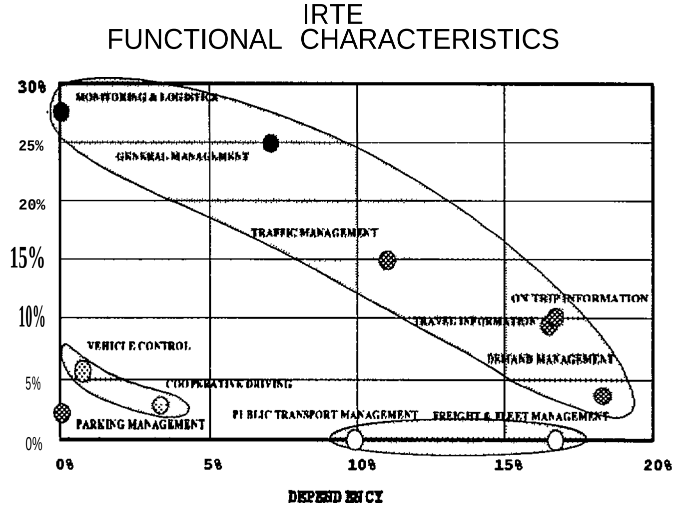
2. Relative position of system in the functional chain of an integrated system (necessary conditions) :

   As noted earlier, the current revolution in road traffic management is based on the interactiveness / interdependency of functional areas which had hitherto been managed as completely separately entities. Before installing new technologies, it is therefore essential to make sure that the latter can be properly integrated into the existing road traffic management scheme, and in particular that any other functions needed to ensure that such technologies work properly are adequately covered by other facilities.

   In other words, the satisfactory performance of “motive” functional areas is an essential prerequisite for successful deployment of any TT system based on ground-to-mobile communications links. We give below the results of a summary motivity / dependence analysis carried out for an integrated road traffic management system.

Figure 4.6.

Motivity versus dependency of functional areas



The motivity of a functional area indicates the scale of its contribution (in terms of information) to the system as a whole : the higher the motive power of an area, the more it is essential to the satisfactory functioning of the system.

The dependency of an area indicates the degree to which its requirements (in terms of information) must be satisfied through input from other areas : the more dependent an area is on other areas, the greater the need to ensure, before starting operations in that area, that all the conditions for satisfactory performance have been met.

NB : The above levels of motivity / dependency are based on the assumption that the bodies responsible for different functional areas have decided to co-operate in order to lower expenditure on the monitoring system and that all the functions within each area are indeed available (certain functions may be abandoned in order to reduce dependency).

The commercial success of a given application will be based not only on its contribution to the system as a whole, but also on the scope it offers for charging users for the services provided. It would therefore be difficult to make drivers pay willingly for a system designed to improve the environmental impact of traffic. In contrast, any service which improves the efficiency of road transport may be charged to users (provided that the relevant facility has been installed).

4.3. TT systems

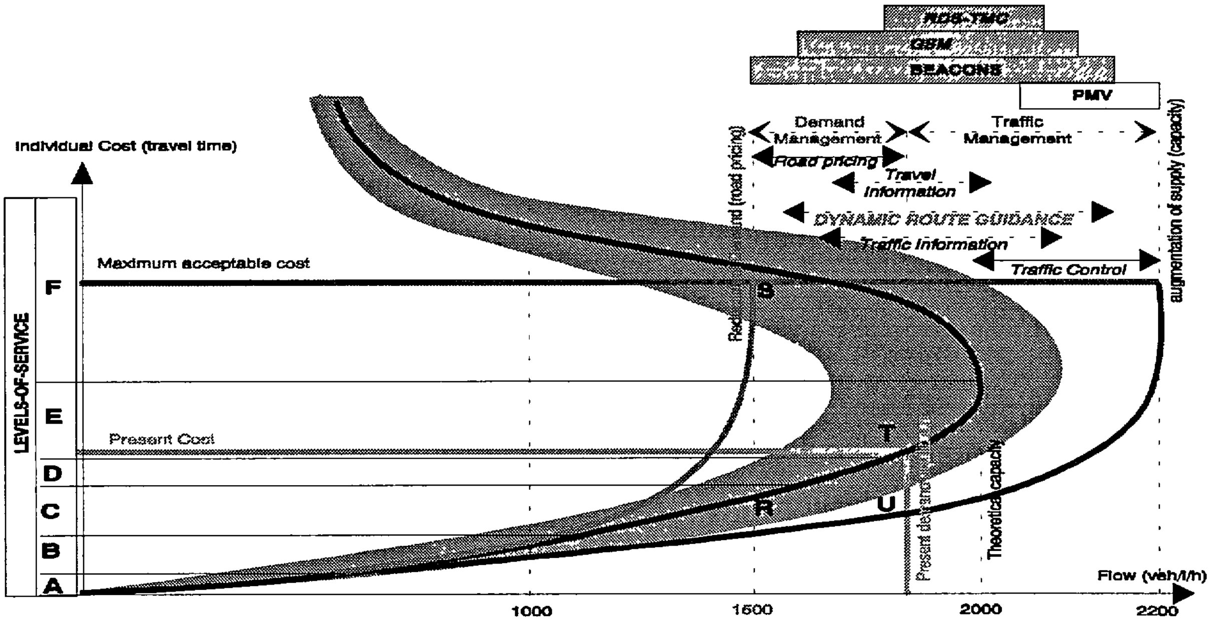
4.3.1. Impact of the new technologies

As it is becoming increasingly difficult to build new infrastructures because of the shortage of available land and the growing concern with environmental protection, it is necessary to introduce new tools to try to overcome these problems. Transport telematics can be used in two ways here :

- as an economist's tool, to influence demand by imposing charges for use,
- as an engineer's tool, to improve the utilisation of existing capacities by reducing accidents / incidents and improving traffic conditions.

Figure 4.7.

Potential impact of information technologies on traffic management (mission ②)

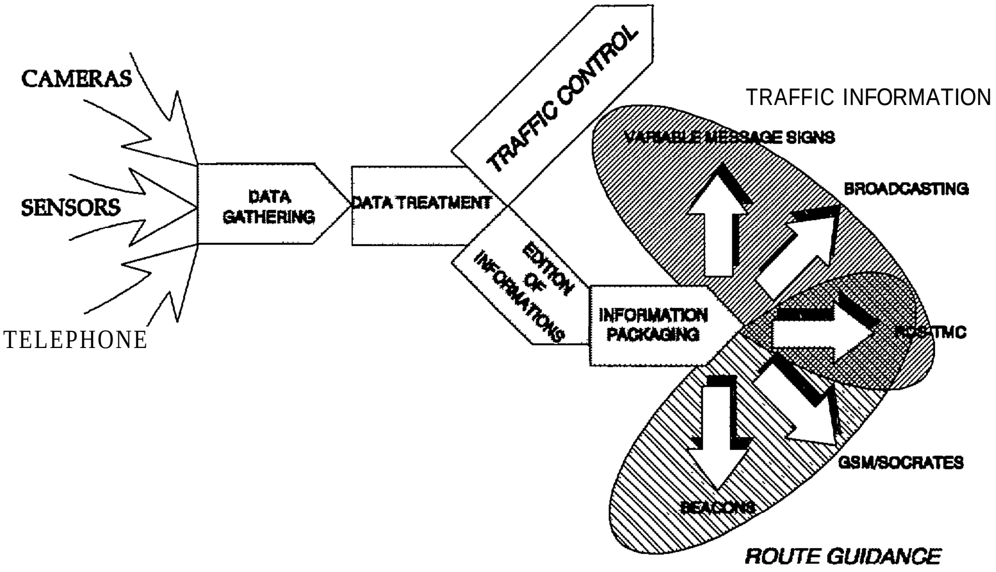


The above figure shows the general appearance of the marginal cost of travel to a user as a function of the level of service (LOS), i.e. as a function of flow with respect to the capacity available, to show how transport telematics can be used to reduce demand or improve driver services and optimise the use of the existing capacity.

There is thus reason to think that the introduction of TT systems, that is to say applications based on information and telecommunications technologies, will allow all functional areas to be integrated into the Road Traffic Management System and use to be finally made of all the means of action (anticipation, adaptation and control) available to the managers of road infrastructure. A description of systems based on three technical principles will be given in chapter 5. These technical principles are essentially dedicated to the transmission of information to the driver by means of real-time ground / vehicle communication. The following figure shows how they fit into the process of traffic management (mission 0) and road information services (mission CD).

Figure 4.8.

Information production chain



Each technical principle can be applied through one or more technologies[74]. The choice of technology, degree of functional integration and market coverage are determining factors in the future success of a given system. We shall outline some of the trends in this area, although we do not intend to specify the potential scopes of application of the various systems considered. This question will be resolved through competition. In contrast, we shall identify the key factors in deployment of such systems at European level.

It is these technology / application combinations that we refer to as TT systems, whose deployment the Tool Box and this Explanatory Guide are designed to aid through clarification of the conditions necessary for creation of a favourable institutional and contractual environment.

It should be noted that although the introduction of TT systems will rapidly become a necessary condition for satisfactory management of the European road network, they will not be sufficient to remove the capacity limitations constraining mobility.

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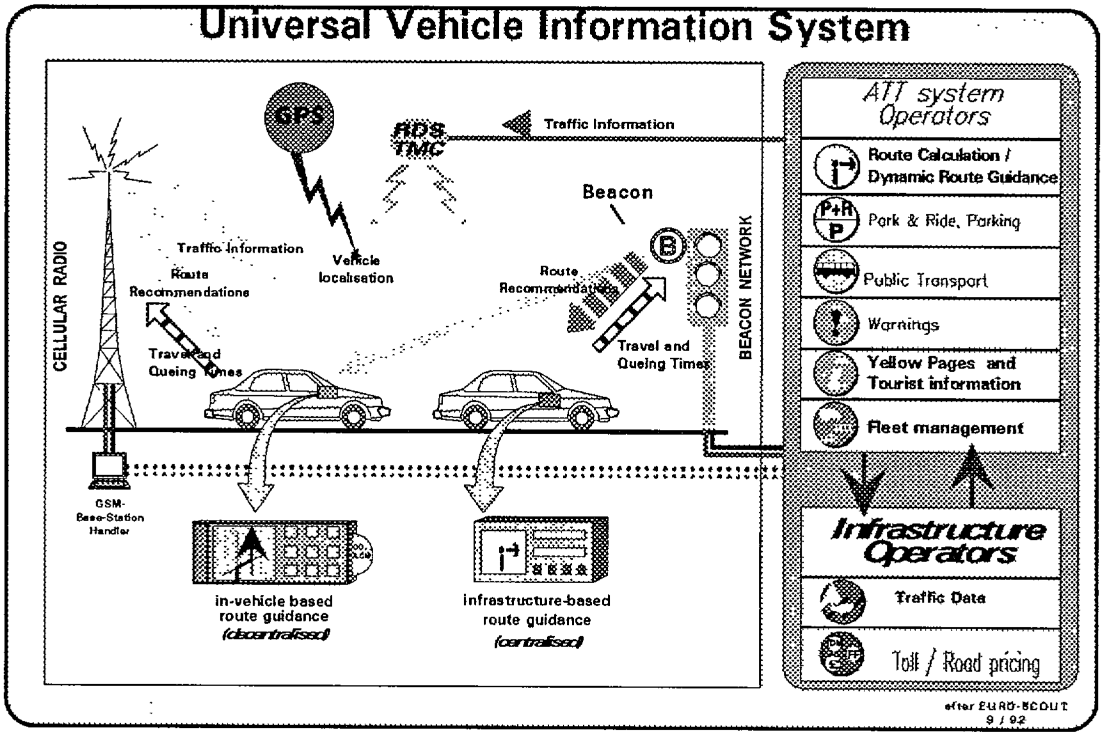
[74] See chapter 5, section 1.

A brief pictorial description is given below of the type of system that might be seen in Europe in the years to come. A more detailed review of the three basic technical principles utilised, that is to say (besides from satellite systems) radio subcarriers, cellular radio telephones and beacon-based communications systems, will be given in chapter 5. The current opinion of experts is that these systems are complementary, and that ultimately drivers will have access to a universal system employing 4 or 5 communications media, as the case may be. The figure shown below, taken from a EURO-SCOUT publication, illustrates the form such a system might take.

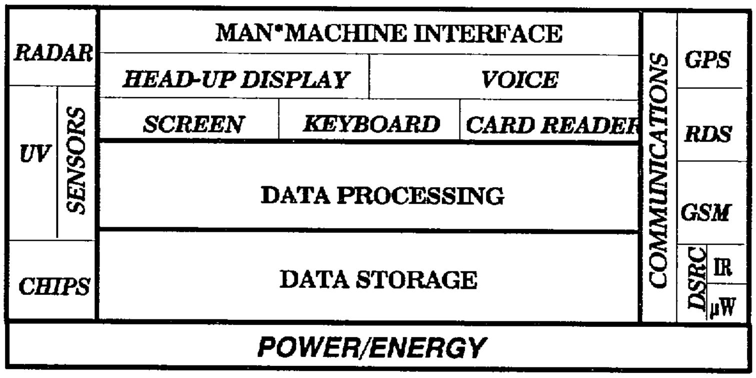
Figure 4.9.



The driver will access the system though an in-vehicle terminal, which is transparent to the driver, organised as shown in the figure below :

Figure 4.10.

Structure of the on-board equipment

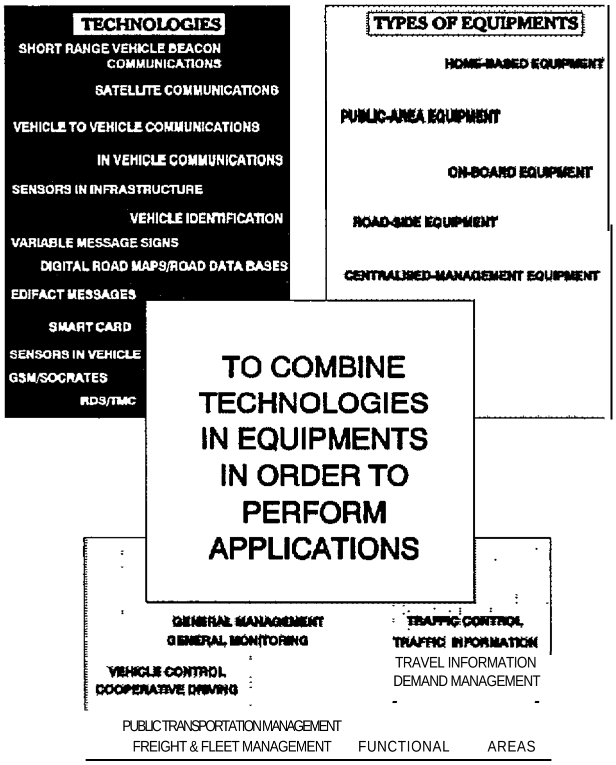


There is therefore no point in waiting until a “fully optimised" ground-to-mobile communications system has been developed. What is important, firstly, is to compile reliable data that can subsequently be supplied to drivers (the task of road infrastructure managers and TT service operators), and secondly to develop a fully transparent man-machine interface (the task of industry).

4.3.2. Functional areas, functions, applications and systems

Lastly, we give below an idea of the “principal dimensions” (technological, instrumental and functional) to take into account in developing applications :

Figure 4.11
The field of TT



The term “application” as used in this Guide is taken to mean using a given system to provide[75] specific functions in one or more fields or functional areas, where a field is a set of functions designed to meet the same objectives : a field is therefore a functional sub-system. The technical principles analysed in the present document may be utilised for some applications[76] but not others, depending upon their characteristics.

Some of these applications will be more cost-effective than others, according to the technical principle adopted. It is not our aim here to judge the economic merits or demerits of individual applications. What matters is whether or not a given application is effective and, if so, under what conditions. The answers to these questions will allow us to identify the legal and contractual arrangements that need to be made before a given application is actually implemented.

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[75] See chapter 5.

[76] This combination of a technical principle with an application is what we refer to as a TT system.

Annexe 4.1.
Impact of the various functions

	SAFETY				EFFICIENCY				ENVIRONMENT			
	RURAL	INTERURBAN	PERIURBAN	URBAN	RURAL	INTERURBAN	PERIURBAN	URBAN	RURAL	INTERURBAN	PERIURBAN	URBAN
GENERAL MANAGEMENT & LOGISTICS												
Strategic planning				·	▨	■	■	■	■	■	■	■
Strategic Management						■	■	■				
Forecasting						■	·	·				
General information management	▨	▨	▨	▨		■	■	■				
Infrastructure management						■	■	■		·	·	·
User rescue services management						■	■	■	·	·		·
Infrastructure services logistics						■	■	■				
Fee collection management							▨	■				
Policing/Enforcing management	■	■	■	■		▨	▨	■			·	
GENERAL INFRASTRUCTURE MONITORING												
Ambient conditions monitoring	▨	▨	▨	▨	▨	■	■	■	▨	▨	▨	▨
Road status monitoring	▨	▨	▨	▨	▨	▨	■	■	▨	▨	▨	▨
Events monitoring	▨	▨	▨	▨		▨	■	■				
Traffic Monitoring	▨	▨	▨	▨		▨	■	■				
VEHICLE CONTROL												
Monitoring Environment & Road	■	■	■	■			·	·			·	·
Monitoring Driver	■	■	■	■			·	·				
Monitoring Vehicle	■	■	■	■			·	·				·
Vision Enhancement	■	■	■	■			·					
Collision risk estimation	■	■	■	■				·				
Actuator Control	■	■	■	■								
Dialogue Management	■	■	■	■			·	·				
COOPERATIVE DRIVING												
Intelligent Manoeuvring & Control	■	■	■	■	·	·	▨	▨				
Intelligent Cruise Control	■	■	■	■	·	·	▨	▨				
Intelligent Intersection Control	■	■	■	■	·	·	▨	▨				
Medium Range Pre-information	■	■	■	■		·	▨	▨				
Emergency Warning	■	■	■	■	·	·	▨	▨			·	·
TRAFFIC CONTROL												
Section traffic control			▨	■		▨	■	■		·	·	·
Intersection traffic control			▨	■		▨	■	■				·
Network traffic control			▨	■		▨	■	■			·	·
Localised area Traffic Control			▨	■		▨	■	■		·	·	·
TRAFFIC INFORMATION												
Navigation					▨	■	■	■	·	·	·	·
Route computation (guidance)					▨	■	■	■		·	·	·
Route guidance direction					▨	■	■	■	·			·
Dynamic route information		■	■	■	▨	■	■	■	·		·	·
TRAVEL INFORMATION												
Travel planning						■	▨	·		·	·	·
Static route information						■	▨					·
Personnal communications						▨	▨	·				
DEMAND MANAGEMENT												
Demand restraints			▨	▨		■	■	■		▨	■	■
Supply control			▨	▨		▨	■	■		▨	■	■
PARKING MANAGEMENT												
Parking space Management				▨			·	■			▨	■
Parking guidance				▨			·	■			▨	▨
Parking Reservation & Payment							·	■				
On-street parking management				▨				■			▨	■
PUBLIC TRANSPORT MANAGEMENT												
Scheduling					■	▨	▨	■				■
Operations management						▨	▨	■				■
Passenger information					■	▨	▨	■				■
Fare collection					■	■	■	■				
Maintenance								■	▨	▨	▨	■
FREIGHT & FLEET MANAGEMENT												
Logistics & Freight Management					▨	▨	▨	▨			·	·
Fleet/resource management					▨	▨	▨	▨	·	·		·
Vehicle/cargo management					▨	▨	▨	▨	▨	▨	▨	▨
Hazardous goods monitoring	■	■	■	■	▨	▨	▨	▨	■	■	■	■

■ Essential

· Useful

▨ Important

☐ No impact

Annexe 4.2.
Beneficiaries of the different functions

FUNCTIONAL AREAS		DRIVERS				AUTHORITIES				INFRA OPERATORS			
		In-vehicle	at home	road side	Public place	Rural	interurban	periurban	urban	Rural	interurban	periurban	urban
GENERAL MANAGEMENT & LOGISTICS	1.0.0												
Strategic planning	1.1.0					▨	▨	▨	▨				
Strategic Management	1.2.0					▨	▨	▨	▨				
Forecasting	1.3.0					▨	▨	▨	▨	▨	▨	▨	▨
General information management	1.4.0									▨	▨	▨	▨
Infrastructure management	1.5.0									▨	▨	▨	▨
User rescue services management	1.6.0			▨						▨	▨	▨	▨
Infrastructure services logistics	1.7.0			▨						▨	▨	▨	▨
Fee collection management	1.8.0	▨		▨						▨	▨	▨	▨
Policing/Enforcing management	1.9.0			▨		▨	▨	▨	▨	▨	▨	▨	▨
GENERAL INFRASTRUCTURE MONITORING	2.0.0												
Ambient conditions monitoring	2.10									▨	▨	▨	▨
Road status monitoring	2.2.0									▨	▨	▨	▨
Events monitoring	2.3.0										▨	▨	▨
Traffic Monitoring	2.4.0										▨	▨	▨
VEHICLE CONTROL	3.0.0												
Monitoring Environment & Road	3.1.0	▨											
Monitoring Driver	3.2.0	▨											
Monitoring Vehicle	3.3.0	▨											
Vision Enhancement	3.4.0	▨											
Collision risk estimation	3.5.0	▨											
Actuator Control (Dynamic vehicle control)	3.6.0	▨											
Dialogue Management	3.7.0	▨											
COOPERATIVE DRIVING	4.0.0												
Intelligent Manoeuvring & Control	4.1.0	▨											
Intelligent Cruise Control	4.2.0	▨											
Intelligent Intersection Control	4.3.0	▨		▨						▨	▨	▨	▨
Medium Range Pre-information	4.4.0	▨		▨						▨	▨	▨	▨
Emergency Warning	4.5.0	▨		▨						▨	▨	▨	▨
TRAFFIC CONTROL	5.0.0												
Section traffic control	5.1.0										▨	▨	▨
Intersection traffic control	5.2.0										▨	▨	▨
Network traffic control	5.3.0									▨	▨	▨	▨
Localised area Traffic Control	5.4.0									▨	▨	▨	▨
TRAFFIC INFORMATION	6.0.0												
Navigation	6.1.0	▨											
Route computation (guidance)	6.2.0	▨	▨										
Route guidance direction	6.3.0	▨		▨									
Dynamic route information (On trip Information)	6.4.0	▨		▨									
TRAVEL INFORMATION	7.0.0												
Travel planning	7.1.0	▨	▨		▨								
Static route information	7.2.0	▨	▨		▨								
Personnal communications	7.3.0	▨	▨		▨								
DEMAND MANAGEMENT	8.0.0												
Demand restraints	8.1.0							▨	▨			▨	▨
Supply control	8.2.0							▨	▨			▨	▨
PARKING MANAGEMENT	9.0.0												
Parking space Management	9.1.0								▨				▨
Parking guidance	9.2.0	▨		▨									▨
Parking Reservation & Payment	9.3.0	▨	▨		▨								▨
On-street parking management	9.4.0								▨				▨
PUBLIC TRANSPORT MANAGEMENT	10.0.0												
Scheduling	10.1.0		▨			▨	▨	▨	▨				
Operations management	10.2.0		▨	▨									
Passenger information	10.3.0		▨		▨								
Fare collection	10.4.0	▨			▨								
Maintenance	10.5.0	▨	▨										
FREIGHT & FLEET MANAGEMENT	11.0.0												
Logistics & Freight Management	11.1.0	▨	▨										
Fleet/resource management	11.2.0		▨										
Vehicle/cargo management	11.3.0		▨										
Hazardous goods monitoring	11.4.0	▨	▨			▨	▨	▨	▨	▨	▨	▨	▨

Annexe 4.3.
Contribution of the functions to the operators missions

Mission 1	Guarantee viability	Class 1	Links
Mission 2	Operate flows	Class 2	Corridors
Mission 3	Inform drivers	Class 3	Networks

	Mission 1			Mission 2			Mission 3		
	C1	C2	C3	C1	C2	C3	C1	C2	C3
GENERAL MANAGEMENT & LOGISTICS									
Strategic planning					▒	█			
Strategic Management	░	█	█						
Forecasting				░	▒	█			
General information management				░	▒	█			
Infrastructure management	█	█	█						
User rescue services management	█	█	█						
Infrastructure services logistics	█	█	█						
Fee collection management				░	░	░	░	░	
Policing/Enforcing management				█	█	█			
GENERAL INFRASTRUCTURE MONITORING									
Ambient conditions monitoring	░	▒	█						
Road status monitoring	█	█	█						
Events monitoring				░	▒	█			
Traffic Monitoring				░	▒	█			
VEHICLE CONTROL									
Monitoring Environment & Road									
Monitoring Driver									
Monitoring Vehicle									
Vision Enhancement									
Collision risk estimation									
Actuator Control (Dynamic vehicle control)									
Dialogue Management									
COOPERATIVE DRIVING									
Intelligent Manoeuvring & Control									
Intelligent Cruise Control									
Intelligent Intersection Control									
Medium Range Pre-information									
Emergency Warning									
TRAFFIC CONTROL									
Section traffic control					░	█			
Intersection traffic control				░	▒	█			
Network traffic control				░	▒	█			
Localised area Traffic Control				░	▒	█			
TRAFFIC INFORMATION									
Navigation							░	▒	▒
Route computation (guidance)								░	▒
Route guidance direction							░	▒	▒
Dynamic route information (On trip information)									▒
TRAVEL INFORMATION									
Travel planning								░	▒
Static route information							░		▒
Personnal communications								░	░
DEMAND MANAGEMENT									
Demand restraints					▒	█			
Supply control					▒	█			
PARKING MANAGEMENT									
Parking space Management						▒			
Parking guidance									░
Parking Reservation & Payment									░
On-street parking management									
PUBLIC TRANSPORT MANAGEMENT									
Scheduling									
Operations management									
Passenger information									
Fare collection									
Maintenance									
FREIGHT & FLEET MANAGEMENT									
Logistics & Freight Management									
Fleet/resource management									
Vehicle/cargo management									
Hazardous goods monitoring	▒	▒	▒						

░ Suggested ▒ Recommended █ Essential

5. Technical and operational aspects of systems

Our aim in the case study of the experience of ERTICO members, of which the present chapter presents the initial findings, was to identify the functions that TT[77] systems might be able to provide through application of the three technologies known to be available in the early 1990[78], namely radio subcarriers and short-range beacon communications, or systems that will be introduced in the near future such as digital cellular radio telephony. The fact that a system is technically capable of providing a given function does not mean to say that it is either desirable (and/or economically viable) to use it in this way.

5.1. Areas in which given technologies are applied

5.1.1. New services[79]

The main benefit to be gained from the introduction of information and telecommunications technologies into the area of road transport is that it will at last allow latent demand from both drivers and road infrastructure managers to be satisfied through the provision of real-time information and traffic management services.

5.1.1.1. Driver aids

The services which can be supplied to drivers while they are at the controls of their vehicle may be summarised as follows :

-- functions connected with travel assistance :

· positioning :	knowing where the vehicle is,
· navigation :	finding a route,
· static guidance :	following a given route regardless of traffic conditions (which does not exclude taking account of average traffic conditions),
· dynamic guidance :	following the best route available on the basis of traffic conditions at any given time and drivers' travel criteria.

-- to which ancillary service functions may be added, such as :

· information regarding : traffic conditions,
availability of parking spaces,
options provided by other modes of transport,
- economic information (yellow pages),
- specific information (fleet management).

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[77] See the definition given in chapter 1, section 4.

[78] To ensure that the results of this study were as realistic as possible, we confined our investigation to three system actually under development, namely RDS-TMC, SOCRATES and EURO-SCOUT. The present chapter therefore steers a middle course between a straightforward description of each system and consideration of each system as the application of a given technical principle.

[79] See the Table at the end of the chapter which summarises the services supplied to (functions performed with regard to) different parties (private and professional users. authorities and road infrastructure managers).

- -- driving aid functions :
    - lateral and longitudinal guidance,
    - speed control,
    - automatic driving.

5.1.1.2. Instruments available to the infrastructure manager

New technologies will allow infrastructure managers to :

- -- regulate demand for infrastructure use by allowing tolls to be levied at rates varying according to both time of day and geographical area (tariff modulation) without vehicles having to stop ;

- -- balance traffic loads within the network through the real-time distribution of traffic flows ;

monitor the network continuously (“black” spots, tracking shipments of hazardous materials, etc.. .).

The remainder of this chapter focuses primarily on travel aid functions, given that the aim of this Guide is to explain the technical aspects of these services which will require a new form of collaboration between public and private actors. It nonetheless should be stressed that provision of many of the above services to drivers will depend upon road infrastructure managers being both authorised and competent to install and run real-time travel demand and traffic management systems”.

5.1.2. Technical principles applied

The revolution brought about by the development of IT systems lies in the fact that it is at last possible to provide a link between the driver and the road infrastructure manager which no longer relies solely on visual aids (road signs) or limited radio communications. For several years now, drivers are no longer isolated in their vehicles and are able to remain in permanent contact with the outside world (CB radio, radio telephones, radio-paging systems and satellite communications). These means of communication are as follows :

	Broadcast coverage	**Data flow rate**	**Exchange of information**
Satellite	continent-wide	low	possible
Radio-broadcasts	country-wide (LW)	low	no
Radio subcarrier	0.20-1000 sq.km.	100 bits/s	**no**
Cellular radio telephones	2000 sq.km	9 600 bits/s	yes
Beacons		From 0.25 Mbits/s[81] to 1 Mbits/s depending on the application	
Infrared	30-100 sq.m		yes
Ultra-high frequency	10-50 sq.m		**yes**

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[80] See chapter 4.

[81] The standard looks set to increase to 512 kbits/s.

Satellite and radio broadcasting are widely used communications technologies. This Guide will mainly be restricted to the last three technical principles listed above. Alternative technologies have been developed for each of these principles :

- for radio subcarriers :
  - Radio Data System Traffic Message Channel (RDS-TMC) using current analog FM radio subcarriers,
  - in about ten years time, the Digital Audio Broadcasting (DAB) system currently under development, which should offer much higher data flow rates ;
- for cellular radio telephony :
  - analog technologies currently available on the market such as Mobitex and the 3 RP network,
  - digital technology covered by the European standard on GSM, for which a complementary standard on GRDS, which would allow channels to be used for services such as driver information on road conditions, is currently under discussion ;
- for beacons :
  - the infrared route-guidance technology which has been tested in full-scale trials in Berlin,
  - ultra-high frequency technology, which would seem to be emerging as the standard technology for automatic toll-debiting systems[82] and with regard to which the CEPT has published a recommendation, subsequently approved by all member countries, that the 5.8 GHz frequency be used for ground-to-vehicle communications links for which this technology is used.

Since the aim of the present chapter is to provide sufficient details of the technical characteristics of systems for an insight to be gained into the legal implications of introducing TT systems based on the above technologies, we felt that it would be preferable to concentrate on the "technological principles" applied rather than the technologies themselves, particularly in view of the fact that the latter are proposed by industry as competing products. The operating principles on which the technologies are based will determine the type of legal relations that will apply between operators, authorities and users, whereas technological capability is the factor which will determine the competitive advantage that firms will attempt to secure, as well as the risks they are prepared to run.

Nonetheless, there is no firm dividing line between the capabilities of a given technologies and the legal requirements applicable to utilisation of the principle underpinning such capabilities ; thus in some countries (such as France) the radio subcarrier is "owned" to the operator (TDF), whereas in others (such as Germany) it belongs to the broadcaster, which can radically affect the development potential of the system as well as the nature of both the technical and the economic risks involved (see below).

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[82] Automatic toll-debiting has not been included in this Guide. It is currently being studied by the AUDIT Task Force, whose findings have been published by ERTICO (so far only circulated to members).

5.2. Classification of travel assistance systems[83]

There are several different types of travel assistance systems. Some (known as “general” systems) supply all users with the same information on traffic conditions within a given area, while others (known as “individual” systems) provide information tailored to the specific requirements of individual motorists. Such assistance may be either “static” (i.e. with no updating of information) or “dynamic” (i.e. real-time information), and may take the form of aid with “navigation” or “route guidance” ; the efficiency of the system may also be optimised through the use of “centralised” or “decentralised” configurations.

5.2.1. General systems : driver information

Some of these systems have been in use for many years (radio broadcasting), others have only been introduced within the past few years (variable message panels).

5.2.1.1. Radio broadcasting

Radio broadcasts may be used in four different ways :

- The first is for infrastructure managers to supply existing radio stations with information about incidents or specific events. This information is then relayed to motorists through news “flashes”. This procedure is used in France at the beginning and end of major holiday periods.
- The second consists in the infrastructure manager reaching an agreement with an existing radio station (or in the manager setting up his own radio station) whereby information on traffic conditions is broadcast on a regular and systematic basis. This procedure is used in France by motorway companies (who are increasingly tending to set up their own broadcasting facilities - Autoroute FM on a frequency of 107.7 MHz) and in Italy (Isoradio on a frequency of 103.3 MHz with an agreement with the national broadcasters).
- The third procedure has been used in Germany for many years (ARI system using a subcarrier of 57 kHz) and consists in drivers being warned by an audio signal (transmitted via an RDS system) that a message of potential interest to them is about to be broadcast by a dedicated radio station set up solely to provide on traffic conditions. The coverage of a given station is in the order of ten kilometres.
- The fourth procedure consists in using RDS (Radio Data System) to transmit a message to drivers that will be stored on their in-vehicle terminals for use at a later time. This is a more advanced form of RDS known as TMC (Traffic Message Channel), for which a standard is currently being drawn up and which will eventually be incorporated into a future dynamic navigation / route guidance system (see below).

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[83] We have drawn a distinction between travel assistance and driver aids. Travel assistance consists in helping drivers to optimise their trips ; driver aids are designed to help enhance the safety of drivers.

5.2. I. 2. Variable Message Signboards (VMS)

This process consists in sending messages to drivers by means of signs positioned at strategic locations chosen according to the type of information to be conveyed. Four types of boards are utilised :

- variable direction signs which enable infrastructure managers to indicate alternative routes as a function of the traffic situation on a network as a whole ;
- alphanumeric signboards which display short phrases providing information about incidents, traffic conditions or safety. The advantage to using such boards is that they can transmit a wide variety of messages, the one disadvantage being that foreign motorists in countries where such boards are used are unable to understand the messages displayed. These boards were first used in France (SAFER), and have since been introduced throughout Europe (e.g. on the M25 around London, etc...) ;
- boards displaying pictograms, which in most cases are simply highway code symbols (Germany and Italy) or schematic representations of the network (Japan). While the information conveyed is less explicit than that displayed on alphanumeric boards, it is accessible to a greater number of drivers ;
- boards displaying a schematic diagram of the network and using colours to indicate the traffic situation. This type of board is found mainly in Japan.

This form of driver information system has been used for many years in France to guide motorists onto alternative routes during holiday periods. However, in recent years, the growing use of fibre optics technology and liquid-crystal display panels has vastly increased the potential applications of the system, indeed to such an extent that it has now become the main instrument used for general traffic control (e.g. the SIRIUS system in the Ile de France region).

5.2.2. Individual systems : vehicle tracking, navigation and route guidance

Technical systems offering navigation and route-guidance services are a far more recent development than the systems described above (some systems are still under development). They may be classified according to the processes used for vehicle tracking / navigation, route optimisation or type of information utilised.

The concepts of tracking, navigation and guidance are closely allied and thus frequently confused :

- vehicle tracking refers to a system that allows a driver to determine his position at any time or at regular intervals,
- navigation refers to a system that allows a driver to enter his destination into a terminal, to check his position periodically and to modify his choice of route by consulting information about traffic conditions along the route,
- route guidance is designed to assist the driver by giving him instructions on the route to follow from his point of departure to his intended destination.

5.2.2. I. Vehicle tracking systems

There are three types of tracking system currently in service which are often used simultaneously (generally 2 x 2) in order to improve system accuracy :

- Triangulation by satellite. This system primarily consists of the GPS (Global Positioning System), which is based on a network of American military satellites. The military version of the system can plot positions to within a metre, but for safety reasons civilian applications are only accurate to within approximately 100 metres. Nonetheless, using a network of ground-based beacons whose position is already known, it is possible to achieve geodesic survey levels of accuracy[84] or to within 8-15 metres for real-time applications. This method can also be used in conjunction with the transmitters utilised by cellular radio telephone networks.

- Map matching. This system works on the principle that a given vehicle must be on a road and therefore its position can be calculated through reference to its most likely position on a map. The procedure consists in measuring the distance travelled from the point of departure by means of an in-vehicle system comprising an oedometer (to measure the distance travelled) and a gyroscope (to measure changes of direction), and then periodically matching the data provided by these instruments to a map according to the point of departure and the configuration of the road network.

- Resetting on passing a beacon (sign post). Rather than calculating the most likely position of a vehicle on a map, this system calculates the position of the vehicle with regard to a beacon of known location as the vehicle passes in front of it.

- Dead reckoning, using compass, gyroscope, oedometer and speed measurement to determine the distance covered from the point of departure. This procedure is precise over short distances and is often used in urban areas where satellite communications may be interrupted. It requires periodical resetting by some other technique to avoid the accumulation of errors.

5.2.2.2. Navigation systems

These systems inform drivers of the optimum route to take for a given trip. There are two types of system :

- Static systems based solely on geographical data (in fact the data consist simply of a map) and, where available, statistical data regarding traffic flows (the links between road nodes are “weighted” according to average traffic density)“. The system helps the driver to find his position on the map, which can be automatically oriented to suit the chosen destination, and then calculates the best route to take according to the estimated distance or travel time; the more sophisticated versions can also indicate routes.

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[84] Accuracy can be improved if calculations are based on measurements made over several hours or even days.

[85] In France, this type of information is given on the maps marked with travel times published by Michelin.

- Dynamic systems providing real-time information on road and traffic conditions. The driver can use such systems not only to determine his position, but also to modify his route according to driving conditions at any given time by carrying out a series of successive calculations of the best route according to update estimates of the remaining distance to be travelled or the travel time.

5.2.2.3. Route guidance systems

Route guidance systems are based on the same principles as navigation systems. Unlike navigation systems, however, they offer drivers the option of either choosing the route proposed (as displayed on a map) or allowing the system simply to give the driver directions as and when they are required, in accordance with the directions (destination and optimisation criteria) entered into the system by the driver.

5.2.2.4. Centralised and decentralised systems

The degree to which calculations regarding the optimisation of individual routes are centralised depends upon the system used to link the vehicle with the provider of the service. Advances in this area are directly related to the power of the computers used.

a) Centralised systems

Centralised systems are systems in which the calculation of optimum routes, according to traffic conditions, is carried out by a central computer which takes into account route requests from all vehicles using the infrastructure and which determines the optimum routes for all vehicles at a given time. In principle, such systems will be of interest to infrastructure managers whose networks are saturated and who therefore require a means of improving their modal distribution. Centralised systems require very powerful computers (the only functions that in-vehicle equipment would need to provide are reception and temporary data storage) and can be adversely affected by overloads (insufficient computing capacity when the system most needs it). Under-optimisation based on zone ranking can undoubtedly improve the robustness of such systems.

Centralised systems are also referred to as infrastructure-based systems.

b) Decentralised systems

Decentralised (or autonomous) systems are systems in which all drivers receive information on traffic conditions through in-vehicle terminals and then choose their routes, or mode of guidance, according to their own personal criteria. Such systems require powerful on-board computing capacity as well as large flows of data to the vehicle to allow real-time updating of on-board databases.

Such systems are also referred as vehicle-based systems.

The term “dud-mode systems” refers to systems that combine several services, and in particular to systems providing autonomous guidance services in rural areas and centralised guidance services in urban areas. This is probably the kind of system that the future UVIS envisaged by experts will evolve into once driver assistance services have reached maturity.

5.2.3. Systems currently under development

Given that determination of vehicle position is one of the basic prerequisites for the deployment of navigation or guidance systems, and that the choice between these two types of travel aid will be made by the driver (as well as the choice of mode : map-based guidance versus step-by-step guidance), while the choice between adopting a centralised or a decentralised system will depend upon the decision made by the operator of the system in accordance with the objectives pursued, the choice between different dynamic systems will in this case be determined by the means of communication used to link ground-based facilities with vehicles. This provides the following breakdown :

	One-Way	**Two-way**	
	Radio	Cellular telephone	Beacons
Centralised	▨	Possible	Recommended
Decentralised	Obligatory	Recommended	Possible

which closely matches the three technical principles for which the present document is attempting to define a suitable legal and contractual framework. Although all of the above navigation and dynamic guidance systems outlined above would work perfectly well in practice, the risks that operators would take in deploying different systems are not the same (see paragraph 3.1.3. above).

A number of systems are either already on the market or ready to enter commercial operation. The Figure below lists the basic features of the main systems currently available :

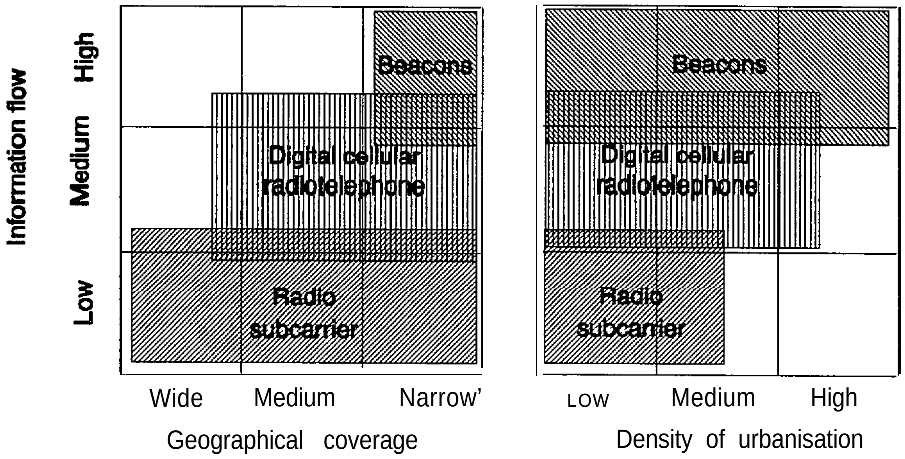
	Without communication	**With communication**	
	Autonomous	One way communication	Two ways communication
Navigation	Travel pilot Navmate	▨	▨
Traffic info	▨	Traffic master ARI/RDS - TMC	▨
Decentralised (individual)	▨	Carminat Travtek	Socrates Advance
Centralised (collective)	▨	▨	Euro-scout Autoguide
Dual mode	▨	Universal Information System	

5.2.4. Areas in which the three technical principles may be applied

It would seem reasonable to assume that each of the three technical principles considered in this Guide would be suited to particular applications, in accordance with their main operating characteristics (which, as we have seen above, depend in turn upon their development potential). This may be represented as follows :

Figure 5.1.

Field for the 3 main technologies



The technical risks involved are clearly illustrated in this Figure ; DAB, for example, would allow the volume of information transmitted by the subcarrier and the number of transmitter stations to be increased, while the increased number of services afforded by beacons (toll debiting, road information, co-operative driving) would make it possible to increase the geographical coverage and thus to spread installation costs more widely. Nonetheless, a comparison of these fields with investment costs and population densities clearly shows that the three technical principles complement rather than compete with each other :

- RDS/TMC does not require substantial investment and covers a wide area[86],
- the profitability of cellular radio telephony can be increased by means of travel aid services in sparsely populated areas[87];
- beacons are particularly suitable for use in densely populated urban areas (former centres) given that they are unaffected by frequency mashing[88].

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[86] The example of CARMINAT shows that RDS-TMC is not restricted to rural areas.

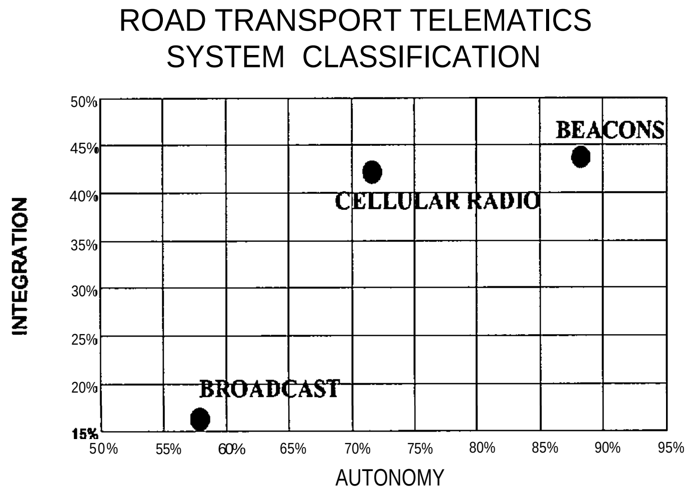
[87] This would appear to be the case in Sweden.

[88] However, the installation of beacons for other purposes such as toll debiting would allow them to he used to provide travel aid services in rural areas.

The economic risks associated with each of these principles is represented schematically in the figure below[89] :

Figure 5.2.

Road transport telematics system classification



The degree of integration corresponds to the number of functions that can be performed by a system utilising the principle considered, as well as to the relative independence of the operator with regard to external providers of data.

Similarly, while obviously there is competition between functions that might be replaced, there are also complementarities :

Figure 5.3.

	Sub carrier	**Cellular Phone**	**Beacons**
Co-operative driving[90]			***
Vehicle control			
Traffic control		**	***
Traffic information	***	***	***
Travel information	***	***	***
Demand management	**	**	***
Parking management	**	***	***
Freight & fleet management		**	**
Public transport management	*	***	***
General management & logistics/Monitoring		*	**

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[89] See the Table summarising the main characteristics of systems given at the end of this chapter as well as the outline of the main obstacles to deployment of each of the three principles addressed in the case study.

[90] Medium Range Pre-Information is a function within the functional area of Cop-Driving.

All of these elements, which have also been studied in other contexts [7], indicate that a certain degree of complementarity would appear to be emerging that might ultimately lead to the concept of "Dual Mode Route Guidance" or WIS (Universal Vehicle Information System). The lines of complementarity would seem to be as follows :

- urban areas / centralised modes,
- intercity areas / individual modes.

A detailed list is given at the end of this document (pages 45 to 48) of the functions and sub-functions that can be performed by systems based on each of the three technical principles outlined below. The descriptions of these principles incorporate the results of the case study undertaken by ERTICO [3].

Although we have generally adopted the generic term applied to each of the technical principles (in order to counter critics who complained that the study was simply a "platform" for a given technology, which was not the case), we have nonetheless provided a number of actual examples, taken from replies to our survey questionnaire from ERTICO members, in order to place the discussion on a firmer basis.

5.3. Broadcast subcarrier based systems

53.1. Introduction

RDS was developed by the EBU (European Broadcasting Union)[91] and standardised by the CENELEC (European Committee for Electronic Standardisation) in 1990. The TMC (Traffic Message Channel) which is the main subject of this section is in the process of being standardised by the CEN (European Committee for Standardisation). It is a one-way point to multipoint transmission system with a single channel. As a result no information can be sent from the vehicle to the service operator. Of these four concern the driver :

- EON (Enhanced Other Network information) : This possibility can be used to update the information recorded on a receiver on programme channels other than the one received. For each of them it is possible to broadcast lists of other frequencies, road message programme identifications and road message announcements. Liaison information enables the receiver to treat several services as a single one during the periods when these services are broadcasting a common programme.

- TA (Traffic Announcement identification) : This is a switching command which announces the broadcast of information for motorists. It may trigger the following switches in the receiver :

    - automatic switch from any radio mode to that of the road traffic announcement,

    - automatic switch to the road traffic announcement when the receiver is in stand-by mode, with the loudspeaker silent,

    - switch from a programme without traffic announcements to one with.

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[91] UER (Union Europeenne de Radiodiffusion) in French.

-- TP (Traffic Programme identification) : This is a switching command which acts on a special pilot light (or similar device) in the receiver to indicate that the programme being received normally contains road traffic announcements. Such a command signal may be taken into account during automatic tuning.

-- TMC (Traffic Message Channel) : This function is intended for the transmission of road information codes. These codes are in the process of being standardised.

This technical principle is based on development of a new service through extension of an existing technology : radio broadcasting [7]. It therefore requires only minor modification of existing driver behaviour inasmuch that nowadays virtually everybody has a car radio and can therefore tune in to news flashes on traffic conditions. Over the years, the use of this medium has been refined through the development of “licensed local radio stations” broadcasting information on traffic conditions under agreements signed agreements with infrastructure managers, as well as “motorway radio stations” operated entirely by motorway operators.

RDS has been used in Germany for many years in the form of the ARI system which warns drivers that a message concerning road traffic conditions is about to be broadcast over a specific channel. The development of TMCs (Traffic Message Channels) will allow encoded information to be broadcast to mobiles, which can then be processed by in-vehicle equipment. The functions provided by such terminals include :

- filtering of useful information,
- reconstitution of voice or visual data,
- incorporation of data into route calculations.

53.2. Technical characteristics[92]

The Radio Data System (RDS) superimposes a silent data channel on a 57 Khz sub-carrier of FM radio transmission. The Traffic Data Channel (TMC) provides digitally encoded, language-independent messages. However, the transmission capacity is very limited, which restricts the quantity of data which can be transmitted by this system. In theory it should possible to transmit 1200 bits per second, but the redundancies and identification signals necessary to guarantee correct reception reduce the useful data transmission rate of RDS to 300 bits per second. What is more, the rules laid down by the EBU stipulate that a particular application cannot use more than one third of the total resource, which in fact reduces to capacity available for RDS-TMC to about 100 bits per second. In the first stage of implementation, RDS-TMC is intended to provide a common European facility for transmitting dynamic traffic and weather information, filtered according to region, to drivers (event-related information). At a later stage of implementation, it should be possible to use RDS-TMC messages to update an autonomous in-vehicle route guidance system. This possibility was investigated as part of the EUREKA CARMINAT project (status-related information).

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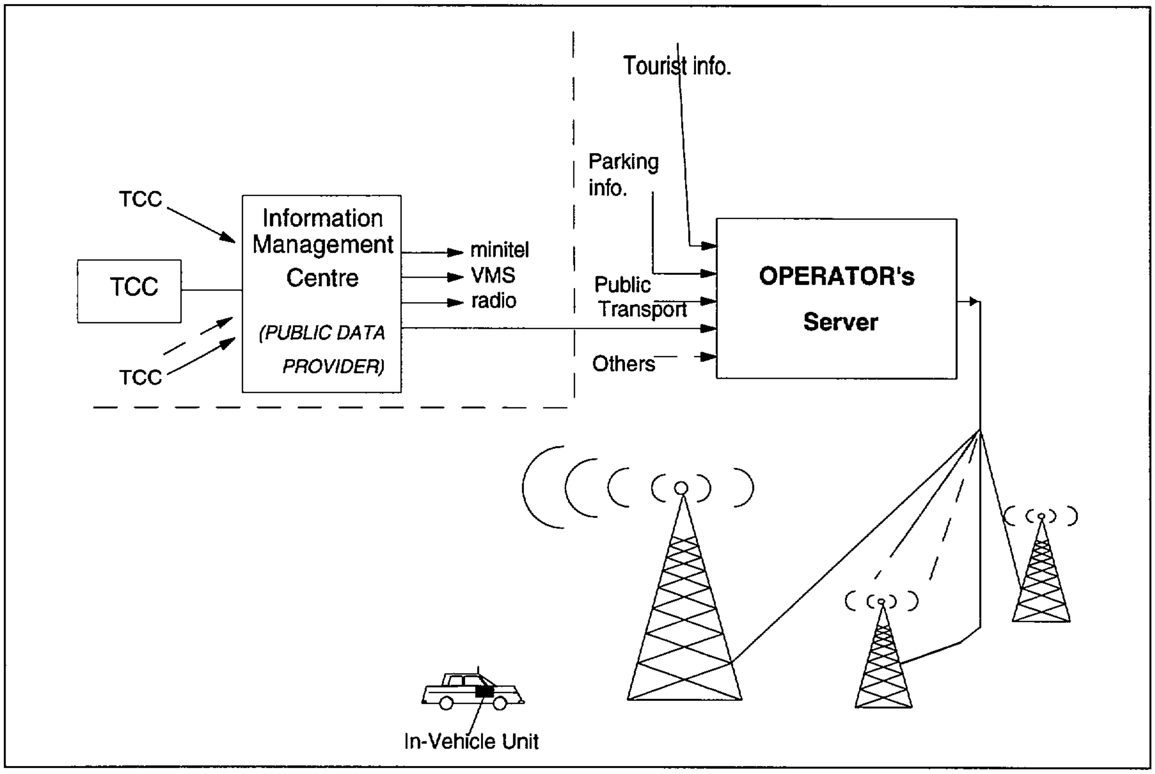
[92] The information presented below is based on two separate interview sessions with Philips and Renault, both of whom are members of ERTICO and active partners in several pilot projects within the TT programme.

Because of the limited transmission capacity, it is necessary to plan the tracking system very carefully. A hierarchical structure known as EUROAD is being developed, which will include 65 536 possible locations for each member state in Europe. This point is still being discussed within the standardisation authorities.

For easy reference, a schematic diagram representing the architecture of a TT system based on RDS-TMC is shown in figure 5.4. below.

Figure 5.4.

Overall architecture of a TT system based on broadcast sub-carrier



RDS system infrastructure costs are minimal since existing wide-area FM radio transmitters can be used, thus making the system a strong candidate for early implementation. However, the system's one-way (down-link) transmission and its low data capacity, due to a maximum available bit rate of less than 300 bits/s, restrict its wider application to RTI (notwithstanding the Digital Audio Broadcasting under development).

Since navigation / route guidance functions are based on one-way flows of traffic data, the system has a decentralised configuration based on in-vehicle units. Efficient exploitation of the transmitter network, however, makes it possible to transmit data relating specifically to given areas.

RDS-based systems have been under development for several years now. Between 1986 and 1990, RDS-TMC integrated with autonomous route guidance was developed by a consortium of five industrial partners who, as part of the EUREKA CARMINAT project, carried out the basic research and development. The partners were Philips and Philips Electronique Grand Public (France), Renault, Sagem and TDF. The work was co-financed by the French and Dutch governments.

A new consortium made up of Renault, TDF and Lyonnaise des Eaux Dumez (LED) have been working on secondary stage development since 1991. LED has expertise in the management of highways and the maintenance of traffic control systems, and as a result can provide the necessary know-how for system implementation.

The present consortium is also active in several TT projects, including PLEIADES, MELYSSA and CITIES.

Philips is also continuing with development work as part of several TT projects including : ACCEPT (harmonisation of TMC databases) and different pilot demonstrations : CITIES (Holland-Rhine corridor, and the German BEVEI project (BEssere VErkehrs Information) with the same partners.

Volvo has also developed an RDS based system known as DYNAGUIDE designed to receive, select and display traffic information transmitted via the RDS-TMC channel. The system utilised colour graphics and a simple symbolic language to display RDS-TMC messages to the driver, and is currently undergoing assessment as part of the Swedish “ARENA” field trials in Gothenburg.

5.3.3. Available services[93]

The services described below represent the functions and sub-functions that an operator can provide through a TT system based on the technical principle of radio subcarriers (RDS-TMC). This does not mean to say that a given operator will necessarily provide all of these functions. We have identified thirty sub-functions that such a technical system might provide out of the 185 listed[94] for the entire road traffic management system.

This type of system can provide a variety of different services, the principal ones being :

- audio information,
- visual information (on an updated map),
- audible and/or visual route guidance instructions

All drivers receive the same information which is then adapted to individual circumstances by the in-vehicle unit. Nonetheless, by adapting the degree of coverage of the transmission network, data can be tailored to given areas.

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[93] See the detailed list of functions given in the Table at the end of this chapter.

[94] See detailed list at the end of this chapter.

5.3.3.1. Basic functions[95]

These functions are essential to system operation in that they are used to define objectives and to assist in the management and monitoring of the system as a whole. The operator of an RDS-TMC system will be unable to provide an adequate service if the public authorities fail to perform these functions properly.

In the case of RDS-TMC systems, this provision is a necessity if the system is to gain public credibility.

5.3.3.2. Driver assistance functions

Some of these functions may be provided by a vehicle equipped with the RDS-TMC system (CARMINAT concept), although their operation does not depend upon interaction with the driver.

5.3.3.3. Traffic management functions

The RDS-TMC system does not provide any direct assistance to road infrastructure managers (i.e. it is not an instrument for traffic control). In contrast, it is one of the easiest ways (apart from variable message signboards which it complements) in which to transmit information to the greatest number of drivers[96].

Navigation and route guidance functions are obviously independent of the technical principle adopted. Such functions are wholly dependent on the information transmitted to the system. They will, however, be extremely important components of any driver-assistance system that eventually reaches the market.

In contrast, real-time dynamic traffic and travel information functions are central to the system. The main problems in this case are message structure (events and/or traffic conditions) and data flow rates.

The RDS-TMC system can be used to manage demand by broadcasting information on alternative routes and other modes of transport.

5.3.3.4. Management functions relating to professional road users

The system can be used by professional road users for freight and fleet management inasmuch that certain types of information can be transmitted to public transport users or drivers employed by haulage companies (public transport and road haulage) by means of paging functions.

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[95] See chapter 4, section 3, for definitions and classifications of functional areas.

[96] However, RDS can be used by infrastructure managers for the remote control of variable message signboards (message transmission).

5.3.4. Information and data handling

Where radio subcarriers are used, the system generates virtually no information. The services supplied to users can vary from the straightforward transmission of event information (ARI system) to real-time travel information (CARMINAT system).

The processing and formatting of driver information can theoretically be carried out either by the public authorities (traffic or travel information centres, or public data provider) or by the system operator[97].

In view of the above, the following description cannot be prescriptive and is given simply by way of an illustration based on information compiled during the survey of potential future operators and partners. Since the area addressed here is central to the competitive environment (optimisation of the information production chain) in which applicants for licences to operate future TT systems will find themselves, it is understandable that only limited information is available.

5.3.4. I. From external systems to the RDS Information Centre

As shown in figure 5.4, the RDS/TMC service provider (RDS-TMC server) receives traffic information from participating traffic control centres (TCCs) via an information management centre. In addition, the RDS-TMC server can be linked directly, where necessary, to other information providers including tourist information centres, weather centres, parking information centres, and public transport control centres.

The information received from "external" sources (i.e. external to the RDS-TMC system) therefore includes :

- weather information,
- information on road conditions,
- information on specific events,
- incident / accident information,
- travel information,
- traffic information,
- parking information,
- parking forecasts,
- tourist information (at a later phase).

5.3.4.2. Service provider to vehicle transmissions

RDS-TMC encoded messages are broadcast to vehicles by the RDS-TMC server operated by the service provider. The messages broadcast comprise :

- weather information,
- information on road conditions,
- information on specific events,

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[97] This is the core component of the "contractual relations" between the public authorities and the 'IT system operator.

- incident / accident information,
- hazard warnings,
- traffic information,
- travel information,
- parking information,
- route advice.

The following will be added at a later stage :

- tourist information,
- limited individual map updating.

Inside the vehicle, the information received is decoded and can be displayed on a screen, converted into synthetic voice data, and also integrated with an autonomous route guidance system to provide dynamic route guidance functions (as in CARMINAT).

Renault's objectives appear to be to broadcast information relating simply to a given urban area or to a well-defined intercity corridor. The idea behind this is to give "close-range" information to drivers at the time a decision needs to be taken (e.g. to make a detour) ; longer-range information about more distant events is not taken into consideration. Even regional coverage is disregarded.

Philips, however, is working on a slightly different basis whereby local information is transmitted regularly at short intervals, whereas regional, national and international information is broadcast at much longer intervals (e.g. general-level information about international main roads would be broadcast every hour). Such information could then be picked up by in-vehicle RDS-TMC receivers and stored for later use.

5.3.4.3. Vehicle to service provider transmissions

RDS is a one-way broadcast transmission system (with only down-link broadcast to vehicles). Therefore, no data flows from vehicles to RDS service provider (the RDS-TMC Server).

5.3.4.4. Service provider to external support systems transmissions

The system does not send any information back to the external support systems (TCC, public transport operator, weather centre, etc...) supplying the RDS-TMC server with the basic information to be transmitted to drivers.

5.3.5. User roaming and payment

The principle on which charging procedures will be based has not yet been decided, although users will probably be asked to pay for the service by purchasing a digital memory card for any region in which they wish to receive the RDS-TMC service. There are plans, however, to offer a minimum level of service to users travelling within a given region who do not have a local map. In some countries (Germany, the Netherlands), this service will have to be provided as a free "public" service. In other countries, there could be two levels of service : the first one supplied free of charge and providing basic messages dealing with safety and traffic management, the second one providing personal services for which drivers will be charged.

Philips have indicated that paying services will be adapted to market demand.

The marketing of the system and associated services, as well as the collection of tolls and charges, must be thought out carefully. Several types of economic actors may apply for licences to operate the system or services :

- the operator himself,
- car radio distributors / installers,
- tobacconists / newsagents for card renewals (driver's cards and payment cards).

This raises another question : will digital cards be made valid for a fixed period of time (e.g. self-destructing after a period of twelve months), or simply updated (i.e. with a new version put on sale every year) ? The latter option would then pose the problem of determining liability in the event of changes in one-way systems.

53.6. Contractual relations between actors

A description of the principles on which contractual relations between actors are based is given in the Tool Box. Given that with this technical principle information traffic is one-way, contract n^{o}1a is not applicable. However, the operator should pay particular attention to contract n^{o}1, since under this type of contract he would be heavily dependent on the public data provider with regard to the format, frequency and accuracy of information. The operator would also have to deal with the large number of actors with jurisdiction in different and sometimes overlapping administrative areas. Lastly, provision would also have to be made for administrative procedures in the area dealt with in the Tool Box under the heading "Administrative Authorisation" (approval with regard to road safety).

The general framework with the identification of the contract types is given below.

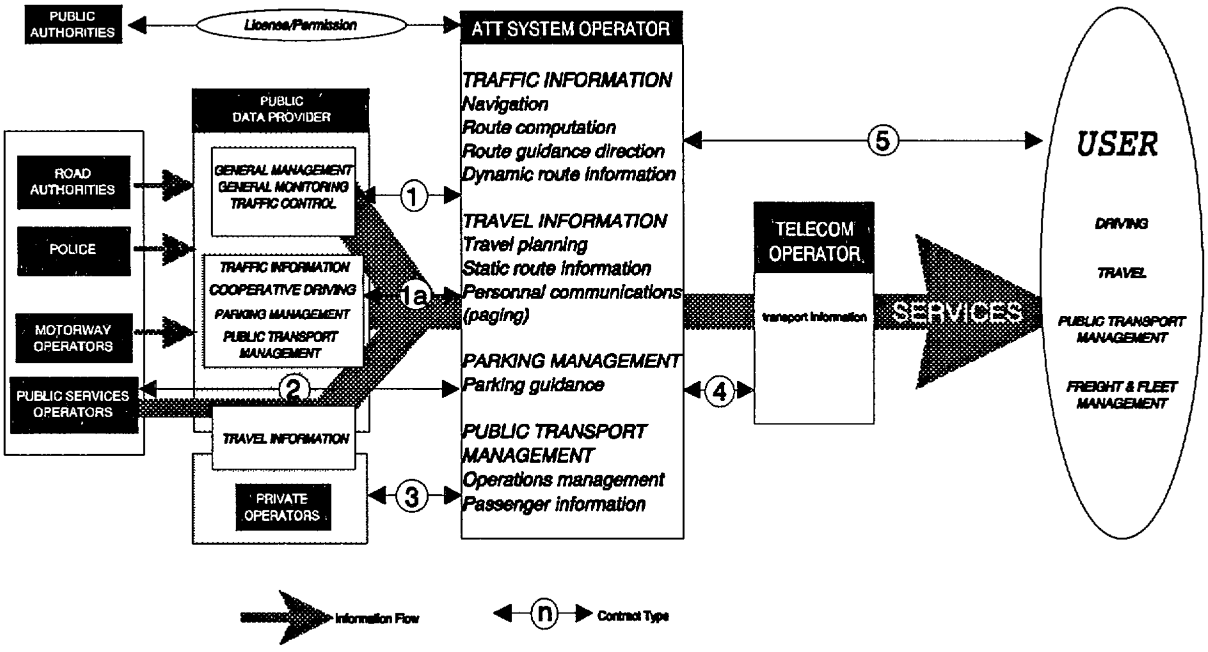
Then critical aspects of the contractual issues are geographical coverage and the intervals at which information is supplied, since this may require different types of relations between :

- local, regional and national information providers,
- information editors (servers),
- system operators,
- local, regional or national information broadcasters, depending on the radio networks.

The problem is that the system operator will have a large number of contracts to sign with actors who, although ranking equally highly in the value-chain[98], do not necessarily have the same importance to the operator (e.g. one broadcaster may be able to achieve wide-ranging geographical coverage and may wish to take advantage of this position).

Figure 5.5.

Institutional / Legal flow framework
for Broadcast subcarrier - Based Systems



CARMINAT is a special case in that it is designed to provide dynamic route-guidance services with access to traffic information provided by RDS-TMC. This means that the system will rely heavily on access to data gathered by traffic control centres, which raises a number of questions such as what information will traffic control centres be expected to provide ? Will they be able to meet the requirements of the CARMINAT system ? What assistance will they need ? What will they receive in return from the operator ?

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[98] The term "value-chain" refers to the linkage between different actors involved in the system who each perform a specific task (thus generating value added) in order to generate road information from the basic data collected.

5.3.7. Standardisation

Further work on standardisation is needed with respect to the following :

- TMC messages,
- TMC location encoding,
- GDF location referencing,
- exchange formats between control / information centres,
- communications protocols.

Renault indicated the need for minimum standards on safety-related aspects of MMI including equipment placement within vehicles to ensure that drivers feel adequately familiar with system operation when changing from one vehicle to another.

With regard to the structure of the message, the RDS-ALERT C standard currently under discussion deals with messages conveying information relating to events. A draft ALERT C+ standard has been proposed to allow the broadcasting of messages relating to status, which would, among other things, allow in-vehicle maps (stored on compact disks ?) to be modified and “updated”. This proposal calls for a change to be made to the principle on which the RDS standard is based, which has not gone down well with all the industrial partners involved (particularly those whose products are already ready to be marketed). Nonetheless, it seems that it should be taken into consideration, not because of the products that those who are in favour of the standard would like to introduce onto the market, but in particular because of the flexibility that it would give to the RDS-TMC standard which it would transform from a closed into an open standard. The aim of the standard is to add an address bit that would allow the space reserved for the TMC to be assigned to different applications, whereas at present the space allocated is used for messages with unique characteristics. In addition, this modification would give operators the option of charging users for specific services, an option that is not currently available under the existing standard.

5.3.8. Control strategies

RDS-TMC provides in-vehicle information emanating from a central point (the RDS-TMC Server) to drivers, thus facilitating, as required, any desired degree of “collective or centralised” control. It cannot, however, optimise the trip of each individual (or group of individuals) from a collective point of view.

RDS-TMC messages are designed to be informative and constitute advice ; no real recommendations are provided. However, route recommendations could be given where RDS-TMC messages are integrated with autonomous route guidance. In which case, again, responsible authorities can maintain desired control over the dynamic information broadcast to vehicles (e.g. access restriction).

53.9. Pilot projects using RDS/TMC

Field trials were successfully carried out between 1989 and 1991 in the Paris-Rennes corridor.

Further and more extensive field trials are now in progress under the current TT programme. A fleet of 500 vehicles will be equipped and tested in three different areas :

- Paris-Ile de France under the CITIES project,
- London-Paris corridor under the PLEIADES project,
- Stuttgart-Lyon-Mediterranean corridor under the MELYSSA project.

The system will also be tested in the Rhine corridor under the ACCEPT and RDS ALERT projects.

If these trials are successful, the system could start commercial operation in 1995.

5.3.10. Other comments

Location referencing will be based on national encoding systems. The developers of CARMINAT do not feel that an extensive transnational encoding standard is necessary because the intention is to develop an in-vehicle memory card for each country which will carry the same location codes as those used in the corresponding national RDS-TMC message encoding centres. Cross-border information is transmitted between national Traffic Control Centres and consequently does not interfere with the RDS-TMC system itself. However, an agreement on a limited set of international location codes is required to enable information (e.g. within major road corridors) to be broadcast via each national broadcast transmitter, thus allowing drivers to tune to any RDS-TMC transmitter for cross-border information.

RDS-TMC based systems do not affect personal privacy (down-link broadcasts only)

The system uses data encryption primarily to make sure that only those users who have paid for the service by purchasing a national memory card can receive the RDS-TMC service. In countries where the RDS-TMC service is to be provided free of charge, transmissions need to be unscrambled.

5.4. Cellular phone based systems

54.1. Introduction

This technical principle derives from the development of new services based on the use of a technology currently being developed : digital cellular radio telephony or GSM. As part of the DRIVE programme, research have been carried out into the use of GSM as a medium for the transmission of road traffic information under the SOCRATES project (see below). The results of this project hold out the prospect of using GSM not only for two-way data transmissions, but also as a means of using the vehicle itself to measure travel times (floating vehicles) using an oedometer and a compass. It has even been suggested that vehicle positions could be plotted by triangulation using transmitters as reference points (radio telephony can normally locate the position of a mobile within a cell).

However, it should be borne in mind that there are already specialised analog systems (3RP, MOBITEX) in service capable of exchanging information between ground-based transmitters and vehicles which commercial transport firms find fully satisfactory. The key factor in the deployment of SOCRATES will be the attitude of managers towards the GSM resource. Managers will share out GSM between those value-added services considered to offer the highest potential profitability or as most likely to reduce any possible under-utilisation.

Lastly, it should also be borne in mind that the deployment of SOCRATES will be restricted as much as possible to drivers using GSM, i.e. approximately 10 per cent of the population by the year 2000.

GSM does not require any specific communications infrastructure. In principle, it allows drivers to choose between individual (selected from the in-vehicle equipment) or collective (centralised selection) navigation / route guidance functions. However, the technical constraints on operation of a cellular radio telephone makes it likely that in this particular case the navigation / route guidance mode will be "individual".

5.4.2. Technical characteristics

The following description of the use of cellular mobile radio networks to support TT services, taken from SOCRATES, has been compiled on the basis of a meeting with Philips, an ERTICO member and partner in several pilot projects conducted under the TT programme.

With the continuing growth and investment in cellular mobile radio communications, it is no surprise that much interest is being shown in the shared use of cellular infrastructure to support the use of TT for the provision of supplementary value-added services. This concept has come to be known as SOCRATES (System of Cellular Radio for Traffic Efficiency and Safety).

Amongst the various cellular mobile radio networks that are either existing or planned in Europe, the cellular mobile radio GSM systems offers a potential pan-European infrastructure which could be extended to provide an economically-efficient implementation of key RTI services [2].

The main characteristics of the SOCRATES approach are continuous cellular radio coverage (often referred to as "anytime, anywhere" service coverage). In addition, the volume of data to be transmitted, as for example in the case of route guidance, is greatly reduced by virtue of the relegation of processing, intelligence and data base (e.g. road-map CD-ROM) functions to the in-vehicle unit.

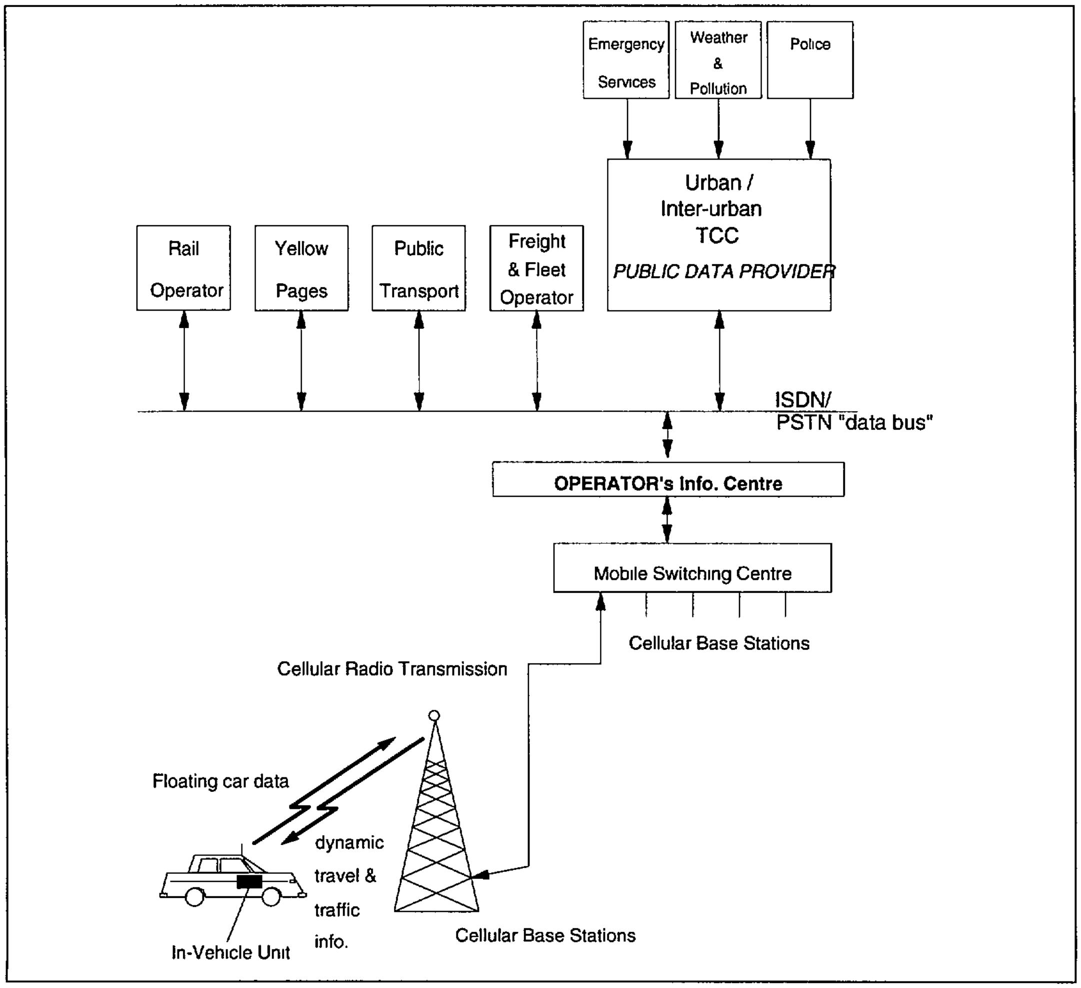
In response to a request from the SOCRATES community, ETSI plans to draw up a standard for a special broadcast channel to be known as General Package Data Service or GPDS (or General Packet Radio Service : GPRS).

In order to optimise use of the resource, ground-to-vehicle broadcasts will be made at regular, closely spaced intervals rather than on a continuous basis. The manner in which routes will be calculated has not yet been properly defined, nor has the structural format of the data transmitted to vehicles. The system therefore falls mid-way between the two other technical principles.

The overall architecture of the SOCRATES systems is shown in figure 5.6.

Figure 5.6.

Overall architecture of the SOCRATES system based on two-way mobile cellular radio networks



The SOCRATES Information Centre (SIC) interfaces with all relevant (external) information centres (e.g. public transport operators) either directly via the ISDN/PSTN or indirectly via the traffic control centre (TCC), depending upon the country or region.

In contrast, although interest is currently focused on the GSM system and other mobile data systems (e.g. trunked MOBITEX and MPT 1327), an evolutionary path could be traced through other future pan-European cellular radio options. These include the Personal Communications network (PCN-, Mobile Digital Trunked Radio System (MDTRS), and the Universal Mobile Telecommunications Services (UMTS) currently being studied under the DG XIII RACE Programme.

5.4.3. Available services[99]

The services described below represent the functions and sub-functions that an operator can perform using a TT system based on the technical principle of cellular radio telephony and of which the best-known example in Europe is the SOCRATES system. This does not mean to say, however, that operators will necessarily offer all of these functions. We have identified 78 functions that could be performed by such a technical system out of the 185 listed for the road traffic management system as a whole.

The system can be used to provide a variety of services to users, the main applications being :

- audio information,
- visual information (on updated maps),
- audible and/or visual guidance instructions.

The information transmitted to vehicles can nonetheless be tailored to meet individual drivers' requirements. Given the added workload for the telephone network, as well as the transmission costs that would be incurred, the operator of the SOCRATES system will probably decide to use m-vehicle units to adapt the information received to individual requirements. However, by adapting the cell structure of the GSM network, information can be adapted to specific areas.

5.4.3.1. Support functions

The fact that the system uses two-way communications makes it suitable for use by traffic management authorities (or the bodies to which such tasks are delegated). It would therefore be feasible to use SOCRATES to levy tolls on vehicles in motion (although it has not been demonstrated whether this would be economically viable - it is highly probable that a beacon-based system would be more efficient). The system can also be used to transmit information on driver behaviour to the police (caution would need to be shown with regard to the latter application, since it is hard to imagine that drivers would willingly pay for a system that would allow their behaviour to be monitored by the police). However, in providing information on vehicle movements (travel times over a given section of highway, accidents) and traffic conditions (condition of road surfaces), it can contribute to general monitoring of road infrastructure and the movements of hazardous waste shipments.

5.4.3.2. Driver assistance functions

The SOCRATES system could be used to provide certain driver assistance functions. While vehicle control functions could not be supplied via the system, the in-vehicle unit could be used to display such functions to drivers. In contrast, SOCRATES could be used for co-operative driving functions by providing a safety message transmission and reception facility.

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[99] See the detailed Table of functions at the end of this chapter.

5.4.3.3. Traffic control functions

SOCRATES can help with traffic control by providing information on road and traffic conditions, particularly by providing traffic control centres with information regarding the intentions (point of departure / destination) of drivers.

Navigation and route guidance functions are obviously independent of the technical principle adopted. Such functions are, however, wholly dependent on the information transmitted to the system. They will be extremely important components of any system eventually introduced onto the market that is designed to provide assistance to drivers.

With regard to traffic and trip information, the SOCRATES system can cover all the services identified ; the same is true for route guidance : SOCRATES is the only system that can accommodate both decentralised and centralised route calculation.

Lastly, SOCRATES can be used to manage demand by broadcasting information on alternative routes and other modes of transport. It can also help with parking space management by broadcasting information on the availability of on- and off-street parking spaces ; it could even be used to collect parking fees (using telephone cards).

5.4.3.4. Professional road user management functions

SOCRATES could be used to help professional road users manage their operations by providing a means of transmitting information either to passengers using public transport facilities or to the drivers of commercial vehicles (public transport or road haulage). Given that the system transmits information on vehicle movements to control centres, it could be used to monitor fleet movements in real time, to forecast travel times and to optimise the use of vehicle fleets.

5.4.4. Information and data handling

SOCRATES is designed to accommodate two-way exchanges of data. Techniques have already been developed to track vehicles over a given route (triangulation and combined oedometer / compass systems). The SOCRATES system could therefore have substantial autonomy and could generate a significant portion of the data it needs to provide drivers with tailor-made services. The problem lies in the “normal” way in which telephone networks are managed. Operation of the SOCRATES system is based on the use of queues and calculated probabilities. Using GSM for traffic management would require continuous and systematic use of the network, the only unknown factor being the number of calls made at the same time (itself a factor of the number of vehicles on the road at any given time), which would pose problems for the telephone network operator[100].

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[100] Nonetheless, proper management of the system should make it possible to reduce the load. The TT system operator only requires a representative sample to be able to determine the traffic characteristics of a given section of road (floating vehicles). Similarly, information will only be sent over the down link when necessary. Despite these factors, this does not completely preclude the possibility of a system overload under difficult traffic conditions.

In addition, even though the acquisition, processing and formatting of data can in principle be carried out by the SOCRATES operator, some kind of a balance will need to found in the co-operative links with the public bodies responsible for traffic management ; it is this balance which will determine whether or not the operation will be either a profitable or a high-risk venture.

The description given below therefore cannot be prescriptive and is given simply by way of an illustration based on information compiled during the survey of potential operators and partners. Since the area addressed here is central to the competitive environment, it is understandable that only limited information is available.

5.4.4.1. External Systems to SOCRATES Information Centre

The SOCRATES Information Centre (SIC) receives either directly or indirectly (via the relevant Traffic Control Centre, TCC) the information to be distributed to drivers. Two-way links to external support systems include the participating TCC, RDS-TMC coding centre, emergency centre, public transport control centre, fleet operators, weather centre, rail operators, tourist centre, “yellow pages”, etc. Required connection can be provided be either the PSTN (Public Switched Telephone Network) or the ISDN (in the case of GSM).

The information received from sources “external” to SOCRATES therefore includes :

- Weather information,
- Pollution information,
- Information on road conditions,
- Information on specific events,
- Incident/accident information,
- Travel information,
- Traffic information,
- Parking information,
- Parking forecasts,
- Tourist information,
- Personal information,
- Other.

Indeed, connection to any interested external information providers can be provided according to market requirements.

5.4.4.2. Service provider to vehicle transmissions

The system makes use of two-way mobile communications links which are used to send the following information to equipped vehicles :

- Voice traffic,
- Paging,
- Electronic mail (available in public buses only),
- Weather information,

- Pollution information,
- Information on specific events,
- Hazard warnings,
- Incident / accident information,
- Travel information (including modal choice),
- Traffic information,
- Driver instructions,
- Parking information,
- Parking space forecasts,
- Individual map updating,
- Link impedances (ranging from fully open to fully closed)

5.4.4.3. Vehicle to service provider transmissions

The up-link is used for the following purposes :

- Voice data,
- Emergency calls,
- Vehicle category identification,
- Vehicle identification (technically feasible if there is any market demand),
- Financial information,
- Operational information :
  - Position,
  - Load status,
  - Vehicle status,
  - Fare collection information.

5.4.4.4. Service provider to external support system transmissions

The SOCRATES Information Centre (SIC) supplies, via the ISDN or PSTN, a range of information, as required, to participating external support systems such as TCCs (e.g. travel data centres, RDS-TMC encoding centre, traffic data base, emergency services, public transport control centres and fleet operators).

The information supplied might include :

- Emergency calls,
- Traffic data (journey times, congestion),
- Operational data (e.g. bus location, vehicle status),
- Traffic trends (provided indirectly),
- Incident / accident information.

5.4.5. User roaming and payment

The pan-European GSM system supports user roaming throughout Europe. This offers the possibility of allowing subscribers to use supported services anywhere within Europe (subject to commercial agreements).

The marketing of the system and services, and also charging procedures, need to be studied carefully. Several different types of economic actor might be involved in the commercialisation of the system :

- the operator himself,
- car radio distributors / installers,
- radio telephone operators,
- tobacconists / newsagents for card renewals (maps and charge cards in cases where prepaid cards similar to telephone cards are used).

Charges on users / customers could be collected in a variety of ways, either :

- the radio telephone operator could collect the fees, subtract his share of the money and then transfer the remainder to the TT system operator ; or
- the radio telephone operator could invoice the SOCRATES system operator, who would then be responsible for collecting fees.

Given the potential impact of the charging system on the cash flow of the party collecting fees (i.e. the possibilities for earning revenue), the choice of procedure for collecting payment will be a core issue in contract negotiations (n^{0}4 type contract).

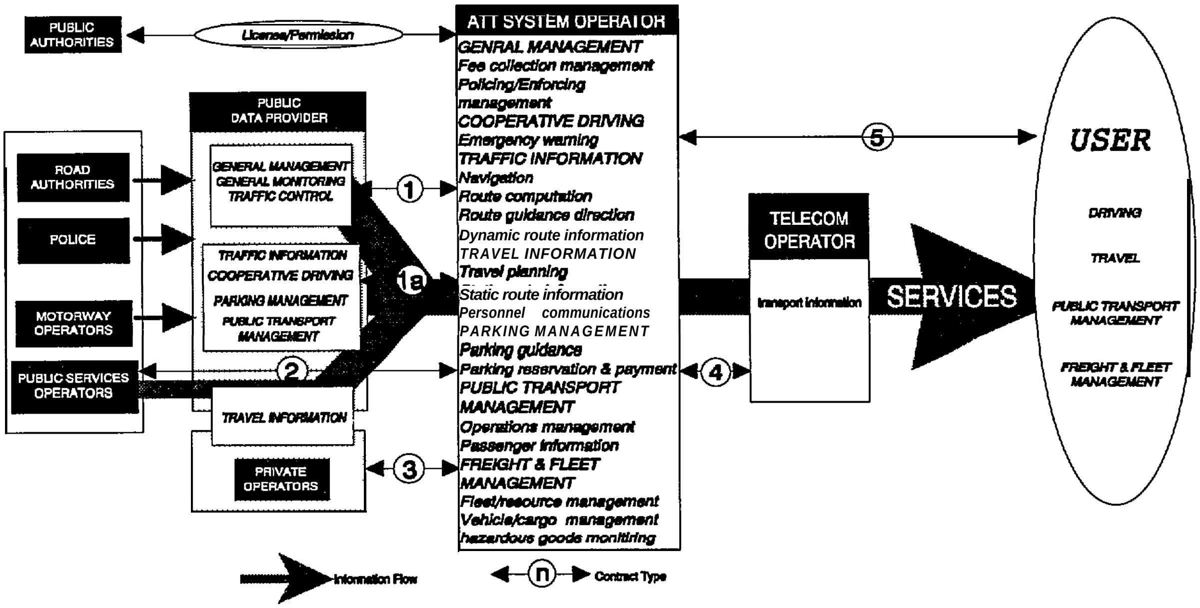
5.4.6. Contractual relations between actors

The principles underpinning these relations are outlined in the Tool Box. The main contracts are the Administrative Authorisation (approval of the system with particular regard to safety) and contract n^{0}4 (access to the telephone network, the core component of the system).

As cellular mobile radio is a two-way communications system, and SOCRATES an “anytime, anywhere” type system, it can be used to handle information and provide services to drivers and at the same time to supply information to traffic control centres on current traffic conditions. As shown in this document, it can also be used for enforcement and demand control. However, would that be suitable for a private service operator ? If so, within what limits ? What kind of relationship should there be between service operators and the authorities with regard to enforcement and access control ? Should such the operator be forced to play such a role?

Figure 5.7.

Institutional /legal flow framework
for cellular radio network based system



Since the SOCRATES system is based on access to the GSM infrastructure, the main concerns of any future SOCRATES operator must be to determine :

- On what conditions the GSM network might be used to market commercial services ?
- What guarantees will have to be secured from the telecom infrastructure operator ?
- Who will be responsible for the maintenance of the resource ?
- What type of restrictions the telecom operator might wish to place on use of the resource (if and when necessary) ?
- Whether the telecom operator would be entitled to refuse the operator access to the resource ?
- The respective roles of the telecom operator, service operator and user in fee payment and collection ?
- Whether it would be necessary to provide users with a guaranteed level of service of simply with a guaranteed resource (in the first case the service operator would have to have - and initially at his own cost - enough floating cars, which might need to be given a special status similar to that of taxis or ambulances) ?

- Whether he should enter into an integrated payment system or whether it would be in his interests to segment the services and charge directly ?

- Whether it would be appropriate to consider separating the functions of the SOCRATES operator (information-handling) from those of the telecom operator (provision of infrastructure) ?

- What information should be given on trip information and what information should be withheld for safety reasons (i.e. the problem of shared liability in the event of an accident) ?

5.4.7. Standardisation

The following items require standardisation :

- TMC location coding,
- GDF location coding,
- SOCRATES communications protocols[101],
- Automatic vehicle location (AVL) on GSM,
- Emergency calls on GSM,
- Smart cards.

MMI and data exchange formats between control and information centres should also be taken into consideration, but are not specific to SOCRATES.

The most important thing is for ETSI to develop a standard for GPRS which would sanction not only the use of ED1 for value-added services, but also the provision of permanent communications links with a SOCRATES management centre.

5.4.8. Control strategies

The information given by the system to users is in the form of pure information, advice or recommendations (e.g. route guidance).

The facility exists to enable drivers to select desired guidance criteria (shortest route, fastest route, motorway route, scenic route, etc...).

The authorities can exercise any required degree of (collective) control over SOCRATES dynamic guidance strategies by controlling the dynamic traffic information sent to vehicles (e.g. traffic can be diverted fully or partially away from a designated road section).

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[101] The ETSI SMG Technical Committee has decided to draft a specification for a General Packet Radio Service (GPRS). This could lead to the commercial implementation of GPRS based applications in 1996/1997.

5.4.9. Pilot projects using Socrates

Several SOCRATES field trials are currently under way in Europe :

- ATT Programme CITIES project, Gothenburg-Sweden.
- ATT Programme RHAPIT project, Frankfurt.
- ATT Programme LLAMD (APPLE) project, London.
- PROMETHEUS Programme, TIGER Project, London.

If these trials are successful, the system could start commercial operation at the beginning of 1995.

5.4. 1O. Other comments

The use of the SOCRATES system guarantees user privacy and anonymity.

The system uses data encryption to ensure secure data transmissions.

5.5. Beacon-based systems

5.5.1. Introduction

Unlike RDS and cellular radio infrastructure (described in the first two sections of this Guide) which are shared with non-TT services, the beacon infrastructure is exclusively dedicated to TT services. Where used for dynamic route guidance, the system may be described as "centralised" in the sense that a central computer computes the guidance data before transmission to participating vehicles. The two-way communication is ensured when the vehicle passes within reach of a short range beacon. The navigation / guidance functions are largely "infrastructure-supported". Between two beacons, however, the driver is guided by the on-board equipment which has been loaded with the map of the city and which is equipped with an oedometer and compass.

Beacon infrastructure can also be used to install non-stop tolls on road networks ; indeed, it is expected that toll collection will be the first application of this technical principle. The use of beacons for non-stop toll collection was investigated by the "AUDIT Task Force" set up by ERTICO, whose conclusions were published in a report as yet circulated only to ERTICO members. We shall limit our discussion here to a review of travel and driving assistance functions that can be provided by a TT system based on roadside beacons.

The technical principle underpinning this technology requires a significant communications infrastructure. In urban areas, such infrastructure can be shared with the traffic lights control system. In addition, the locations at which beacons will need to be installed varies according to the functions required ; co-operative driving systems, for example, will require beacons to be sited at the approaches to intersections, whereas guidance systems will require beacons to be located at intersections and toll-debiting systems will need beacons downstream of points where route changes are made. The largest component of the investment costs, however, will still be the transmission system and beacons.

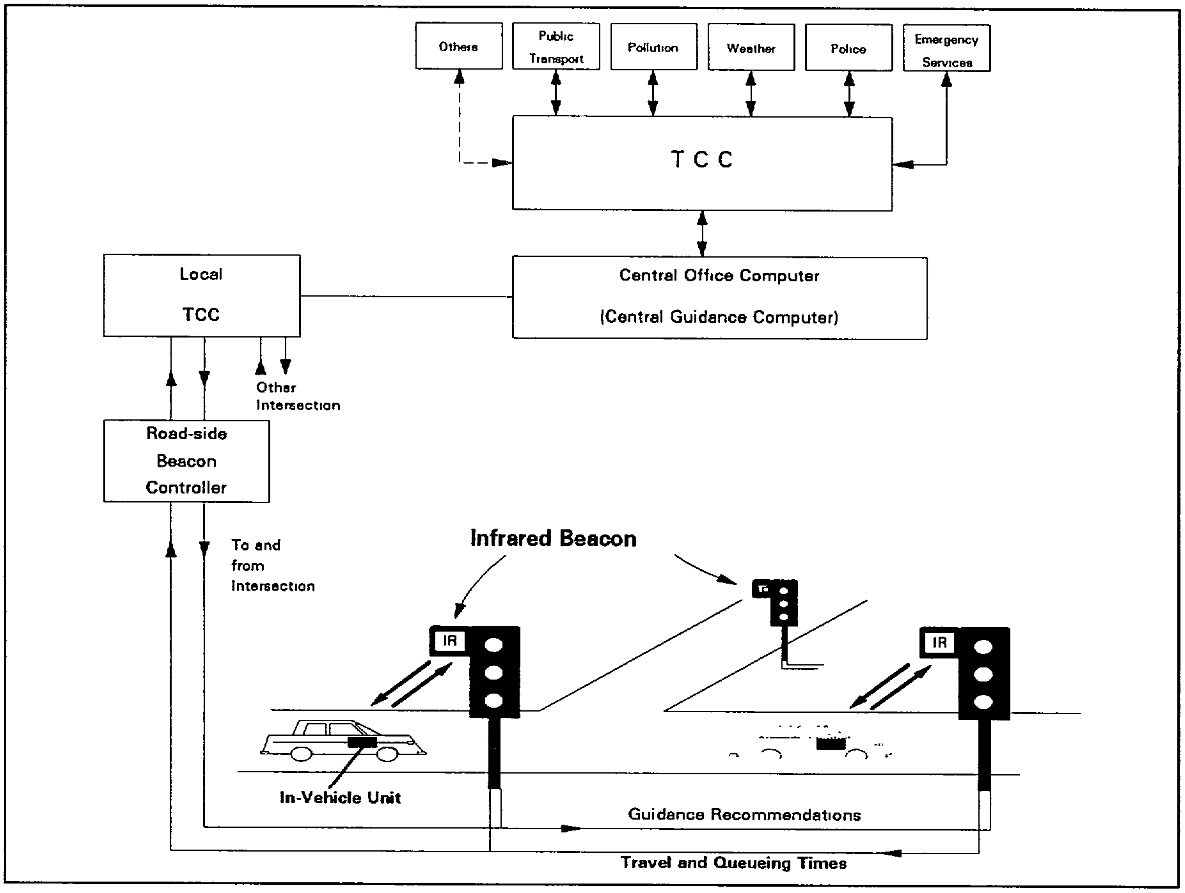
Lastly, the key feature of the system is the fact that it is self-standing (i.e. it generates all the information it requires itself), which is a major advantage inasmuch that it is thus less dependent on public data providers, but a disadvantage in that the performance of the system will depend upon the number of customers.

5.5.2. Technical characteristics

The rest of this section has been prepared on the basis of a series of interviews Siemens representatives and is based on the EURO-SCOUT system (which uses infrared beacons). The system has been, and continues to be, developed by Siemens, which is both a member of ERTICO (on behalf of EURO-SCOUT) and a partner in several pilot projects carried out under the ATT Programme (QUARTET, HERMES, LLAMD, MELYSSA, CITRA and SCOPE). However, for the purposes of this study, this section should be taken to apply to all beacon-based DSRC systems.

Figure 5.8.

Overall design configuration of a beacon-based system



Dedicated Short-Range Communications (DSRC) based on beacon systems provide two-way communications between a roadside beacon and passing vehicles [3]. Transmissions are short-range and intermittent (only in the vicinity of a beacon), thus making the system highly suited to automatic toll collection and the diffusion of real-time traffic information in the form of a news flash.

The technologies currently in use include :

- microwave transmission used primarily for automatic debiting / toll systems and automatic vehicle identification ;
- infrared transmission, the technology used by EURO-SCOUT, a dynamic route guidance and traffic management system.

Various basic (physical) differences in the characteristics of the microwave and infrared technologies have been reported over the recent years. However, it appears that such differences have very little, if any, impact on the range of TT services which could be supported by a DSRC infrastructure.

Apart from the fact that the operation of microwave DSRC requires the allocation of relevant frequencies by the regulatory authorities, we assume that the actual choice of microwave or infrared technology has no bearing on this study of institutional and legal issues. Indeed, it is the range of supported TT services and related aspects (e.g. data exchange requirements) which have introduce institutional / legal implications rather than the type of technology employed. It should nonetheless be noted that field trials have already been made of the use of infrared beacons for route guidance and with microwave transmitters for automatic fee collection. No infrared systems are currently being used for automatic fee collection.

In fact, the choice between ultra-high frequency / microwave and infrared technology can have a substantial impact on the ultimate economic viability of the system :

- infrared communications are to some extent sensitive to air-borne pollution and to interference from the sun at sunrise and sunset, though according to the industry these difficulties can be overcome by specific techniques, and in addition this system requires an on-board energy source (large battery) ; on the other hand, infrared radiation is coherent (i.e. there are no problems connected with the position of the source or the wave path, covers a wide range and is harmless to health ;
- microwave communication is less sensitive to obstacles, though it may be subject to problems connected with the position of the source or the wave path and may have difficulty going through certain types of windscreen, and it only needs a small energy source (flashlight-sized battery) ; however, at certain energy levels microwave radiation can be a health risk and it is reflected by metallic objects.

This would explain the specialisation that would seem to be emerging in route guidance and toll-debiting applications. However, there still remains the problem of determining which technology would be appropriate for co-operative driving functions, which would also be able to use “DSRC” to aid users (lateral guidance, automatic safety signal management, speed control, etc.. .).

In the following section we describe a system that would be able to perform all possible types of function by means of beacon technology[102], which, given the comments made above, is not possible at present. However, it should at least be possible for a combination of two different technologies to be made transparent for the user (by means of a shared UVIS terminal).

The in-vehicle equipment would include a unit for tracking and calculating the position of the vehicle between beacons, which would thus make it possible to provide route guidance services. Centralised route calculations would not be carried out for individual vehicles, but for all vehicles located within a given area. This approach would seem to offer a sensible compromise between the collective and individual optimum on the one hand, and the robustness of the system on the other.

5.5.3. Available services

The services described below are functions and sub-functions that an operator can provide by means of a TT system based on the technical principle of roadside beacons, of which the best known example in Europe is the EURO-SCOUT system. This does not mean to say that operators will necessarily provide all the functions described. We have identified 81 sub-functions that beacon technology would be able to perform out of the 185 listed[103] for the entire road traffic management system.

A variety of services could be offered to users by means of this technology, the main ones being :

- audio information,
- visual information (on updated maps),
- audible and/or visual guidance instructions.

In principle, information transmitted to drivers is tailored to their individual requirements ; however, given the high workload that this would generate for the central computer, data are “collectively” optimised for the specific group of vehicles located within a given area.

5.5.3.1. Support functions

The fact that the system uses two-way communications makes it suitable for use by traffic management authorities (or the bodies to which such tasks are delegated). The system can therefore be used to collect tolls from vehicles in motion. It can also be used to transmit information on driver behaviour to the police (although caution would need to be shown with regard to the latter application, since it is hard to imagine drivers paying willingly pay for a service that would allow them to be monitored by the police). However, in providing information on vehicle movements (travel times over a given section of highway, accidents) and traffic conditions (condition of road surfaces), the system could be used to monitor the road infrastructure in general as well as the movements of hazardous waste shipments.

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[102] For toll-debiting, see the AUDIT report published by ERTICO.

[103] See the list given at the end of the chapter.

5.5.3.2. Driver assistance functions

Beacon technology could be used to supply some of these functions to vehicles fitted with a ground-to-vehicle communications link While beacon-based systems would not supply vehicle control functions, the in-vehicle unit could provide a display for such functions. A beacon-based system is the best one to use for co-operative driving since it allows safety messages to be transmitted and received at specific locations (intersections, dangerous bends, areas where fog is commonly encountered, etc...), it can also be used to exchange data with other vehicles by using the beacons to relay data from one vehicle to the vehicle or beacon behind.

5.5.3.3. Traffic management functions

By providing information on road and traffic conditions, as well as driver intentions (origin / destination), the EURO-SCOUT system can be used to monitor traffic flows and network demand.

EURO-SCOUT is primarily designed to provide navigation and route guidance services, and the associated functions are therefore an integral part of the system.

The system is capable of supplying all the services identified. It can broadcast information on traffic flows and trip planning. It can be used to manage demand by broadcasting information on alternative routes and other modes of transport. It can also help with parking space management by broadcasting information on the availability of on- and off-street parking spaces ; it could even be used to collect parking fees by means of telephone cards.

5.5.3.4. Professional road user management functions

The system can be used to help professional road users manage their operations by providing a means of transmitting information either to passengers using public transport facilities or to the drivers of commercial vehicles (public transport or road haulage). Given that the system transmits information on vehicle movements to control centres, it could be used to monitor fleet movements in real time, to forecast travel times and to optimise the use of vehicle fleets.

Given the system's performance characteristics, it would seem to be particularly suited to applications in densely populated urban areas.

5.5.4. Information and data handling

The EURO-SCOUT system offers a two-way communications link and is designed to track vehicle movements (as they pass in front of each beacon, which means that movements can be completely anonymous given that the systems uses information in the form of aggregated data). To guide vehicles between two given beacons, the system can be supplemented by an in-vehicle computer board and an oedometer / compass unit. The system is therefore virtually independent of public services in that it generates most of the information it needs to tailor services to the requirements of individual motorists from within its own networks. The problem lies in estimating the degree of co-operation that will be needed between EURO-SCOUT and traffic control/management centres. Since EURO-SCOUT is a centralised guidance system, the public authorities cannot allow it to be operated without supervision.

Furthermore, even though the acquisition, processing and formatting of data can in principle be carried out by the EURO-SCOUT operator, some kind of a balance will need to found in the co-operative links with the public bodies responsible for traffic management ; it is this balance which will determine whether or not the operation will be a profitable or high-risk venture.

The description given below therefore cannot be prescriptive and is given simply by way of an illustration based on information compiled during the survey of potential future operators and partners. Since the area addressed here is central to the competitive environment, it is understandable that only limited information is available.

5.5.4. I. External Systems to EURO-SCOUT

In the current configuration of the EURO-SCOUT system in place in Germany, EURO-SCOUT central computer[104] receives all the information it needs from the TCC[105] participating in the network (see figure 5.8.). Consequently, all the other information providers involved in the system, e.g. tourist information centres, weather centres, pollution monitoring centres, parking information centres, public transport control centres, are connected directly to the TCC.

The information transmitted to the central computer includes :

Weather information
Pollution information
Information on road conditions
Iinformation on specific events
Incident/accident information
Traffic information
Parking information
Parking space forecasts
Tourist information
Public transport information

5.5.4.2. Service provider to vehicle transmissions

The system uses two-way (roadside-vehicle) communications links for most of the information transmitted down-link to vehicles. Such information includes :

Weather information
Information on specific events
Hazard warnings
Incident/accident information
Travel information (including modal choice)
Traffic information
Parking information
Parking forecasts
Instructions to drivers
Travel vectors and guidance information

5.5.4.3. Vehicle to service provider transmissions

The up-link is primarily used to provide the system with information on actual journey times (also called floating car data), thus helping to build a statistical picture of the prevailing travel situation.

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[104] The EURO-SCOUT TT system operator.

[105] Public data provider.

Information transmitted on the up-link (from vehicles) includes :

- Floating car data (travel time),
- Origin-destination data,
- Vehicle category.

Other information not available at present, which it would be technically feasible to provide if there were sufficient market demand, includes :

- User financial transaction data (for automatic toll debiting),
- Emergency calls (only in the vicinity of beacons),
- Vehicle identification data,
- Parking space reservations,
- Operational information,
- Position,
- Load status,
- Vehicle status,
- Toll collection data.

5.5.4.4. Service provider to external support system transmissions

The EURO-SCOUT central computer supplies a wide range of data, as required, to the participating TCC and then can relay information from the TCC to external support systems (e.g. emergency centres, public transport control centres).

Information which could be supplied in this way includes :

- Emergency calls,
- Traffic data (journey times, congestion, etc...),
- Traffic trends,
- Operational data (bus locations, loads, etc.. .),
- Incident / accident information.

5.5.5. User roaming and payment

The marketing of the system and associated services, as well as the collection of tolls and charges, must be thought out carefully. Several types of economic actors may apply for licences to operate the system or services :

- the operator himself,
- car radio distributors / installers of in-vehicle equipment (car radios, radio telephones),
- tobacconists / newsagents for card renewals (maps and charge cards in cases where prepaid cards similar to telephone cards are used).

Charges on users / customers will be collected by the operator. The type of charging system adopted :

- subscription payable either in advance or in arrears,
- sales of telephone type cards,
- itemised invoices,

will be particularly important given its potential impact on the cash flow of the party collecting fees (i.e. the possibilities for earning revenue) and on management expenses (cost of managing the invoicing system and/or percentage paid to card distributors).

Subscriptions for the service will be paid for by means of “national” smart cards. Motorists will be able to gain access to the system in foreign countries by purchasing the relevant national prepaid smart card.

5.5.6. Contractual relations between actors

The principles underpinning these relations are outlined in the Tool Box. The most important “contracts” in this respect are the administrative authorisation (approval of the system with regard to safety in particular), and above all contracts n°1 and la (relations with public authorities, and in particular with traffic control centres). Use of an existing telephone network could be covered either within the framework of contract n°4, where the network is managed by a third party, or within that of contract n°1 where the network is owned (network utilised by the traffic lights control system) by the public authorities party to a n°1 type contract.

DSRC is a communications technology that can be used for a variety of applications :

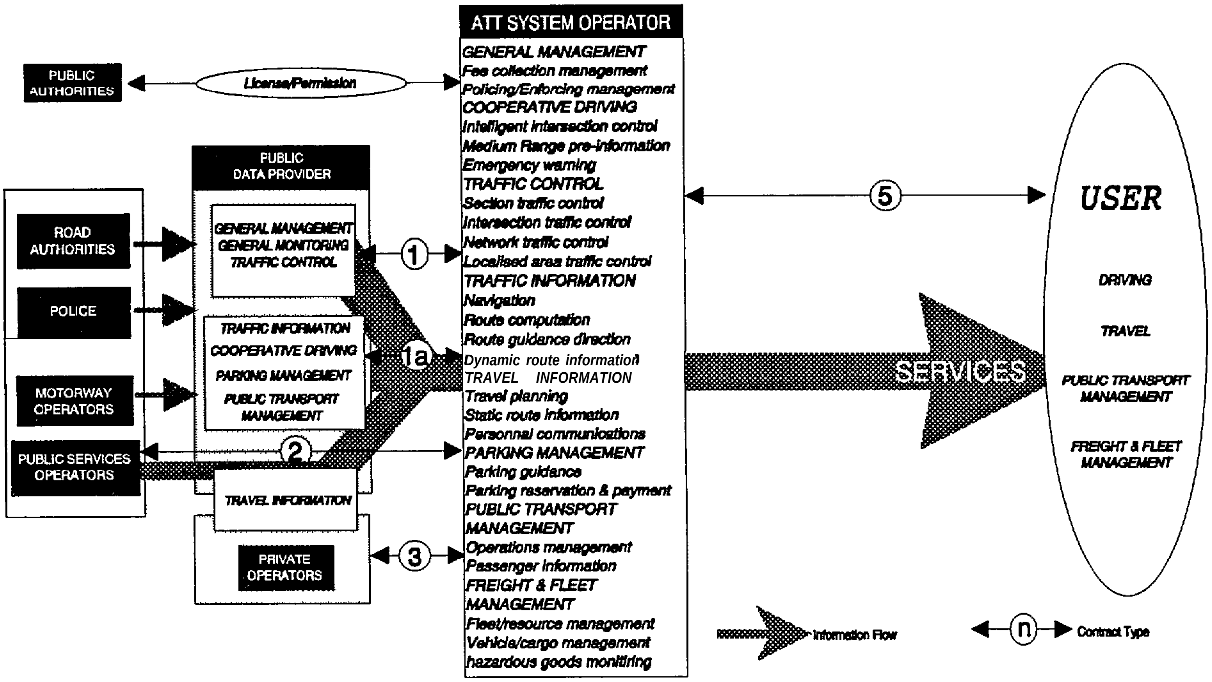
- toll collection,
- tax collection (infrastructure charging),
- co-perative driving,
- information on traffic and travel,
- route guidance.

Since DSRC is a two-way communications system, it can provide the same kind of services as GSM-based systems (SOCRATES), although it differs from the latter in several important respects :

- it does not share a communications infrastructure with a telecom operator,
- communications are local and intermittent,
- it is the most self-sufficient system, given that it generates its own raw traffic data,
- it is highly dependent on the willingness of the regional authorities to authorise the installation of beacons.

Figure 5.9.

Institutional legal flow framework for beacon-based systems



DSRC is the system which will require the largest investment from the private service-operator and which will have the greatest impact on city traffic management. It is therefore in the operator's interest to **seek** to lower break-even point through co-operation with the public authorities. The main challenge here lies in determining what the operator has that might be of interest to the authorities. If the operator were to supply the authorities with real-time information on traffic conditions, for example, the latter could use such information to give public transport priority over private cars. Apart from this information, however, the operator does not have much to offer the authorities in return for their permission to **install the** system.

Will the operator be allowed to divert user vehicles through residential areas to improve travel time ? Excessive diversion of traffic would increase the number of accidents and encourage the authorities to ban through-traffic, thus making the system less attractive to customers.

Will the private service operator be authorised to share cable channels to transmit data to the central processing facility centre (which would substantially lower the operator's investment costs) ? With whom will the operator negotiate ? How will maintenance costs be shared ?

55.7. Standardisation

Items requiring standardisation include :

- GDF location coding,
- Communications protocols for the beacon system,
- Smart cards.

Further standardisation is also needed in the area of the MMI and data exchanges between control and information centres, although not specifically with regard to beacon systems.

Work on the standardisation of ground-to-vehicle communications currently falls is currently being carried out within the framework of CEN TC 278. The work is proceeding well, although there is currently debate over the question of whether standards should apply solely to toll-debiting operations or whether they should be extended to cover all the functions that might be provided by a beacon-based system : this question has implications with regard to both the transmission protocol (degree of security) and the control language (degree of complexity).

Work is currently proceeding on the standardisation of so-called "centralised" systems of the EURO-SCOUT type under the auspices of IS0 TC 204 WG 11.

5.5.8. Control strategies

The system supplies users with information in the form of pure information, advice, or recommendations (e.g. route guidance).

Route recommendations are calculated centrally according to a number of collective (network-level) criteria based on shortest journey times, thus facilitating control strategies in accordance with the requirements of the responsible authorities.

55.9. Pilot projects using EURO-SCOUT

The system has been successfully operated on a trial basis in Berlin since 199 1 (LISB).

New field trials within the current ATT Programme include :

- ATT Programme, LLAMD project, Munich and Amsterdam.
- ATT Programme, CITIES project, Paris.
- ATT Programme, QUARTET project, Stuttgart and Turin.

5.5.10. Other comments

It is expected that cross-border exchanges of information will be handled by the relevant traffic control centres and as a result will not interfere with operation of the EURO-SCOUT system.

The EURO-SCOUT system does not infringe privacy rights given that the system uses data encryption in the IR link to ensure secure data transmission.

MAIN CHARACTERISTICS OF DIFFERENT TRANSMISSION SYSTEMS

	RDS-TMC	GSM	BEACONS
Radius of operation	50 to 70 Km	1 to 15 Km	**IR** 70 m in town 140 m on motorway ***μW vertical***: height of beacon *horizontal*: no definite limitation of range possible
Transmission medium	FM transmitters consumer's commercial radio broadcasters	GSM radio telephone transceivers	Infrared μW (Microwaves)
Users	Car drivers with TMC radio receivers	Professionals in future consumers	Users of ATT equipments
Onboard equipment	Can be combined with commercial radio reception	Service added to an equipment used for other purpose	Specific
Type of transmission	One way (to the car)	One way and two ways possible	One way or two ways
Number of possible ministered users by one station	>100 000	> 100 000	No limit
Information rate	Low to be used for long term and emergency messages	Medium	High but the car remains a short time in the beam
Infrastructure	Existing commercial broadcasting stations with (small) extension	Basic infrastructure (GSM) will exist Additional (GSM/GRDS) infrastructure must be added	Specific
Usability for tracing	***No***	Yes if 2-way communication	Yes if 2-way communication
Obstacle	Distance to transmitter	Geographical cover Distance to transmitter Management of peak demand	High directivity of the beam. Direct viewing but IR permits multisource of illumination
Conclusion	Interurban regional/national information	Regional/urban information	Mainly urban or motorways

CONSTRAINTS DEPENDING ON THE BROADCASTING MEDIUM

	RDS-TMC	GSM	BEACONS
Freedom of choice for the user	YES Is it yes if you pay for information?	YES Is it yes if you pay for information?	YES Is it yes if you pay for information?
Freedom of moving of the user	YES	YES if 1-way communication or 2-way without identification. NO if 2-way communication with idendification	YES if 1-way communication or 2-way without identification. NO if 2-way communication with idendification
Pay for information	As a consumer's service: very difficult	Acceptable for professional use	Acceptable for professional use
Right of use of public property	Already granted to broadcasters	Already granted to service operators	Permission from infrastructure owner
Service operators	Legal problem of the allocation of the RDS subcarrier	Legal problem of the allocation of the service frequency	Governmental decision. No obstacle due to the system
Frequency band allocation	International frequency plan National frequency plan	International frequency plan National frequency plan	International frequency plan for Microwaves IinfraRed is free
Frequency compatibility/ Interferences	International frequency plan National frequency plan	International frequency plan National frequency plan	IR (non coherent radiation) has no interferences at all μW (coherent radiation) risks severe interferences in urban traffic (reflexion +multisource illumination
Cost of Infrastructure	Low major part paid by RDS	Major part paid in existing infrastructure. No information on additional infrastructure cost available	Investment depending on the size of the network

Field of application of the three basic technologies

SUPPORTING FUNCTIONS

		BROADCAST SUBCARRIER	DIGITAL CELLULAR NETWORK	BEACONS
GENERAL MANAGEMENT & LOGISTICS	1.0.0			
Strategic planning	***1.1.0***			
Spatial traffic distribution	1 1 1	☐	☐	☐
Temporal traffic distribution	1 1 2	☐	☐	☐
Strategic Management	***1.2.0***			
Area parking strategy	1 2 1	☐	☐	☐
Network management policy	1 2 2	☐	☐	☐
Roadworks management policy	1 2 3	☐	☐	☐
Enforcement management policy	1 2 4	☐	☐	☐
Payment management (policy)	1 2 5	☐	☐	☐
Forecasting	***1.3.0***			
Traffic forecasting	1 3 1	☐	☐	☐
Special events forecasting	1 3 2	☐	☐	☐
Weather forecasting	1 3 3	☐	☐	☐
General Information management	***1.4.0***			
Individual information management	1 4 1	☐	☐	☐
Collective information management	1 4 2	☐	☐	☐
Digital road maps management	1 4 3	☐	☐	☐
Infrastructure management	***1.5.0***			
RTI infrastructure management	1 5 1	☐	☐	☐
Section technical management	1 5 2	☐	☐	☐
Intersection technical management	1 5 3	☐	☐	☐
Tunnel technical management	1 5 4	☐	☐	☐
Roadworks management	1 5 5	☐	☐	☐
User rescue services management	***1.6.0***			
Emergency call management	1 6 1	☐	☐	☐
Hazardous goods rescue service	1 6 2	☐	☐	☐
Special rescue service (User rescue)	1 6 3	☐	☐	☐
Infrastructure services logistics	***1.7.0***			
Road works planning/scheduling	1 7 1	☐	☐	☐
Infrastructure maintenance	1 7 2	☐	☐	☐
Road surface maintenance	1 7 3	☐	☐	☐
Section maintenance	1 7 4	☐	☐	☐
Intersection maintenance	1 7 5	☐	☐	☐
Tunnel maintenance	1 7 6	☐	☐	☐
RTI infrastructure maintenance	1 7 7	☐	☐	☐
Fee collection management	***1.8.0***			
Fee collection	1 8 1	☐	■	■
Payment management	1 8 2	☐	☐	☐
Policing/Enforcing management	***1.9.0***			
Hazardous goods location monitoring	1 9 1	☐	■	■
Violation detection	1 9 2	☐	▨	▨
Vehicle identification	1 9 3	☐	▨	▨
Incident management	1 9 4	☐	☐	☐
Police response to offense	1 9 5	☐	☐	☐
Violation registration	1 9 6	☐	☐	☐
GENERAL MONITORING	2.0.0			
Ambient conditions monitoring	***2.10***			
Meteo (data) monitoring	2 1 1	☐	☐	☐
Visibility monitoring	2 1 2	☐	☐	☐
Wind monitoring	2 1 3	☐	☐	☐
Area pollution monitoring	2 1 4	☐	☐	☐
Road status monitoring	***2.2.0***			
Friction monitoring	2 2 1	☐	■	■
Infrastructure monitoring	2 2 2	☐	☐	☐
Tunnel monitoring	2 2 3	☐	☐	☐
Road infrastructure capacity reduction / Road works effect calculation	2 2 4	☐	☐	☐
Weight in motion monitoring	2 2 5	☐	■	■
Events monitiring	***2.3.0***			
accident detection	2 3 1	☐	■	■
Incident detection & identification	2 3 2	☐	■	■
Traffic Monitoring	***2.4.0***			
Section state monitoring	2 4 1	☐	■	■
Intersection state monitoring	2 4 2	☐	☐	■
Network state surveillance	2 4 3	☐	■	■
Parking entry/exit monitoring	2 4 4	☐	☐	■
Floating car monitoring	2 4 5	☐	■	■

Field of application of the three basic technologies

OPERATIONAL FUNCTIONS

(DRIVERS)

		BROADCAST SUBCARRIER	DIGITAL CELLULAR NETWORK	BEACONS
VEHICLE CONTROL	3.0.0			
Monitoring Environment & Road	***3.1.0***			
Road surface and marking monitoring	3.1.1	☐	☐	☐
Road geometry monitoring	3.1.2	☐	☐	☐
Visibility monitoring	3.1 3	☐	☐	☐
Road regulations monitoring	3.1.4	☐	☐	☐
Monitoring Driver	***3.2.0***			
Driver status monitoring	3.2 1	☐	☐	☐
Creation of driver profile & identification of trends	3 2 2	☐	☐	☐
Monitoring Vehicle	***3.3.0***			
Vehicle dynamics monitoring	3 3 1	☐	☐	☐
Vehicle oerational satus monitoring	3.3 2	☐	☐	☐
Vision Enhancement	***3.4.0***			
Active illumination of the scene	3 4 1	☐	☐	☐
Enhancement of the scene contrast	3.4.2	☐	☐	☐
Enhancement of the Sensitivity and range of driver vision	3.4.3	☐	☐	☐
Collision risk estimation	***3.5.0***			
Relative Position Determination	3.5.1	☐	☐	☐
Conflict Zone Monitoring & Trajectory Prediction	3.5.2	☐	☐	☐
Safety margin determination	3.5.3	☐	☐	☐
Critical Course Determination	3 5.4	☐	☐	☐
Actuator Control (Dynamic vehicle control)	***3.6.0***			
Lateral activation/control	3.6.1	☐	☐	☐
Longitudinal activation/control	3.6.2	☐	☐	☐
Dialogue Management	***3.7.0***			
User presentation	3.7.1	☐	☐	☐
Driver tutoring	3.7.2	☐	☐	☐
Monitoring of driver response	3.7.3	☐	☐	☐
COOPERATIVE DRIVING	4.0.0			
Intelligent Manoeuvring & Control	***4.1.0***			
Lane change situation evaluation	4.1.1	☐	☐	☐
Optimized lane changing	4.1.2	☐	☐	☐
Generate driver information	4.1.3	☐	☐	☐
Generate trajectory	4 1 4	☐	☐	☐
Intelligent Cruise Control	***4.2.0***			
Generate driver information	4.2.1	☐	☐	☐
Generate speed command	4 2.2	☐	☐	☐
Generate distance command	4.2.3	☐	☐	☐
Manage clusters	4.2.4	☐	☐	☐
Intelligent Intersection Control	***4.3.0***			
Determine driver's intention	4.3 1	☐	☐	☐
Detect intersection	4 3 2	☐	☐	☐
Evaluate intersection situation	4.3 3	☐	☐	■
Organize intersection traffic flow	4.3 4	☐	☐	■
Generate driver information	4.3 5	☐	☐	■
Medium Range Pre-information	***4.4.0***			
Recommended speed	4 4 1	☐	☐	■
Poor visibility warning	4 4 2	☐	☐	■
Dangerous road surface warning	4 4 3	☐	☐	■
Heavy traffic density warning	4 4.4	☐	☐	■
Dangerous climatic conditions	4 4.5	☐	☐	■
Traffic regulations	4.4.6	☐	☐	■
Emergency Warning	***4.5.0***			
Incident report	4.5.1	☐	■	■
Incident localisation	4 5 2	☐	■	■

Field of application of the three basic technologies

OPERATIONAL FUNCTIONS

(INFRASTRUCTURE & SERVICE OPERATORS)

		BROADCAST SUBCARRIER	DIGITAL CELLULAR NETWORK	BEACONS
TRAFFIC CONTROL	5.0.0			
Section traffic control	***5.1.0***			
Section control computation	5 1 1	□	□	■
Section control actuating	5 1 2	□	□	■
Intersection traffic control	***5.2.0***			
Intersection control computation	5 2 1	□	□	■
Intersection control actuating	5 2 2	□	□	■
Network traffic control	***5.3.0***			
Origin/Destination computation	5 3 1	□	■	■
Demand prediction	5 3 2	□	■	■
Traffic prediction	3 3	□	■	■
Network control computation	5 3 4	□	■	■
Localised area Traffic Control	***5.4.0***			
Tidal flow control	5 4 1	□	□	□
Ramp control	5 4 2	□	□	□
Tunnel traffic control	5 4 3	□	□	■
Bridge traffic control	5 4 4	□	□	■
Lane management	5 4 5	□	□	□
Local speed enforcement	5 4 6	□	□	■
TRAFFIC INFORMATION	6.0.0			
Navigation	***6.1.0***			
Autonomous location estimation	6 1 1	■	■	■
Externally assisted location	6 1 2	□	■	■
Route computation (guidance)	***6.2.0***			
Individual route computation	6 2 1	■	■	□
Collective (network) route computation	6 2 2	■	■	■
Route guidance direction	***6.3.0***			
Route presentation	6 3 1	■	■	■
Route guidance instruction	6 3 2	■	■	■
Dynamic route information (On trip information)	***6.4.0***			
Roadworks	6 4 1	■	■	■
Accidents	6 4 2	■	■	■
Restrictions	6 4 3	■	■	■
Local warning advice	6 4 4	■	■	■
Traffic conditions	6 4 5	■	■	■
Weather conditions	6 4 6	■	■	■
Environmental conditions	6 4 7	■	■	■
Special Events	6 4 8	■	■	■
(Alternative) Routes	6 4 9	■	■	■
Link travel times	6 3 10	■	■	■
TRAVEL INFORMATION	7.0.0			
Travel planning	***7.1.0***			
Transport mode selection/planning	7 1 1	■	■	■
Route planning	7 1 2	■	■	■
Tourist information	7 1 3	■	■	■
Services information	7 1 4	■	■	■
Facilities booking	7 1 5	□	■	□
Static route information	***7.2.0***			
Roads characteristics	7 2 1	■	■	■
Parking facilities	7 2 2	■	■	■
Modal interchange points	7 2 3	■	■	■
Individual Map updating	7 2 4	■	■	■
Personnal communications	***6.4.0***			
Emergency paging	6 4 1	■	■	□
Personnal Mail Box	6 4 2	□	■	■
Emergency call	6 4 3	□	■	□
DEMAND MANAGEMENT	8.0.0			
Demand restraints	***8.1.0***			
Area access restriction	8 1 1	□	■	■
Route diversions	8 1 2	■	■	■
Road pricing & Road tolling	8 1 3	□	□	■
Supply control	***8.2.0***			
Car pooling	8 2 1	□	■	□
Modal interchange	8 2 2	■	■	■
PARKING MANAGEMENT	9.0.0			
Parking space Management	***9.1.0***			
Parking occupation prediction	9 1 1	□	□	□
Parking availability control	9 1 2	□	□	■
Parking guidance	***9.2.0***			
Dynamic Parking Information	9 2 1	■	■	■
Network parking guidance	9 2 2	■	■	■
Final destination guidance	9 2 3	□	■	■
Parking Reservation & Payment	***9.3.0***			
Parking space booking	9 3 1	□	■	□
Parking payment	9 3 2	□	■	■
On-street parking management	***9.4.0***			
Parking payment	9 4 1	□	■	■
Parking offense enforcement	9 4 2	□	□	□

Field of application of the three basic technologies

PROFESSIONAL USERS' FUNCTIONS

		BROADCAST SUBCARRIER	DIGITAL CELLULAR NETWORK	BEACONS
PUBLIC TRANSPORT MANAGEMENT	10.0.0			
Scheduling	***10.1.0***			
Travel time definition	10 1 1	☐	☐	☐
Detailed time table planning	10 1 2	☐	☐	☐
Vehicle scheduling	10 1 3	☐	☐	☐
Operations management	***10.2.0***			
On line monitoring	10 2 1	☐	■	■
Arrival prediction	10 2 2	☐	■	■
Operations control	10 2 3	☐	■	■
Assistance to operator	10 2 4	☐	■	■
Assistance to driver	10 2 5	■	■	■
On Demand Service Provision	10 2 6	☐	■	■
User estimation	10 2 7	☐	■	■
Information on operation	10 2 8	☐	■	■
Passenger information	***10.3.0***			
Basic information	10 3 1	■	■	■
Customised trip preparation help	10 3 2	☐	■	■
Information on current operation	10 3 3	☐	■	■
Fare collection	***10.4.0***			
Operating sales	10 4 1	☐	☐	☐
Validation/control of travel documents	10 4 2	☐	☐	☐
Fare collection data processing/collection	10 4 3	☐	☐	☐
Maintenance	***10.5.0***			
Vehicle diagnostic & data recording	10 5 1	☐	☐	☐
Maintenance Management	10 5 2	☐	☐	☐

		BROADCAST SUBCARRIER	DIGITAL CELLULAR NETWORK	BEACONS
FREIGHT & FLEET MANAGEMENT	11.0.0			
Logistics & Freight Management	***11.1.0***			
Logistics Management Business Transaction	11 1 1	☐	☐	☐
Intermodal change planning preparation	11 1 2	☐	☐	☐
Logistics Management Operation Preparation	11 1 3	☐	☐	☐
Logistics Management Operation Control	11 1 4	☐	☐	☐
Logistics Management Operation Evaluation	11 1 5	☐	☐	☐
Fleet/resource management	***11.2.0***			
Fleet management business transaction	11 2 1	☐	☐	☐
Fleet Management Operation Planning & Preparation	11 2 2	☐	☐	☐
Fleet Management Operation Control	11 2 3	☐	■	■
Fleet Management Maintenance	11 2 4	☐	☐	☐
Fleet Management Operation Evaluation	11 2 5	☐	☐	☐
Vehicle/cargo management	***11.3.0***			
vehicle management preparation	11 3 1	☐	☐	☐
Vehicle management operation	11 3 2	☐	■	■
Vehicle Management evaluation	11 3 3	☐	☐	☐
Hazardous goods monitoring	***11.4.0***			
Special route planning	11 4 1	☐	■	☐
Communication with traffic control	11 4 2	☐	■	■
Special emergency call	11 4 3	☐	■	■

6. Institutional Aspects

The institutional aspects can be considered as barriers to the introduction of information and telecommunications technologies in transport to the extent that nobody can yet say what their real impact will be on the implementation of systems. In fact it seems probable that the same legal rules may have very different effects depending in the country in which they will be applied. This observation means admitting that the solutions to permit implementation will have to be varied and adapted to the local circumstances. It should however be possible to take certain decisions at European Union level by agreement between member States, while in other cases direct negotiations between the authorities concerned will make it possible to resolve the problems. At this stage it therefore appears most useful to approach the institutional problems in a flexible and pragmatic fashion making the maximum use of the existing legal tools.

The purpose of the Tool Box is to permit the adaptation of existing legal tools to the circumstances associated with the implementation of personalised road information services. It must be stressed however that it proposes nothing to resolve the problems of competence which will arise between the various public authorities in their relations with the private operators. The aim of this chapter is to identify these problems, whose solution is not legal but organisational and political, in order to help the actors to prepare for negotiations without forgetting certain aspects which, if they were left aside at the beginning, could appear later as sources of conflict and call into question either the service itself or the economic equilibrium of the contract. In fact it will be necessary, before embarking on negotiations, to have found the answers to the following four questions :

-- who will be responsible for traffic management and driver information and who will bear the corresponding costs ?

-- what additional costs will have to be borne in order to supply personalised (value-added) services to drivers ?

-- are drivers, and users in general, prepared to pay for these services ?

-- is it desired (or can it reasonably be hoped) that the receipts from the sale of information and ancillary services should be greater than the marginal cost (corresponding disbursements) ?

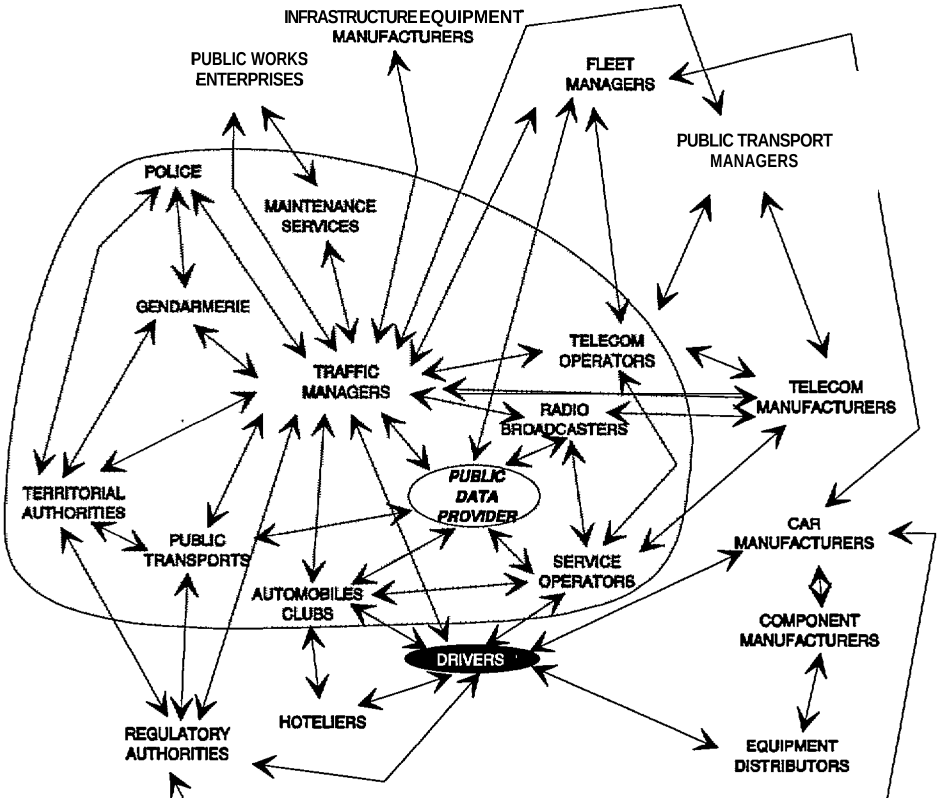
To be able to reply to these questions it is necessary to identify the objectives and constraints of the different parties and the organisational, financial and regulatory context in which they work. In addition, a distinction needs to be made between the statutory and managerial functions of public authorities. Whereas the latter can be delegated to private operators, the former cannot. However, the very term “statutory functions” means that any contract involving the delegation of public services (or collaboration with the authorities providing such services) must contain clauses setting out the conditions under which the authorities may resume direct managerial control, and the compensation that would consequently be due to the supplier to whom the provision of public services had initially been delegated.

6.1. Interdependence of the actors

The constitution of a road information branch of economic activity will be influenced in particular by the great interdependence of the actors. And the actors involved will range from public works enterprises to carry out the civil engineering work necessary for installing telecommunications cables to hoteliers wanting to be able to make information on their services available to drivers. Figure 6 illustrates very well the complexity of the relations between all these parties and highlights the key roles of the traffic (infrastructure) managers, service operators and the “public data provider” who will ensure interoperability between managers and operators.

Figure 6.1.

Road traffic management system :
relations between the parties involved



Today road information is the responsibility of the public authorities (infrastructure managers and/or police) and the automobile clubs and in any event concerns only collective information provided in totally independent fashion. Tomorrow all the links shown in the figure will have to be activated, which will give rise to a certain number of problems, in particular for the public authorities.

In fact, for our purposes, which concern the establishment of sound contractual relationships between the public and private sectors for the provision of personalised services for drivers, three types of actor have to be considered :

- drivers,
- public authorities,
- private operators.

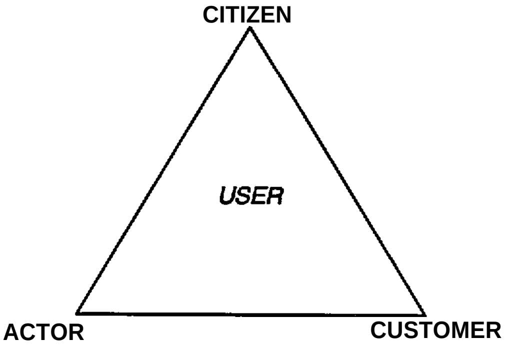
They are considered here not from the standpoint of their contractual relations (which are discussed in detail in chapter 2 of the Tool Box, but from the standpoint of their interests and their constraints.

6.1.1. The driver

The management of traffic flows and road information poses problems of a far more complex nature than those encountered in the case of either public or traded services, in that in this particular instance the same individual driver is :

- a citizen, who must comply with given rules and regulations (the highway code),
- a client, to whom services are proposed,
- an actor, who influences (through the degree to which he “obeys” the instructions he is given) the efficiency of the system as a whole.

We therefore propose to define the user / driver as an individual who, as a motorist, embodies all three aspects simultaneously. This will allow us to avoid the ambiguity inherent in the term client / user, which is often used to emphasise the need for the provision of high-quality services, but which tends to obscure the fact that the interest of society as a whole can take priority over that of the individual.



The citizen is answerable to the authorities ; the user makes use of public services managed either by public authorities or by bodies to whom the public authorities have delegated their responsibilities ; the client purchases the services supplied by competing suppliers; the actor[106] is both subject to (as a component of traffic flows), and an agent of (as an autonomous decision-making sub-system), the traffic management system.

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[106] The actor is both a producer who uses the road system to trade goods, and a driver who contributes to traffic flows ; see paragraph 6.5.2. below.

61.2. The public sector

The introduction of information and telecommunications technologies in transport is going to change the nature of the relations not only between the public and private sectors, but also between national, regional and local authorities. Historically, in most countries, the first measures to control traffic through the installation of traffic lights at crossroads were taken by the police, for safety reasons. Today there is a strong tendency towards a sharing of responsibilities with the traffic engineers who install signs and signals and the safety devices required by the police when they have to intervene at the scene of an accident in heavy traffic. On the other hand, over 80% of the traffic information is provided by police and/or the gendarmerie, depending on the country, received via road patrols or emergency calls reaching them, though there is growing a tendency towards installing independent, more stable and permanent data collection systems using telematics. Although the respective degrees of involvement vary according to country, the increasing safety problems in dealing with accidents connected with the growing congestion situations are going to necessitate ever closer cooperation between police services and transport ministries. And it will be necessary to find answers to the following questions :

- who is responsible for accident management ? and who intervenes with support ?
- who is responsible for traffic control (speed control and lane allocation) ?
- who is responsible for traffic management (deviations, control of access) traffic information and recommendations to road users ?

The answers to these questions need to be found not only at national level, between ministerial departments, but also at local level, between territorial authorities. Once these organisational problems have been resolved, then when negotiations begin with one of more private operators for the signature of contracts like those set out in chapter 3 of the Tool Box, it will have to be decided :

- who will lead the negotiations ?
- who will receive and manage the revenue ?

on behalf of all the public authorities involved.

6.1.3. The private sector

However, the difficulty today is not so much to know whether the public authorities will have any revenue to share between them, but rather to know whether there are private operators willing to run the risk of entering the business of providing real-time personalised information for drivers.

As shown by the schematic diagram of relations between actors (figure 6.1.) above, the private interests connected with the implementation of TT are distributed between the automotive industry, components suppliers, manufacturers and installers of telecommunications equipment and public service operators.

For the vehicle manufacturers the aim is to make the car safer and more comfortable to drive in order to meet the criticisms made as to its main function. For the components suppliers the aim is to create a new market which will replace existing car radios by more sophisticated on-board equipment. For the telecommunications industry it is a matter of finding favourable ground for financing the installation of the infrastructures for the future information highways which can later be used for other, no doubt more profitable, value-added services. Lastly, the public service operators see here an opportunity to provide local authorities with a more complete service in an area where they already manage water, public transport and various municipal services.

All these considerations show that the private actors (industrial firms and service providers) are dependent on one another and that it is necessary to have at the same time :

- equipped vehicles,
- a telecommunications infrastructure,
- commercial services.

The big question will then be :

- who will be the first to take the risk of entering this business ?

Now, the description of the relations between public authorities at both national and local level shows that there can be almost as many virtually independent situations as market segments, which could lead to the multiplication of market niches using mutually incompatible techniques. This is very important from the standpoint of economies of scale and reduction of the cost of on-board equipment.

6.2. Functions performed

The relations between public authorities, TT system operators and users will be determined by the objectives / functions that each party must fulfill. These objectives/functions may be broken down into four categories :

- sovereign functions deriving from the exercise of the supreme public authority vested in the State or its territorial agencies ;

- public service functions which cannot be performed by the private sector either because the services involved, despite being essential, are unprofitable, or because they can only be provided on a monopolistic basis ;

- the supply of services which must be provided by the private sector inasmuch that the services concerned are not essential to the nation (the scope of this concept varies according to author) and so must be supplied on a competitive basis, with the result that :
  - consumers must be willing to pay the requisite price for such services,
  - services may be supplied by any economic actor who so desires ;

- supply of transport information services. Whether such supply falls within the scope of public service of that of the supply of services is unclear, given that this area is currently being deregulated.

62.1. Sovereign functions

With regard to traffic management, the sovereign functions of public authorities encompass :

- national defence,
- law and order,
- civil defence.

These functions impose a number of constraints on the management of TT systems that will need to be taken into account in contracts drawn up between public authorities ("public data providers" and traffic control centres) and TT system operators, who may find that their collaboration falls within the compass of official secrecy regulations and is thus subject to approval by the military authorities.

6.2. I. I. National defence

Every nation must make plans to cover the unlikely eventuality of armed conflict. Were this ever to happen, one of the key factors in the successful prosecution of the conflict will be the speed with which troops and equipment can be moved to the theatre of operations, on the one hand, and the evacuation of the civilian population from the theatre of operations on the other.

In both cases, the configuration of the road network and the way in which it is exploited, will be key factors in the success of any military operations.

The military authorities therefore cannot avoid taking an interest in the design and operation of the road network. Specific corridors may be chosen to separate flows of troops towards the battlefield from flows of civilians moving in the opposite direction. Special procedures must be drawn up for the management of such flows, which will involving the stationing of personnel along the corridors, observation and communications posts and command facilities.

For obvious economic reasons, there can be no question of setting up separate systems that can be operated in parallel to the civil system used for everyday management of traffic flows.

The installation of modem dynamic traffic control systems must therefore take account of military requirements with regard to secure transmission facilities and autonomous command structures which might be needed in the event of an international crisis (particularly the protection of transmissions against electromagnetic radiation of nuclear origin, as well as, of course, sabotage). Provision must be made to allow civilian employees of public services and bodies to whom public services have been delegated to be drafted into service immediately to ensure that they remain in their functions.

6.2.1.2. Maintaining law and order

While the danger of armed conflict breaking out between European States would fortunately seem to be increasingly unlikely, the possibility of varying degrees of civil unrest and social disorder cannot be discounted. The recent national strikes by lorry drivers in France is one example of such unrest. These are normal emergency situations in democratic countries which require a specific response.

While the risk of assassination attempts can generally be disregarded, precautions should nonetheless be taken to avoid damage to certain installations and, above all, to the misuse of traffic information given to users (road barricades might be moved to block roads which the media have reported to be clear, for example). In such cases, the police authorities will assume responsibility for operations and the public services for traffic management ; TT system operators will therefore have to make their services available to the above authorities and, in particular, have them vet road information before it is broadcast to users.

6.2.1.3. Civil defence

Natural disasters (hurricanes, avalanches, floods, etc.) or industrial accidents (explosions, spillages of hazardous materials, etc...) must also be taken into consideration. The major industrial areas in Europe must be seen as high-risk areas in that they are linked to communications corridors (motorways, rail lines) of vital importance to the economy of a given country or region. In most cases, the authorities in such areas have drawn up emergency plans covering the evacuation of the resident population and access for helpers. Road traffic management, as well as controls on information in order to avoid panic, are major components of such plans. The Ministry of the Interior will be responsible for co-ordinating operations, which will involve the mobilisation of all public services.

6.2.2. Management of public services

Under normal circumstances the State is the guarantor of freedom of movement and personal safety. In other words, the State must ensure, without undue expense, the general fluidity of traffic flows without recourse to discriminatory measures other than those relating to safety. To do this, the State makes use of specialised technical agencies and the police.

For a number of reasons, the responsibility for ensuring that traffic flows freely cannot be exercised as a purely commercial activity :

- in building new infrastructure, it may prove necessary to expropriate land or home owners to prevent one property owner from holding up the project or demanding unreasonable compensation ;

- the construction of infrastructure solely in order to make a financial profit may lead to aberrations in terms of :
  - territorial coverage (all citizens are equal before the law),
  - protection of the environment,
  - safety ;

- traffic flows might be managed without reference to the situation on adjacent or parallel networks ;

- the policing of traffic is a sovereign activity which cannot be delegated, and which when traffic levels are high cannot be dissociated from flow management.

It is for the above reasons that the private sector is never allowed to perform such activities. They are either performed directly by the public services or contracted out to suppliers (generally by means of concessions) ; the latter are closely monitored by the public authorities and work in collaboration with the public services.

62.2. I. Infrastructure construction and managementfunctions

For many years the most prestigious area of activity for the Ministry of Public Works, Transport or the Environment (depending upon the country and administrative circumstances) has been the construction of infrastructure, maintenance being seen as a more mundane occupation[107].

It is only recently that traffic management has taken on a larger role as a result of both the problems posed by increased traffic flows with regard to the capacity of existing infrastructure, and the growing opposition from the population to the construction of new infrastructure (owing to the negative impact of increased traffic levels on the quality of life of those living in the vicinity of the infrastructure).

For many years management activities have been scorned by engineers, and even today they still bear the stigma of this contempt. Indeed, although the main objective is to manage traffic flows, services are in most cases organised on a regional basis and directed primarily towards the maintenance of existing infrastructure. Furthermore, although the provision of services to users would require the entire managerial function to be organised according to the volume of traffic flows, very often the organisational structures in place still relegate traffic managers to a secondary role compared with that of their colleagues responsible for maintenance (traffic flows are reorganised in order to facilitate maintenance work, rather than vice versa).

Lastly, road networks in all countries are ranked by size and by volume of traffic (national, regional and local connections), and are generally owned by the regional authorities at the relevant level. This organisation is superimposed, often poorly, on that of the engineering services[108]. Usually, the elected representatives of local authorities usually have policing powders which allow them, within certain limits, to decide upon the use to which highways can be assigned as well as the conditions under which they may be used (one-way streets, speed restrictions, etc...). These arrangements make it difficult to negotiate the creation of a shared organisational structure for the management of traffic flows, since an elected representative will give priority to the interests of his electors rather than to those of the wider community.

All these aspects need to be taken into account when introducing traffic management and driver information services, and also in the management of TT systems by private-sector operators. The latter would be well advised to determine which officers in the public services actually have decision-making power with regard to traffic management and road information.

6.2.2.2. Policing functions

In all countries, the police is responsible for road safety and enforcement of the highway code. The participation of the police in traffic management is therefore unavoidable [109] inasmuch as each accident / incident may be considered as a threat to law and order or public safety.

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[107] It needs to be borne in mind that people in many countries still want new roads to be routed through their village to encourage business and contacts with the outside world.

[108] Thus the DDE in France provides services at commune and department level, whereas in Switzerland the Cantons provide services on behalf of the Federal government.

[109] Whenever discussions are held on the introduction of information and communications technologies into the area of traffic management, very often little or no consideration is given to collaboration with police services. This "oversight" may well result in projects grinding to a halt once the system has been introduced.

However, the situation varies from one country to another. In some countries, the everyday management of traffic flows (traffic lights, diversions, etc...) is the job of the Ministry of Transport, with the police only intervening in the event of an incident / accident. In other countries, the scope of the Ministry of Transport's responsibility is limited to the construction and maintenance of infrastructure, leaving traffic management entirely to the police. This latter type of arrangement is inherently unstable in that the police has little funding available to invest in the installation of information and telecommunications systems.

Lastly, some countries have a highway police force, with jurisdiction over either the entire country or simply certain corridors, whose management costs can be funded either by the Ministry of Transport or by a body to whom the service has been delegated (concession holder).

Before signing a contract with a "public data provider", a TT system operator must therefore check that all his partners have the same understanding of the provider's commitment and that the key partner is indeed the driving force behind the operation.

6.2.2.3. Delegating public services

When a public authority delegates a public service, this means that although the authority is still responsible for the service, the provision of that service has been entrusted to an operator chosen on the basis of public procurement contract tendering procedures.

Depending upon the country and the type of contract, powers may be delegated to the operator "intuitu personae" without prior review[110] or further to a call for tender. In all cases the contract will include exorbitant private law clauses.

The operator to whom a service has been delegated must meet three requirements. He must undertake to :

- provide an uninterrupted service under all circumstances,
- adapt to new conditions,
- ensure that all users are treated equally.

In return, the State must allow the operator to make a reasonable profit to ensure that he can continue to operate in the event of force majeure, price restraint, unexpected servitudes, etc...

In Southern Europe (Belgium, Spain, Italy, France, etc...), statutory powers are delegated to the operator by means of a concession ; a similar arrangement is used in Germany and the Netherlands. In the United Kingdom and Denmark, preference is given to "Operating Contracts".

In addition, public authorities managing road infrastructure can contract out certain services (other than those listed in paragraph 6.4.) under arrangements which, depending upon the country concerned, may be referred to as "management" or "operating" contracts.

These types of contractual arrangement are outlined in paragraph 6.4.2.

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[110] As under French law with regard to concessions.

6.3. Organisation of the public authorities

The economic crisis and the financial constraints of the Treaty of Maastricht mean that reducing budget deficits is the main concern of governments. There is therefore a clear tendency to "debudgetise" all the activities which are not public service missions, either by transferring them to other public authorities or by privatising them. From this standpoint traffic information and personalised services for drivers[111] appear to many to be a good opportunity to transfer certain obligations to the private sector or to supplement budgetary resources by collecting money from users.

6.3.1. The choices open

However, even though these ideas are developing in both Europe and the United States, they have not so far been applied other than on toll motorways[112]. This is no doubt due to the difficulty of evaluating their impact on the functioning of the public service. In most cases the provision of services for drivers will necessitate making traffic information available to the private operator or public body responsible for marketing them, which means that the public authorities will have to organise themselves to be able to guarantee delivery. This is likely to cause serious management problems because of the annual budget constraint (financing beyond the current fiscal year is not guaranteed) to which they are subject. They will have to face different situations, the two extreme cases of which may be summarised as follows :

- the authorities wish to control the information and impose very strict obligations on the private operator (see contracts n^{0}1 and la in the Tool Box). To compensate they will be led to provide the operator with the base information available to them. In addition, the operator will require guarantees as to the quality and availability of the information. It will then be necessary **to** evaluate the impact in terms of costs for infrastructure managers and to ensure that the extra costs are covered by the fee paid by the operator or will be justified by the economic and social advantages brought by the service (in terms of enhanced safety and reduced congestion). Otherwise there is a danger of blocking the public investment insofar as a budget increase is requested before any receipts are generated ;

  the authorities consider that if road information and personalised services for drivers are of some utility to the user then he should be willing to pay to obtain them, and do not wish to exercise any control over the operator's activity provided that he has obtained the requisite authorisation (see Licence in the Tool Box). In addition the authorities, insofar as the private sector is now supposed to sell the information service, reduce their expenditure and limit their objectives to the management of incidents / accidents and traffic control. The result is that the private operator even if he asks for it will have no guarantee regarding the quality and availability of the base information produced by infrastructure managers and will have to make arrangements to overcome this problem.

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[111] These services are often called "value-added" services as opposed to public services. The term is ambiguous however, because it implies that public services have no value-added, which is clearly false because then there would be no such services.

[112] It must not be forgotten however that there are conventional traffic information services in the USA with METRO traffic and services using the new technologies with Traffic Master in the United Kingdom.

There will then be reason to fear that private investment will have to be increased, inevitably reducing profit expectations and increasing the entrepreneurial risk. This threatens to block private initiative because of the significantly greater risks involved.

- The question then is to know where public investment ends and private initiative begins ?

6.3.2. The structures

All this shows that it is necessary to make the roles and responsibilities within the public authorities evolve in such a way as to be able to on the one hand deal with the growing congestion on infrastructures and on the other meet the demand for the provision by the private sector of services for drivers. Up to now, infrastructure managers have been organised on a territorial basis, as have the police, but in the years to come, growing circulation of goods and persons in Europe, it will be increasingly necessary to control traffic and assist users. The public authorities will therefore have to introduce appropriate information systems to monitor not territories any more, but networks, so as to be able to follow certain flows from their point of departure in one country to their destination in another. This will induce changes in organisational structures and working methods, in particular between traffic management centres. The main questions are then :

- what is the proper territorial coverage for :
  - a traffic control centre,
  - a traffic information centre,
  - a travel information and demand management centre ?

- what information should be exchanged between centres ?

Up to now the problem has been approached from two standpoints :

- that of the integration of functions[113],
- that of the integration of payments[114],

without too much attention being paid to the frequency of requests between different types of information centre and the volume of information to be exchanged or distributed on the one hand and the different market segments to which this corresponds on the other. This may lead to over-sized and unprofitable systems. In order to avoid making such an error, any institution, public or private, must find its own answers to the following questions before embarking on investment in the production of information or the provision of services :

- what should be the relations between traffic centres in the same districts ? should they cooperate in real time, should they share resources (telecommunications, captors, databases, etc...) ?

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[113] See chapter 4, section 2.2.

[114] More directly connected with automatic toll payment, which is not dealt with here,

- what should be the relations between traffic information centres in the same zone ? should they coordinate their traffic management strategies ? should they agree on common procedures for the exchange of information and for making it available to private operators ?

- what should be the relations between the authorities responsible for transport in a region ? should they harmonise their demand management objectives ? should they jointly define an operating philosophy ?

The replies to these questions may lead to different forms of organisation on the ground and to different relations between authorities within the "public data provider"[115].

6.3.3. *The imputation of costs*

The construction of a road infrastructure is often financed by contributions from several public authorities (central government, region, etc...). Very often the money is made available to one of these authorities which is made responsible for the project. In the case of telematics equipment the situation is much more complex. In fact it is common in Europe to find along a motorway a transmission cable belonging to the state, an equipment control device belonging to the region and the data processing computer belonging to the police. It is then very difficult, if not impossible, to determine the total investment cost. What is more, the organisations involved traffic management and road information management belong to different ministerial departments (police, transport, justice, defence), authorities (state, region, municipality) and/or private bodies (broadcasting stations, automobile clubs).

Services are provided despite this very complex organisation. This is due to the fact that they are financed out of public budgets and there are no receipts. When it becomes a matter of commercial activities with income derived from the sale of services then difficulties will appear which are not of a legal nature, but political, and answers will have to be found to the following questions :

- will each public entity claim a share of the revenue ?
- how will the distribution be calculated ?

If negotiations with private operators are to have any chance of success, the replies to these questions will have to be found before they begin. However, in view of the budgetary constraints, it is highly probable that the reply to the first question will be positive, and two problems will have to be solved in order to find an answer to the second :

- evaluation of the investment and operating costs through a cross-sectional and consolidated analysis of the budgets of the different authorities involved (central and local) bearing in mind that the rules of public management are based on annual budgets, that there is no common accounting system and that wages are grouped under a budget item different from that of the administrative divisions responsible for road information management,

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111 See chapter 2 of the Tool Box.

- the imputation of costs between the different public service missions and in particular between road maintenance, traffic flow management and assistance to drivers[116].

6.3.4. The framework for action

All the problems raised above have little to do with legislation (unless we want to reform the principles of public financial management). However, certain commentators believe that it is necessary to create a new legal framework specific to road information and personalised services for drivers in the following fields :

- public / private partnership,
- protection of individual privacy,
- public procurement,
- third party liability.

In fact it would appear that the customs, laws and rules which exist in the different European countries can be applied provided there is a clear definition of the principal subject of any eventual dispute, i.e. road information and personalised services for drivers. This has been done in the United Kingdom. But there are two real problems which have to be resolved before services can be implemented :

1. the guarantee of the commitment of the public authorities with regard to the provision of information,
2. the status of road information and services with respect to existing methods of taxation.

6.3.4.1. Commitment of the public authorities

We have seen that the field of road information and personalised services for drivers extends beyond the territorial limits of the various public authorities. There is hence a great need for cooperation between these authorities. In most countries the existing legislation may be used to oblige a recalcitrant authority to cooperate (generally in the name of the constitutional guarantee of the free circulation of goods and persons). In addition it appears increasingly difficult to pass legislation intended to limit the power of local elected representatives. Lastly, in each area only a small number of local authorities is confronted with traffic management problems and it may be asked whether specific laws could have any other purpose than to anticipate problems which could be resolved simply through negotiation. The question therefore is :

- is it necessary to engage on a politically hazardous legislative process in order to force a small number of local authorities to negotiate and to respect their engagements when existing laws together with good jurisprudence can handle this problem ?

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[116] See the definition of these missions in chapter 3, section 2.1.

6.3.4.2. Taxation

In the case of a public / private partnership there is no problem of VAT (Value Added Tax) if the services are marketed essentially by a private operator. On the other hand difficulties will arise where a private operator collects money on behalf of public authorities or if a multi-service, multi-operator "compensation chamber" manages the money for public and private operators. If this is the case it is necessary to answer the two following questions :

- in the first case, what will be the tax base for the total amount collected or the cost of the operator's service ?
- in the second case, how to distribute the money (and the cost of the accounting and management) between the private operators subject to VAT and the public authorities or public operators not subject ?

6.4. Service provision

In principle, user services are supplied on a market basis. However, with traffic management and driver information services, the situation is rather more complex than might appear at first sight :

- the information supplied might affect the performance and thus the provision of a public service,
- the full cost of producing information may be disproportionately higher than the price that users would be prepared to pay for such information.

6.4.1. Impact on public service obligations

The impact on public service obligations (see discussion above with regard to sovereignty and public service) requires a number of obligations to be imposed on the TT system operator. These usually consist in the requirement to provide a minimum service and to ensure the availability of services. This may generate significant structural costs that a purely commercial operation would seek to avoid.

6.4.2. Cost of service provision

On the other hand, the TT system operator might be able to utilise data generated by the management system set up by the public services. However, the installation of such a system requires substantial investment. In addition, if income from the sale of services to users were the only basis on which the investment could be amortised, the financial balance of the system would be irretrievably jeopardised, particularly with regard to services supplied to intercity travellers.

These two constraints ensure that the price at which services can be sold by TT system operators will in most cases be different to the actual cost price. A fair balance would be one in which the public service does not spend money helping to “manufacture” services for purely private use, on the one hand, and in which the TT system operator realises an acceptable profit of his activities on the other. In order to meet these two objectives, the selling price of the service might be calculated on the following basis :

Additional expenditure incurred by the public services in ensuring
that the information they provide is both accurate and supplied at regular intervals
+
TT system management costs, including the cost of producing services,
amortisation of fixed assets and marketing costs

Charges incurred as a result of the obligation to provide a public service and subsequently reimbursed
by the authorities which imposed the obligation - by including it in the specification of work
+
Industrial and commercial profits
=
Retail price of service

6.4.3. Carriage of information

For many years (and until quite recently), the carriage of information was considered to be a public service and was therefore operated as a monopoly. This sector is now being deregulated. It seems likely that any changes in the situation will depend upon the particular environment in individual EU Member States, some of whom will undoubtedly entrust certain public services to the former national operator[117]. As with the rural and urban environment, the radio spectrum is a finite resource. Indeed, it should probably even be treated as a scarce resource. In the long term, this will pose the problem of how this resource should be shared between applications which can generate substantial profits and those which provide a public service”*.

This problem will have particularly serious implications for the use of radio subcarriers and also for information carrier services based on cellular radio telephony. Should the use of such resources be freely negotiated between telecom operators, on the one hand, and public services, bodies to whom services have been delegated and TT system operators on the other, or should statutory action be taken to ensure that a portion of the spectrum is made available for the transmission of road information messages.

Moreover, the situation may vary substantially from one country to another :

- Thus in northern Europe, where radio telephony is widely used but where the number of users is relatively low compared with the capacity of the available spectrum, operators would be well advised to promote the use of cellular radio telephony for the transmission of traffic information. In other countries, however, where the management of the resource is more complicated (peak calling rates coinciding with times where traffic conditions are difficult), operators may prefer to keep spectrum resources free for services with higher value added.

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[117] On the other hard, experience of the damage caused to national airlines will perhaps prompt the authorities to seek to re-organise the market rather than to proceed with full-scale liberalisation (law of the back-garden rather than the jungle).

118 There are two ways in which to approach the problem of frequency allocation :
- they can go to those who offer the best service from the standpoint of the community as a whole ;
- they can go to those who are willing to pay the highest price.

- Furthermore, in some countries, radio subcarriers are the property of the radio broadcaster to whom the frequency has been allocated, whereas in other countries they belong to the transmitter operator. In some cases, large numbers of radio broadcasters may find themselves faced with a monopoly on transmission facilities, whereas in others there may be a single radio broadcasting channel controlling several local radio stations.

TT system operators would therefore be well advised to take such local arrangements into account before choosing which technical principle to exploit.

6.5. User expectations

Although customer expectations and behaviour in normal commercial relationships can be accurately predicted (marketing is now a well established discipline, but not yet an exact science), our understanding of the management of public services is still rudimentary. The managers of such services are tom between a vociferously modernist approach that attempts to attract customers in the same way in which detergent manufacturers advertise their wares, and the self-satisfied, smug approach of those “in the know” who are ready to act for the good of society despite any objections the latter might have.

Moreover, people who are accustomed to have their lives taken care of by society and to being treated like cattle are always ready to complain about “civil servants”, but are seldom prepared to pay for improved services.

These are the psychological factors which must be taken into account in the planning of TT systems if failure is to be avoided. This is why it is important to determine not only what the customer desires, but also what the ordinary citizen demands and how producers behave[119].

The user exhibits all three of the above traits. However, until now, traffic managers have basically addressed the needs of the ordinary citizen using the roads and motorists, and have rarely taken the aspect of the user as consumer into account. Road information has always been provided with the aim of improving either the collective optimum (i.e. the citizen) or general traffic conditions (i.e. the participating actor). The introduction of TT systems that will allow route guidance services and information to be tailored to the requirements of individual motorists will modify managerial modes by introducing the concept of the consumer. The problem will be how to make users who are accustomed to receiving services free of charge pay for such services.

6.5.1. The citizen

As both a maker of the law, through the intermediary of his elected representative in parliament, and an ordinary man in the eyes of the law, the citizen can steer policy in a particular direction by exercising his right to vote. It is the citizen as voter who sets out, more or less explicitly, the criteria to be taken into account when assessing the impact of a road on the socio-economic environment in terms of:

- road safety,
- pollution,
- congestion.

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[119] That is to say both the economic actor who uses the roads to trade goods and the motorist.

The attitude of the citizen towards road transport will vary according to whether he is a driver, a haulier or a householder living in the vicinity of a road. It is often said that while everybody wants to have access to motorways, nobody wants to live next to a motorway; each member of society is therefore caught in the dilemma whereby :

- as a householder living near to a road, society must protect him against disamenities,
- as a taxpayer, such protection must be paid for by those creating the disamenities,
- as a user, he claims the right to freedom of movement without charge.

6.5.2. The actor

This term embraces two concepts :

firstly — that of the economic actor for whom transport is a factor of production which has an impact on the efficiency of the production process. Producers want to keep the direct cost to them of this factor of production as low as possible, hence the pressure they apply to keep infrastructure toll-free, to combat speed restrictions and to be allowed to use larger trucks,

secondly — that of an actor in traffic flows. Every individual motorist makes a personal contribution to traffic management through his travel intentions and mode of driving, both of which are a function of his autonomy.

It is doubtless by embracing the first definition that TT system operators will secure their first customers. Indeed, although road hauliers can bring pressure to bear to secure the lowest possible charges for the use of infrastructure, they will be perfectly prepared to pay for any service that will allow them to improve their performance in terms of deadlines and punctuality.

The second definition offers a fresh approach to investigation of the modes in which traffic management systems and road information systems might be managed, as well as to the marketing of the services supplied by TT systems. Studies addressing user behaviour patterns and the way in which users adapt to new media (such as variable message signboards) are based this line of approach.

6.53. The consumer

The term “consumer” is used here to mean an economic actor consuming goods which are not indispensable to the continued operation of society. Services associated with these goods are subject to the law of the market-place. However, the area of road information represents a special case in that services may be classified as either existing, new or future services.

- Existing services are those which have been used for many years to supply information to road users (“Bison Fute" in France, ARI in Germany). They also include services currently (or formerly) available, whereby information is provided by means of specialised telephone enquiry systems or radio stations. These services are provided free of charge and are now widely known and trusted. Such services are aimed at road users rather than potential consumers.

- New services are those which make use of new technologies that allow information to be given in greater detail and in real time, and which require more complex forms of collective organisation.

- Future services are those which might eventually be derived from new technologies being developed today, and which offer information and route guidance services tailored to the requirements of individual users.

It is only in the latter case that it is justified to talk in terms of consumers. However, the existence of the first two categories of services poses formidable problems in terms of marketing and contractual arrangements if a balance is to be struck between services to users (public services) and payment for tailor-made services.

6.6. Relations between the public and private sectors

It is clear from the above that the public authorities responsible for managing infrastructure and the operators of TT systems will need to forge a new form of relationship in which shared resources (such as data on traffic flows and movements) can be used simultaneously for both the management of public services and the supply of tailor-made services to drivers. As a result, public procurement procedures will need to be reshaped and adapted in terms of :

- the way in which contracts are awarded to firms,
- the nature of risk-sharing.

6.6.1. A ward ***of contracts to firms***

The selection of TT system operators raises a number of problems :

- firstly, the regulations governing public procurement specify that contracts must be awarded on a fair and competitive basis ;
- secondly, the high standard of service required in terms of quality and safety calls for strict selection procedures which cannot be based solely on the usual criteria of price and production potential.

In fact, there are three basic factors that need to be taken into account :

- the operator’s skill at utilising the technologies adopted,
- ability to meet the constraints of public service (24-hour a day service, peak-time operations),
- the ability of the operator’s staff to collaborate with different public services.

The rules of public procurement carry the risk where the competing technologies are few (not to say unique per application or market segment) of placing the public authorities in a difficult situation when it comes to selecting a partner. In fact Directive 90531 on excluded sectors forces network operators to obey rules comparable to those obtaining for public markets for their purchasing. This Directive applies if one of the following obtains :

- the service is of public interest,
- one of the parties to the contract has public status,

- public funding is involved,
- there is exclusivity on a territory either by legislation or by contract.

These conditions will have a certain influence on whether the private operator decides to request exclusivity or not. If his job is that of a service operator to the exclusion of any other he will have an interest in requesting exclusivity and possibly financial support insofar as the application of the Directive will not harm his interests by making him put equipment suppliers in competition with one another. On the other hand, if the operator is the subsidiary of an equipment manufacturer, he may have an interest in not requesting exclusivity and even less financial support, insofar as, not being subject to the Directive, it will retain its freedom of choice with regard to equipment and can thus split the margins between parent company and subsidiary.

Lastly, another Directive being prepared on design may oblige the holder of a patent with a quasi-standard status to make the corresponding technology available to its competitors under economic conditions permitting competition.

6.6.2. Risk-sharing[120]

A private operator will only contemplate setting up a TT system if he can be sure of making a reasonable profit. With some systems (particularly those based on the use of beacons), however, the size of the capital investment involved may be substantial. The operator will therefore seek to secure guarantees from the public authorities, and in particular :

- a long-term operating licence,
- one or more clauses restricting competition,
- an undertaking from the authorities with regard to transport policy in the area served by the TT system (traffic planning, relations with public transport services, etc...),

in order to obtain maximum coverage for the risks he is taking.

The risks involved in setting up TT systems are particularly high in that, in addition to the inherent technological risks associated with such systems, as set out in chapter 3, and the risk of innovation (which represents a formidable problem in that the viability of a TT system can only be proven by means of large-scale demonstration projects), operators must also contend with “normal” business risks, which may be broken down into the following three categories :

- investment risks, in terms of the sums invested in equipment and launching the product on the market,

- operating risks, covering the operating expenses incurred in running the organisation and maintaining equipment,

- the commercial risk associated with estimating the potential market (earnings) for the services supplied by the organisation.

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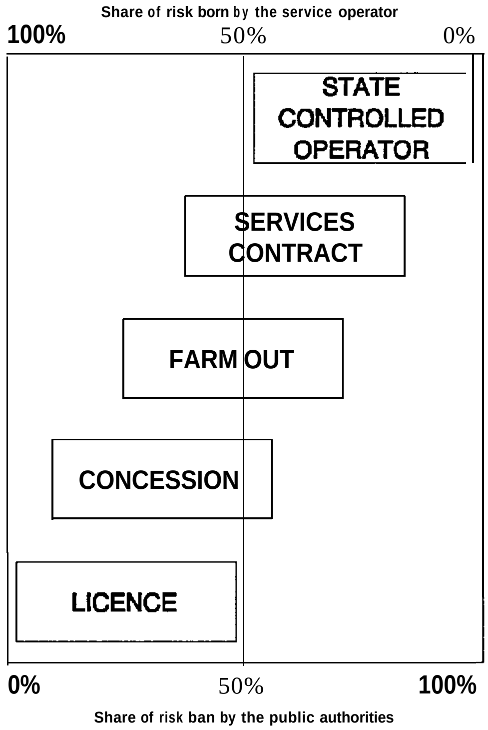
[120] See chapter 2, for definitions of the risks involved.

Faced with all these uncertainties, there is a danger that both the public sector and industry may be reluctant to commit themselves. In order to avoid the creation of such a vacuum, which would simply provide a window of opportunity for systems developed outside Europe, contractual arrangements which take proper account of the risk-sharing aspects need to be developed. The most appropriate forms of contractual basis are as follows :

Figure 6.2.



6.6.2.1. Licensing agreements[121]

Under a licensing agreement, the public authorities have no financial involvement in the management of the TT system. Their responsibilities are limited to approving the running of the system and establishing the term of the licence. On the other hand, the operator of the service cannot be awarded a monopoly. In fact, if the operation of the system requires the use of public property, the problem of restricting the scope of the operator’s activities may be dictated by technical considerations. However, it would seem reasonable to assume that, given the size of the potential market for TT systems, the minimum level of profitability for such systems will naturally restrict the number of candidates (failing which they would all find themselves in difficulty).

6.6.2.2. Concessions

Concessions offer operators greater protection. Under such an arrangement a public service is delegated to an operator who thereby enjoys certain guarantees with regard to competition and tariffs in exchange for accepting the corresponding obligations. The risk taken by the operator lies in correctly estimating the capital investment and operating costs. The operator also runs the risk of underestimating the minimum earnings required.

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[121] See “Administrative Authorisation” in the Tool Box.

6.6.2.3. Farm-outs

Farm-outs differ from concessions in that the facilities are owned by the public authorities and therefore do not need to be amortised by the operator. The operator can nonetheless assume responsibility for their maintenance and upkeep. As with concessions, the risk lies in estimating revenues.

6.6.2.4. Contract for the supply of services

With a contract for the supply of services, the risk taken by the operator is limited to that of estimating his operating costs, with the public authorities assuming responsibility for amortising the cost of the facilities and the risk of underestimating revenues. In the UK and North America, such a contract might be termed an “Operating Contract”.

6.6.2.5. State-owned companies

With a state-owned company, the role of the operator is limited to securing and supplying the facilities requested of him by the public authorities. Under such an arrangement the operator, in principle, runs no risks, since all his charges are reimbursed and income from the services he supplies is collected by the public authorities.

Under such arrangements, as with contracts for the supply of services, the operator may be offered a share in the economic performance of the service by means of incentives based on profits, turnover, or on parameters measuring the impact of his management.

All these legal arrangements may be adapted to the standard contract n^{0}1 (or la) given in the Tool Box, depending upon the legal framework adopted.

Nota Bene : These contractual instruments are designed for “normal” economic activities. A comparable instrument for the indispensable demonstration phase has not as yet been developed. With TT systems requiring close collaboration with a wide variety of actors, the basic elements of the system, which in this case are the organisational structures and the organic links between traffic control centres and the operator, cannot be efficiently tested solely on the basis of industrial - type pilot projects.
Indeed, it is this very demonstration phase that will ultimately make it possible to properly validate the proposals contained in the Tool Box.

ANNEX

THE QUESTIONNAIRE

This Questionnaire was designed to validate the Tool Box on which it is based.

It was supported by the following :

- a list of the functions which TT systems can fulfil, together with allocation of these functions to a series of actors of differing legal status. Respondents were asked to complete a list provided at the end of the questionnaire in accordance with an example given inf the Tool Box (synthesis of the answers is provided by figure 3 of the final "Tool Box" and detailed list is given below) ;

- questions under the heading "institutional sphere" regarding the relationships and links between actors. Respondents were recommended to refer to figures 1 and 2 of the Tool Box when filling out this part of the questionnaire.

Questions to be answered by public authorities[122]

These questions are primarily aimed at legislative and regulatory bodies[123]. However, answers to some questions may be given by local authorities with responsibility for road traffic on certain types of highway. Each country is asked to co-ordinate replies to ensure that all possible configurations are covered.

1. The exercise of public power

The functions which ATT systems[124] might provide may be subject to specific regulations regarding the use of roads and highways, telecommunications or radio broadcasts, as well as to legislation on personal privacy. To give respondents some idea of the general context, two functional tables have been provided :

- one as a completed form in the Tool Box, based on previous surveys carried out the TCT group and indicating the arrangements most commonly encountered in Europe
- the other as a blank form, given at the end of this Questionnaire, which is to be filled out respondents[125].

Question 1 : After completing this form, please indicate any areas or points which you feel have been missed out or for which you would like propose changes or amendments.

Question 2 : Do you intend to introduce specific legislation to provide a legal basis for the management and supervision of driver information and route guidance systems (as in the U.K.), and in particular for administrative authorisation (see page 30 of the Tool Box)?

2. Respective responsibilities of public authorities

Do State and regional / local authorities have shared or separate responsibilities for the same road networks ? Will the installation of ATT systems require prior designation of the roads concerned, the organised planning of installation work within such networks and a specific policy on traffic ?

Question 3 : Does your country have legislation or an arbitration procedure[126] which allows actions of all parties to an agreement to be co-ordinated within a given geographical area ?
If so, please describe the main provisions of such arrangements and, where applicable, your plans for future action in this area.

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[122] For more details on institutional aspects, see chapter 4 of the "Explanatory Guide".

[123] The constitution of countries whose legal system is based on Roman law may in some instances allow the government to issue regulations that have the force of law.

[124] The term "ATT system" is used to refer to any system providing route guidance / driver information services through a ground-to-mobile communications link

[125] The completed form is provided at the end of this questionnaire.

[126] In some countries, public authorities are not allowed to accept compromise arrangements (i.e. arbitration). What is the situation in your country ?

3. Role of the public data provider[127]

The contracts set out in the Tool Box are based on the assumption that public data will be centralised by a “public data provider”.

A typical organisation chart for such a provider is given in figure 2 of the Tool Box. The status of the centralised data bank may vary.

Question 4 : Do you think that it would be preferable for the public data centre to be operated by :

- a central or local government department with responsibility for centralising data supplied by other departments ?
- an independent corporate body acting on behalf of public data providers and bound to the latter by agreements ? And if so,
- should such a body operate as a public or private organisation ?

In the event that no such centre is set up :

Question 5 : Will you allow the TT system operator to negotiate the supply of data with each authority individually ?

- if not, will you set up some form of co-ordinating structure ?

Question 6 : Will the contracts used in such arrangements be regulated ?

Since the “contract” covering relations between the different public authorities party to the agreement is primarily subject to the principle of subsidiarity or covered by bilateral agreements, we have not provided a framework contract for this area in the Tool Box.

Question 7 : Would you like a contractual framework for the management of the data centre of the kind proposed in the Tool Box, to be drawn up under the present programme ? If so, what should it contain ?

4. Relations between the public data provider and the TT system operator

Processing and output of data may be carried out by either the public data provider or the TT system operator.

Question 8 : Do you wish the public data provider to :

- validate data (i.e. have responsibility for checking data) ?
- format data ?
- in the latter case, do you want the operator to edit messages in a specific format, notably for safety reasons ?

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[127] See paragraph 2.5.1. of the Tool Box.

Question 9 : Do you think that the provider should charge the operator for the data supplied ?

if so, should the operator pay for all or only some of the data ?
on what basis should payments be calculated, i.e. should they based on full, direct or marginal costs ?
how should the operator be invoiced ? Should it be by subscription or on an itemised basis ?

-

Type 1 contracts (page 32 of the Tool Box) impose certain obligations on the operator, notably the use of a standardised message formats for information transmissions, minimum intervals between message broadcasts and compliance with official road traffic management policy.

Question 10 : What means will be given to the provider to ensure that such obligations are respected :

financial penalties ?
unilateral suspension of data transmissions further to the serving of formal notice to comply ?

Question 11 : Would you like the above means to given the force of law or simply written into contracts between the provider and the TT system operator ?

∴

Some systems, notably those which use beacons[128], generate their own data on traffic conditions.

Question 12 : Will you oblige the operators of such systems to supply real-time data to the public data provider or, if there is no such provider, directly to the various operators of road infrastructure ?

Question 13 : If your answer to the above question is “yes”, do you think that the operator should be paid for this service or would you make such service a condition for access to public property ?

Question 14 : Is the use of such data restricted to the needs of road traffic management or do you make them available to :

other public departments (public transport, fire brigade, police) ?
other private-sector operators providing driver information / route guidance services ?

If the TT system is to be financially viable, the operator must be given assurances regarding the security and quality of his data supply.

Are you prepared to :

Question 15 : Make available the material, human and financial resources needed to ensure that the provider is supplied with the requisite data and is able to operate under satisfactory conditions ?

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[128] These systems are described in section 6 of chapter 5 of the Explanatory Guide.

Question 16 : Give an undertaking that the above resources will remain available for the time it will take for the TT system operator to amortise his investments ?

5. Relations with end users

The contract (contract n^{o}5 of the Tool Box) between the operator and the end user is of a purely commercial nature ; however, this is only possible because the basic data are supplied by the operators of the road infrastructure.

Question 17 : Do you wish to exercise some degree of control over such contracts, either through specific regulations or simply through the inclusion of specific provisions in contracts between the operator and the public data provider ?

Given that the activity of operators may be seen as the delegation of, or collaboration with, a public service, the charges levied by operators may be open to control on the principle of the equality of citizens.

Question 18 : Would you exercise such control, should it prove necessary, by means of :

fixed price ceilings ?
annual negotiation of price increases ?

6. Suggestions and proposals

The above is by no means a definitive set of questions and in view of the novelty of the subject area under investigation we would welcome any suggestions from respondents regarding either the Questionnaire or the Tool Box that would lend added relevance and precision to our proposals.

Questions to be answered by operators of TT systems

These questions are aimed at corporate bodies (which are generally subject to private law) intending to offer services to road users in areas such as trip planning, navigation, route guidance and tourism (yellow pages). The origin of the equity capital of such bodies (i.e. whether they are funded by the public or the private sector) is of no relevance to the following questions.

1. Contract n^{0}1

With regard to data supplied by the public data provider :

Question 1 : Do you require data to be supplied in a specific format or do you carry out all or part of the editing (form and content) of raw data ? Do you specify a given time interval for the updating of information ?

Question 2 : In the first instance, are you prepared purchase data from the provider :

on a subscription basis (in order to secure your data supply) ?

on a batch (itemised) basis (to retain flexibility in your management) ?

Question 3 : How do you think the contract should be worded to distinguish between your responsibilities with regard to third parties and those of the public authority supplying you with data ?

Question 4 : What precautions do you think that it is reasonable to take safeguard yourself in the event of the regularity and quality of the services supplied by the public data provider falling below a certain standard ?

With regard to data which you have collected yourself (see contract n^{0}la on page 37 of the Tool Box)

Question 5 : Do you systematically supply such data to the public data provider or the public body responsible for the road infrastructure which has been assigned to you ?

if so, do you place any restrictions on the use made of such data by the public data provider, e.g. do you specify that they may solely be used for traffic management or the management of public services (public transport, fire brigade, hospitals) ?

Question 6 : How are you paid for this service ? Are you paid in kind ? With other services ? On a fee or lump-sum basis ? On an itemised basis ?

what is the basis used to calculate prices ? Are they based on full, direct or marginal costs ?

2. Contract n^{0}2

See questions regarding contracts n^{0}1 and 3.

3. Contract n^{0}3

Question 7 : Who is responsible for the formalities and costs of transmitting data ?

Question 8 : How do you pay, or how will you be paid by, the supplier ?

4. Contract n^{0}4

In your contracts with radio broadcasting operators :

Question 9 : Do you wish to keep full control over your messages (form, frequency) and your signature, or are you prepared, under certain conditions, to allow them to be incorporated into broadcasts of a more general nature ?

Question 10 : In the latter case, do you add a general clause to the contract disclaiming liability for the contents of such broadcasts ?

..

In your contracts with broadcasting operators :

Question 11 : Do you pay them directly ?

Question 12 : If not, do you authorise such operators to charge users directly and to remit your share of the payments to you later (as with the Minitel system, for example) ?

5. Contract n^{0}5

A) Description of service

Do you describe the service offered to subscribers in terms of :

Question 13 : Road information systems :
- geographical coverage ?
- type of message ?
- frequency of messages ?

your degree of responsibility ?

Question 14 : Route guidance systems :

geographical coverage ?
- continuity ?

accuracy ?

Question 15 : Automatic toll-debiting :

geographical coverage ?

speed at which vehicles can pass through toll stations ?

B) Payment for service

Question 16 : Which do you consider to be the best method of payment :
subscriptions ?
purchase of the terminal and subsequent updates ?
a kiosk-type system ?

Question 17 : Which do you consider to be the best system of payment :
regular invoices (annually, monthly, etc...) ?
regular payments of itemised statements of account ?
automatic debiting ?
other ?

6. Suggestions and proposals

The above is by no means a definitive set of questions and in view of the novelty of the subject area under investigation we would welcome any suggestions from respondents regarding either the Questionnaire or the Tool Box that would lend added relevance and precision to our proposals.

Roles and responsibilities
(filled form)

SUPPORTING FUNCTIONS

		REGULATED	PUBLIC OPERATORS	DELEGATEE	PRIVATE OPERATOR	DRIVER	CAR MANUFACTURER
GENERAL MANAGEMENT & LOGISTICS	**1.0.0**						
Strategic planning	***1.1.0***						
Spatial traffic distribution	1 1 1	■	▨	☐	☐	☐	☐
Temporal traffic distribution	1 1 2	■	▨	☐	☐	☐	☐
Strategic Management	***1.2.0***						
Area parking management policy	1 2 1	☐	▨	☐	☐	☐	☐
Network management policy	1 2 2	☐	▨	☐	☐	☐	☐
Roadworks management policy	1 2 3	☐	▨	☐	☐	☐	☐
Enforcement management policy	1 2 4	■	▨	☐	☐	☐	☐
Payment management (policy)	1 2 5	■	▨	☐	☐	☐	☐
Forecasting	***1.3.0***						
Traffic forecasting	1 3 1	☐	▨	▨	☐	☐	☐
Special events forecasting	1 3 2	☐	▨	▨	☐	☐	☐
Weather forecasting	1 3 3	☐	▨	▨	☐	☐	☐
General information management	***1.4.0***						
Individual information management	1 4 1	■	▨	▨	☐	☐	☐
Collective information management	1 4 2	■	▨	☐	☐	☐	☐
Digital road maps management	1 4 3	☐	▨	▨	▨	☐	☐
Infrastructure management	***1.5.0***						
RTI infrastructure management	1 5 1	☐	▨	▨	☐	☐	☐
Section technical management	1 5 2	☐	▨	▨	☐	☐	☐
Intersection technical management	1 5 3	☐	▨	▨	☐	☐	☐
Tunnel technical management	1 5 4	☐	▨	▨	☐	☐	☐
Roadworks management	1 5 5	☐	▨	▨	☐	☐	☐
User rescue services management	***1.6.0***						
Emergency call management	1 6 1	☐	▨	▨	☐	☐	☐
Hazardous goods rescue service	1 6 2	☐	▨	▨	☐	☐	☐
Special rescue service (User rescue)	1 6 3	☐	▨	▨	☐	☐	☐
Infrastructure services logistics	***1.7.0***						
Road works planning/scheduling	1.7 1	☐	▨	▨	☐	☐	☐
Infrastructure maintenance	1.7 2	☐	▨	▨	☐	☐	☐
Road surface maintenance	1 7 3	☐	▨	▨	☐	☐	☐
Section maintenance	1 7 4	☐	▨	▨	☐	☐	☐
Intersection maintenance	1 7 5	☐	▨	▨	☐	☐	☐
Tunnel maintenance	1 7 6	☐	▨	▨	☐	☐	☐
RTI infrastructure maintenance	1 7 7	☐	▨	▨	☐	☐	☐
Fee collection management	***1.8.0***						
Fee collection	1 8 1	☐	▨	▨	☐	☐	☐
Payment management	1 8 2	☐	▨	▨	☐	☐	☐
Policing/Enforcing management	***1.9.0***						
Hazardous goods location monitoring	1 9 1	■	▨	▨	☐	☐	☐
Violation detection	1 9 2	■	▨	☐	☐	☐	☐
vehicle identification	1 9 3	■	▨	☐	☐	☐	☐
Incident management	1 9 4	■	▨	▨	☐	☐	☐
Police response to offense	1 9 5	■	▨	☐	☐	☐	☐
Violation registration	1 9 6	■	▨	☐	☐	☐	☐
GENERAL MONITORING	**2.0.0**						
Ambient conditions monitoring	***2.10***						
Meteo (data) monitoring	2 1 1	☐	▨	▨	☐	☐	☐
Visibility monitoring	2 1 2	☐	▨	▨	☐	☐	☐
Wind monitoring	2 1 3	☐	▨	▨	☐	☐	☐
Area pollution monitoring	2 1 4	☐	▨	▨	☐	☐	☐
Road status monitoring	***2.2.0***						
Friction monitoring	2 2 1	☐	▨	▨	☐	☐	☐
Infrastructure monitoring	2 2 2	☐	▨	▨	☐	☐	☐
Tunnel monitoring	2 2 3	☐	▨	▨	☐	☐	☐
Road infrastructure capacity reduction / Roadworks effect calculation	2 2 4	☐	▨	▨	☐	☐	☐
Weight in motion monitoring	2 2 5						
Events monitoring	***2.3.0***						
accident detection	2 3 1	☐	▨	▨	☐	☐	☐
Incident detection & identification	2 3 2	☐	▨	▨	☐	☐	☐
Traffic Monitoring	***2.4.0***						
Section state monitoring	2 4 1	☐	▨	▨	☐	☐	☐
Intersection state monitoring	2 4 2	☐	▨	▨	☐	☐	☐
Network state surveillance	2 4 3	☐	▨	☐	☐	☐	☐
Parking entry exit monitoring	2 4 4	☐	▨	☐	☐	☐	☐
Floating car monitoring	2 4 5	☐	▨	▨	☐	☐	☐

Roles and responsibilities
(filled form continued)

OPERATIONAL FUNCTIONS
(DRIVERS)

		REGULATED	PUBLIC OPERATORS	DELEGATEE	PRIVATE OPERATOR	DRIVER	CAR MANUFACTURER
VEHICLE CONTROL	3.0.0						
Monitoring Environment & Road	***3.1.0***						
Road surface and marking monitoring	3.1.1	☐	☐	☐	☐	▨	▨
Road geometry monitoring	3.1.2	☐	☐	☐	☐	▨	▨
Visibility monitoring	3.1.3	■	☐	☐	☐	▨	▨
Road regulations monitoring	3.1.4	■	☐	☐	☐	▨	▨
Monitoring Driver	***3.2.0***						
Driver status monitoring	3.2.1	☐	☐	☐	☐	▨	▨
Creation of driver profile & identification of trends	3.2.2	☐	☐	☐	☐	▨	▨
Monitoring Vehicle	***3.3.0***						
Vehicle dynamics monitoring	3.3.1	☐	☐	☐	☐	▨	▨
Vehicle oerational satus monitoring	3.3.2	☐	☐	☐	☐	▨	▨
Vision Enhancement	***3.4.0***						
Active illumination of the scene	3.4.1	☐	☐	☐	☐	▨	▨
Enhancement of the scene contrast	3.4.2	☐	☐	☐	☐	▨	▨
Enhancement of the Sensitivity and range of driver vision	3.4.3	☐	☐	☐	☐	▨	▨
Collision risk estimation	***3.5.0***						
Relative Position Determination	3.5.1	■	☐	☐	☐	▨	▨
Conflict Zone Monitoring & Trajectory Prediction	3.5.2	■	☐	☐	☐	▨	▨
Safety margin determination	3.5.3	■	☐	☐	☐	▨	▨
Critical Course Determination	3.5.4	■	☐	☐	☐	▨	▨
Actuator Control (Dynamic vehicle control)	***3.6.0***						
Lateral activation/control	3.6.1	☐	☐	☐	☐	▨	▨
Longitudinal activation/control	3.6.2	☐	☐	☐	☐	▨	▨
Dialogue Management	***3.7.0***						
User presentation	3.7.1	■	☐	☐	☐	▨	▨
Driver tutoring	3.7.2	■	☐	☐	☐	▨	▨
COOPERATIVE DRIVING	4.0.0						
Intelligent Manoeuvring & Control	***4.1.0***						
Lane change situation evaluation	4.1.1	■	☐	☐	☐	▨	▨
Optimized lane changing	4.1.2	■	☐	☐	☐	▨	▨
Generate driver information	4.1.3	■	☐	☐	☐	▨	▨
Generate trajectory	4.1.4	■	☐	☐	☐	▨	▨
Intelligent Cruise Control	***4.2.0***						
Generate driver information	4.2.1	☐	▨	▨	☐	☐	☐
Generate speed command	4.2.2	■	▨	▨	☐	☐	☐
Generate distance command	4.2.3	■	▨	▨	☐	☐	☐
Manage clusters	4.2.4	■	▨	▨	☐	☐	▨
Intelligent Intersection Control	***4.3.0***						
Determine driver's intention	4.3.1	☐	☐	☐	☐	▨	▨
Detect intersection	4.3.2	☐	☐	☐	☐	▨	▨
Evaluate intersection situation	4.3.3	☐	☐	☐	☐	▨	▨
Organize intersection traffic flow	4.3.4	■	☐	☐	☐	▨	▨
Generate driver information	4.3.5	☐	☐	☐	☐	▨	▨
Medium Range Pre-information	***4.4.0***						
Recommended speed	4.4.1	■	▨	▨	☐	☐	☐
Poor visibility warning	4.4.2	■	▨	▨	☐	☐	☐
Dangerous road surface warning	4.4.3	☐	▨	▨	☐	☐	☐
Heavy traffic density warning	4.4.4	☐	▨	▨	☐	☐	☐
Dangerous climatic conditions	4.4.5	☐	▨	▨	☐	☐	☐
Traffic regulations	4.4.6	■	▨	▨	☐	☐	☐
Emergency Warning	***4.5.0***						
Incident report	4.5.1	☐	▨	▨	☐	☐	☐
Incident localisation	4.5.2	☐	▨	▨	☐	☐	☐

Roles and responsibilities
(filled form continued)

OPERATIONAL FUNCTIONS
(INFRASTRUCTURE & SERVICE OPERATORS)

		REGULATED	PUBLIC OPERATORS	DELEGATES	PRIVATE OPERATOR	DRIVER	CAR MANUFACTURER
TRAFFIC CONTROL	5.0.0						
Section traffic control	*5.1.0*						
Section control computation	5.1.1	☐	▨	▨	☐	☐	☐
Section control actuating	5.1.2	☐	▨	▨	☐	☐	☐
Intersection traffic control	*5.2.0*						
Intersection control computation	5.2.1	☐	▨	▨	☐	☐	☐
Intersection control actuating	5.2.2	☐	▨	▨	☐	☐	☐
Network traffic control	*5.3.0*						
Origin/Destination computation & route assignment estimation	5.3.1	☐	▨	▨	☐	☐	☐
Demand prediction	5.3.2	☐	▨	▨	☐	☐	☐
Traffic prediction	5.3.3	☐	▨	▨	☐	☐	☐
Network control computation	5.3.4	☐	▨	▨	☐	☐	☐
Localised area Traffic Control	*5.4.0*						
Tidal flow control	5.4.1	☐	▨	▨	☐	☐	☐
Ramp control	5.4.2	☐	▨	▨	☐	☐	☐
Tunnel traffic control	5.4.3	☐	▨	▨	☐	☐	☐
Bridge traffic control	5.4.4	☐	▨	▨	☐	☐	☐
Lane management	5.4.5	☐	▨	▨	☐	☐	☐
Local speed enforcement	5.4.6	■	▨	▨	☐	☐	☐
TRAFFIC INFORMATION	6.0.0						
Navigation	*6.1.0*						
Autonomous location estimation	6.1.1	☐	☐	☐	▨	☐	☐
Externally assisted location	6.1.2	☐	☐	☐	▨	☐	☐
Route computation (guidance)	*6.2.0*						
Individual route computation	6.2.1	■	☐	☐	☐	▨	☐
Collective (network) route computation	6.2.2	■	▨	▨	☐	☐	☐
Route guidance direction	*6.3.0*						
Route presentation	6.3.1	■	☐	☐	☐	☐	▨
Route guidance instruction	6.3.2	■	☐	☐	☐	☐	▨
Dynamic route information (On trip infomation)	*6.4.0*						
Roadworks	6.4.1	■	▨	▨	☐	☐	☐
Accidents	6.4.2	■	▨	▨	☐	☐	☐
Restrictions	6.4.3	■	▨	▨	☐	☐	☐
local warning advice	6.4.4	■	▨	▨	☐	☐	☐
Traffic conditions	6.4.5	■	▨	▨	☐	☐	☐
Weather conditions	6.4.6	■	▨	▨	☐	☐	☐
Environmental conditions	6.4.7	■	▨	▨	☐	☐	☐
Special Events	6.4.8	■	▨	▨	☐	☐	☐
(Alternative) Routes	6.4.9	☐	▨	▨	☐	☐	☐
Link travel times	6.4.10	☐	▨	▨	☐	☐	☐
TRAVEL INFORMATION	7.0.0						
Travel planning	*7.1.0*						
Transport mode selection/planning	7.1.1	☐	☐	☐	▨	☐	☐
Route planning	7.1.2	☐	☐	☐	▨	☐	☐
Tourist information	7.1.3	☐	☐	☐	▨	☐	☐
Services information	7.1.4	☐	☐	☐	▨	☐	☐
Facilities booking	7.1.5	☐	☐	☐	▨	☐	☐
Static route information	*7.2.0*						
Roads characteristics	7.2.1	☐	☐	☐	▨	☐	☐
Parking facilities	7.2.2	☐	☐	☐	▨	☐	☐
Modal interchange points	7.2.3	☐	☐	☐	▨	☐	☐
Individual Map updating	7.2.4	☐	☐	☐	▨	☐	☐
Personnal communications	*7.3.0*						
Emergency paging	7.3.1	■	▨	▨	☐	☐	☐
Personnal mail box	7.3.2	☐	☐	☐	☐	▨	☐
Emergency call	7.3.3	■	▨	▨	☐	☐	☐
DEMAND MANAGEMENT	8.0.0						
Demand restraints	*8.1.0*						
Area access restriction	8.1.1	■	▨	☐	☐	☐	☐
Route diversions	8.1.2	■	▨	▨	☐	☐	☐
Road pricing & Road tolling	8.1.3	■	▨	▨	☐	☐	☐
Supply control	*8.2.0*						
Car pooling	8.2.1	■	☐	☐	▨	☐	☐
Modal interchange	8.2.2	☐	▨	▨	☐	☐	☐
PARKING MANAGEMENT	9.0.0						
Parking space Management	*9.1.0*						
Parking occupation prediction	9.1.1	☐	▨	▨	☐	☐	☐
Parking availability control	9.1.2	☐	▨	▨	☐	☐	☐
Parking guidance	*9.2.0*						
Dynamic Parking Information	9.2.1	☐	▨	▨	☐	☐	☐
Network parking guidance	9.2.2	☐	▨	▨	☐	☐	☐
Final destination guidance	9.2.3	☐	▨	▨	☐	☐	☐
Parking Reservation & Payment	*9.3.0*						
Parking space booking	9.3.1	☐	▨	▨	☐	☐	☐
Parking payment	9.3.2	☐	▨	▨	☐	☐	☐
On-street parking management	*9.4.0*						
Parking payment	9.4.1	☐	▨	▨	☐	☐	☐
Parking offense enforcement	9.4.2	■	▨	☐	☐	☐	☐

Roles and responsibilities
(filled form continued)

PROFESSIONAL USERS' FUNCTIONS

		REGULATED	PUBLIC OPERATORS	DELEGATEE	PRIVATE OPERATOR	DRIVER	CAR MANUFACTURER
PUBLIC TRANSPORT MANAGEMENT	10.0.0						
Scheduling	***10.1.0***						
Travel time definition	10 1 1	■	☐	☐	▨	☐	☐
Detailed time table planning	10 1 2	☐	☐	☐	▨	☐	☐
Vehicle scheduling	10 1 3	☐	☐	☐	▨	☐	☐
Operations management	***10.2.0***						
On line monitoring	10 2 1	☐	☐	☐	▨	☐	☐
Arrival prediction	10 2 2	☐	☐	☐	▨	☐	☐
Operations control	10 2 3	☐	☐	☐	▨	☐	☐
Assistance to operator	10 2 4	☐	☐	☐	▨	☐	☐
Assistance to driver	10 2 5	☐	☐	☐	▨	☐	☐
On Demand Service Provision	10 2 6	☐	☐	☐	▨	☐	☐
User estimation	10 2 7	☐	☐	☐	▨	☐	☐
Information on operation	10 2 8	☐	☐	☐	▨	☐	☐
Passenger information	***10.3.0***						
Basic information	10 3 1	☐	☐	☐	▨	☐	☐
Customised trip preparation help	10 3 2	☐	☐	☐	▨	☐	☐
Information on current operation	10 3 3	☐	☐	☐	▨	☐	☐
Fare collection	***10.4.0***						
Operating sales	10 4 1	☐	☐	☐	▨	☐	☐
Validation/control of travel documents	10 4 2	☐	☐	☐	▨	☐	☐
Fare collection data processing/collection	10 4 3	☐	☐	☐	▨	☐	☐
Maintenance	***10.5.0***						
Vehicle diagnostic & data recording	10 5 1	☐	☐	☐	▨	☐	☐
Maintenance Management	10 5 2	☐	☐	☐	▨	☐	☐
FREIGHT & FLEET MANAGEMENT	11.0.0						
Logistics & Freight Management	***11.1.0***						
Logistics Management Business Transaction	11 1 1	☐	☐	☐	▨	☐	☐
Intermodal change planning preparation	11 1 2	☐	☐	☐	▨	☐	☐
Logistics Management Operation Preparation	11 1 3	☐	☐	☐	▨	☐	☐
Logistics Management Operation Control	11 1 4	☐	☐	☐	▨	☐	☐
Logistics Management Operation Evaluation	11 1 5	☐	☐	☐	▨	☐	☐
Fleet/resource management	***11.2.0***						
Fleet management business transaction	11 2 1	☐	☐	☐	▨	☐	☐
Fleet Management Operation Planning & Preparation	11 2 2	☐	☐	☐	▨	☐	☐
Fleet Management Operation Control	11 2 3	☐	☐	☐	▨	☐	☐
Fleet Management Maintenance	11 2 4	☐	☐	☐	▨	☐	☐
Fleet Management Operation Evaluation	11 2 5	☐	☐	☐	▨	☐	☐
Vehicle/cargo management	***11.3.0***						
vehicle management preparation	11 3 1	☐	☐	☐	▨	☐	☐
Vehicle management operation	11 3 2	☐	☐	☐	▨	☐	☐
Vehicle Management evaluation	11 3 3	☐	☐	☐	▨	☐	☐
Hazardous goods monitoring	***11.4.0***						
Special route planning	11 4 1	■	☐	☐	▨	☐	☐
Communication with traffic control	11 4 2	■	☐	☐	▨	☐	☐
Special emergency call	11 4 3	■	☐	☐	▨	☐	☐

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6	A review of navigation projects in European cities	L Selles	DRCO	Août 1992
7	Conséquences pour l'aménagement des innovations routières attendues vers 2000 - 2020. Essai de prospective.	A. Bieber B. Ferry P.Y. Texier	INRETS	Oct. 1992
8	EURO-SCOUT Important Component of a Universal Vehicle Information System	H. Sodeikat J. Kossak	SIEMENS AG	Août 1992
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