CARISMA-Telematics
(project TR 4103)
Coordinated Architectures for the Interconnection of Networks
for Sustainable Mobility with Telematics Applications

Final Deliverable

Current and Planned Use of Transport Telematics in Urban Areas

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Final

May 2000

CARISMA-Telematics is an Accompanying Measure of the
Transport sector of the Telematics Applications Programme
(Fourth Framework Programme for RTD&D of the EU, 1994-1998)

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1. Preface

The CARISMA-Telematics accompanying measure was funded by the European Commission to support the Transport sector of the Telematics Applications Programme (1994-1998), a specific programme of the 4th Framework Programme for Research, Technological Development and Demonstration (RTD&D).

This project was an important step in seeking telematics solutions to the problems faced by cities and regions. It follows on from the work of the City Pioneers project led by ERTICO.

CARISMA-Telematics describes the experiences of seven leading cities/regions in deploying transport telematics and compares this with the approach recommended by City Pioneers. Since it was established in 1989, the POLIS network of cities and regions (which manages the CARISMA-Telematics project) has been closely associated with the development of Transport Telematics Applications under successive European Framework Programmes for RTD & D.

Many people have assisted in the preparation of this report. The CARISMA-Telematics project team would like to thank in particular the members of the Urban and Regional Steering Committee representing Barcelona (E), Glasgow (UK), Hampshire (Southampton) (UK), Munich (D), Paris (Ile-de-France) (F), Trondheim (N) and Turin (I). Their role was central in making the arrangements for the on site meetings which took place in the seven cities selected because of their forward thinking in transport telematics. The full list of organisations consulted in each city/region are included in the Acknowledgements at the end of this report.

CARISMA-Telematics reviewed the technical, institutional, political and financial aspects of telematics deployment, primarily as it affects road and public transport. The project looked at trials and demonstrations of new telematics applications, and also evaluated cases where the technology is sufficiently established to justify full-scale deployment. Each visit involved interviews with a large number of individuals, far too numerous to mention here. The project team were very appreciative of the time and attention given by everyone they met, and their willingness to share their knowledge and expertise of transport telematics. This report can only provide a high-level summary of what has been achieved. Nevertheless it is hoped that this account of their experiences will contribute to the debate about the role of telematics in planning for transport management by cities and regions in the future.

The conclusions of the project illustrate clearly the great potential that telematics offers cities and regions at the start of the 21st century. The report is addressed to politicians, senior managers and professionals involved in developing city transport and mobility programmes, and we hope it will circulate widely in these circles.

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POLIS

2. Executive Summary

The CARISMA-Telematics[1] accompanying measure is funded by the EU as part of the Telematics Applications Programme of the Fourth Framework Programme (1994-1998). The lead contractor is the POLIS network of European cities and regions which aims to solve urban transport and environmental problems through the introduction of advanced Transport Telematics applications and services. The conclusions of the project illustrate clearly the great potential that telematics offers cities and regions. The report is addressed to politicians, senior managers and professionals involved in developing city transport and mobility programmes.

Essentially the CARISMA-Telematics Project is an evaluation of how seven European cities and regions – Barcelona, Glasgow, Munich, Paris (Ile-de-France), Hampshire (Southampton), Trondheim and Turin – are adopting transport telematics in the management of their transport systems. Each city is leading in some (but not all) key areas of transport telematics and collectively they provide a benchmark for best practice. These cities face many financial, legal, institutional and technical challenges, and consequently their experiences will provide invaluable advice and guidance for others.

The seven CARISMA-Telematics cities are at the forefront of moving transport telematics from small-scale pilot schemes and demonstration projects into full-scale deployment. Without exception, transport telematics has become an integral part of their programme of activities to deliver transport policies which will best meet the needs and expectations of their citizens. Thus the cities have had to appraise the competing and often conflicting demands placed on urban and regional road networks from different groups of users. The CARISMA-Telematics project looks at how transport telematics has been adopted in ways which support these goals.

The six sections of the main Report are summarised below. In addition there are supplementary Deliverables which provide more detailed information on each city and telematics application. The four **Advice and Guidance Notes** address generic topics which all cities and regions need to address when considering whether to deploy transport telematics e.g. planning deployment, promoting a partnership approach, facilitating intermodal transport etc.

Part 1 of this report provides the background to the project and summarises the policy context and study methodology. Specific objectives of CARISMA-Telematics include:

- to facilitate further deployment of transport telematics applications by authorities well-advanced in their use;
- a state of the art review of key results from European RTD&D transport telematics projects;
- to identify further research needs and the dissemination of good practice for the deployment of transport telematics in cities and regions;

The site visits provided a unique opportunity to understand the issues faced by those directly concerned with the deployment of transport telematics. A wealth of information was collected based on interviews with key personnel, workshops, and subsequent document reviews. The seven **City Profiles** and 32 Project **Fact Sheets** synthesise the main findings for each city and discuss the transport telematics schemes which have been introduced including the many financial, legal, institutional and technical challenges.

Part 2 examines how transport telematics contribute to transport management measures in each of the seven cities/regions where a common objective is to guarantee sustainable mobility for people and goods whilst avoiding or reducing the negative effects of traffic. It is expected that telematics-based technology and services will play an important role in achieving these goals, particularly the objectives of improving safety, transport efficiency, energy consumption and urban and environmental quality.

Transport telematics systems that have been developed and/or implemented in the CARISMA-Telematics cities and regions have been classified according to the cities' transport problems and objectives, e.g. "providing park-and-ride at the fringe of cities" or "traffic calming in the CBD and residential areas". The applications which have been most widely and successfully implemented are those which will improve inter-modal travel information and traffic information quality for both public

[1] Coordinated ARchitectures for the Interconnection of Networks for Suitable Mobility with Telematics Applications.

and private users. Passenger information systems are recognised as being among the most important systems likely to have a direct influence on the modal choice of travellers and **Advice and Guidance Note 3** provides information on setting up Intermodal Traveller Information Systems. Urban traffic control, public transport priority measures and traffic information all contribute to the objective of improving the safety and performance of arterial road networks. These are often supported by parking guidance systems. In contrast urban road pricing and tolling schemes are still rare although the highly successful example of an urban toll ring in Trondheim may demonstrate a way forward elsewhere.

Part 3 considers the telematics infrastructure, supporting technologies and methods which are available to CARISMA-Telematics cities/regions as the basis for deployment of transport telematics. Many technologies are advancing rapidly and cities and regions will need to monitor the latest developments. The important components of the telematics infrastructure include: the system architectures framework, data capture and monitoring techniques, data transmission standards and protocols, navigation and positioning technologies, wireless communications technologies, control centres and user interfaces.

All of the CARISMA-Telematics cites are moving towards a more integrated approach to the deployment of telematics systems and this requires the development of an overall system architecture which serves as the reference framework for linking and integrating different applications. There is an increasing interest in open systems as a means of developing interoperable systems and telematics services. However, transport telematics services cannot be delivered by technology and system integration alone, so it is important not to overlook the need for new organisational arrangements.

Another observed trend is the increasing use of real-time data whether for parking availability systems, traffic conditions or bus-stop information. The universal availability of the internet has made it very easy for cities to distribute information to end-users quickly and efficiently. Harmonisation to ensure interoperability and transferability of functions and systems is thus a basic requisite for the deployment of transport telematics services.

Part 4 discusses some of the institutional and supporting issues to be considered given that deployment of transport telematics in cities and regions is not simply a question of securing the most appropriate technology. Successful deployment requires cities and regions to work together to develop a Strategic Plan which integrates transport telematics into all stages of the planning process, from concept, through implementation to evaluation. The Plan will define the framework for future progress and will recognise the objectives, technical and other requirements, potential actors and their possible contributions. **Advice and Guidance Note 1** covers many of these planning issues.

In some cases a new organisational structure may be necessary to deliver transport telematics services which may not fit neatly under existing organisational arrangements. Securing support from all of the major organisations and agencies that will be associated with deployment is essential and the list of potential stakeholders may include many actors. Setting up a new body to run telematics services, often with the private sector involved, can sometimes be easier than achieving inter-agency cooperation. This has to be decided case by case. The views of the travelling public are also important and taking account of their responses and perceptions is crucial – both as consumers and voters.

Defining what is public sector responsibility and what is commercial is central. The public sector role is perhaps the easiest to define - namely safety and traffic management. For example, the roads authorities are charged with providing the necessary roads infrastructure. Similarly with collective transport, the requirement for passenger safety is a public obligation which all operators – public and private – must respect. Developments in the private sector may demand a response from the public authorities. For example, the emergence of Mediamobile required Paris city authorities to organise themselves as harmonised data providers and to adopt a common policy for the commercialisation of public data.

Recent trends show an increased fragmentation of transport data and a growing need for coordination. Inter-agency cooperation could play a key role in the provision of both quality and quantity data, but it will be important to define specific partner's responsibilities at each stage of the information chain – validation, ownership etc. Many regions and cities have set up focal points to coordinate data collection and distribution and to establish standards. **Advice and Guidance Note 4** discusses establishing and organising advanced information services.

Part 5 considers some of the strategies which, in the experience of the CARISMA-Telematics cities, have been valuable in achieving successful deployment of transport telematics as an integral part of the ongoing city region programme. Deployment strategies need to take account of the political context and the importance of demonstrating to local politicians and to the public at large the clear benefits that can be derived from investing in telematics. There is a need for greater public awareness of these benefits in order to secure support for any public investment. There is also value in achieving a partnership approach between the main actors in telematics deployment.

Timely political support at all levels is essential. Collectively, the CARISMA-Telematics cities' experiences demonstrate that securing strong political support and commitment at a high level for transport telematics objectives is essential throughout all stages of deployment. The frequent changes in local government officials means that these situations will remain an ongoing institutional and political challenge for future projects.

Regions must address organisational issues and inter-agency cooperation problems in order to secure the full benefits of telematics. City administrations and authorities have a pivotal role in securing partnership arrangements. The first step is to consult a wide range of interests, and build up a local partnership for deployment. As well as public administrations and transport operators, new players may have a place in building the "transport telematics vision" such as banks, retailers, broadcasters, commercial service providers and telecommunications operators. Often the different actors will first need to be convinced of the benefits of telematics. The theme of building a partnership approach is developed in **Advice and Guidance Note 2**.

For transport telematics systems to really make a difference to transportation problems, they must provide value or benefits to a significant number of users and stakeholders. An important theme in the CARISMA-Telematics cities is to improve the methods used to assess the benefits of telematics applications particularly given that most of the benefits that accrue remain invisible to the general public. One politically sensitive issue concerning information society technolgies in general and transport telematics in particular is to ensure that high technology solutions will serve all sectors of society and not merely the well-off. Once the public service requirements have been satisfied, the more advanced value-added services and premium services will be more readily developed through private sector initiatives.

Public acceptance of the proposed schemes is essential and the more radical the proposal (e.g. access control) then the more importance this element will assume. Authorities need to explain what is being proposed, the reasons for introducing the particular system and what is expected of citizens using the system. Experience in the CARISMA-Telematics cities suggests that officials have to work hard to publicise the positive benefits of transport telematics projects, given that any efficiency gains achieved are often eroded in the medium term by traffic growth. Media briefings ensure that telematics systems remain visible to the public and are not taken for granted. Sometimes schemes may have to be modified in order to become acceptable. Therefore, a good communication and education strategy is important at all stages of the project. However one consequence of a very effective information campaign may be that public expectations of the system exceed those which are actually realised.

Part 6 presents the main conclusions. The focus of the CARISMA-Telematics project has been very much towards the non-technical aspects of the use of the technology, covering political support, public awareness, consensus formation etc. The project set out to provide an overview of current position regarding deployment of telematics in seven leading cities/regions and to determine how this has been achieved.

CARISMA-Telematics has identified the reasons for the cities' successes and touches on one or two of the failures. There has been direct and open discussions with top level actors. The leading applications and gaps in deployment have been identified. Four advice and guidance notes have been prepared to distil some of that experience and it is hoped this will provide useful hands-on guidance for the cities which have not already engaged in deployment. The project has provided help to other European cities in their telematics ventures.

The picture presented by the CARISMA-Telematics cities/regions is one of deployment confined to a few important areas, with considerable scope for much wider deployment of transport telematics. Based on the discussions with CARISMA-Telematics city officials, the next wave of deployment is likely to be in electronic payment, pollution monitoring and further development of real-time travel information services.

All seven CARISMA-Telematics cities illustrate how a corporate approach to transport telematics is needed which goes well beyond an appreciation of what is technically possible. Research and development activities have been concerned with the technical possibilities of transport telematics and consequently this is often seen as the domain of technical experts rather than being mainstream to the delivery of transport policies.

Relying on very strong public innovative potential has been one very good way of progressing deployment in the CARISMA-Telematics cities. However other cities, particularly if they are smaller and do not have the same financial and technical resources, will need to be more cautious and to engage the deployment process very carefully. The institutional context for investment in intelligent transport systems is often complex and a robust organisational structure is the key.

On their own transport telematics and intelligent transport systems will not solve the increasing problems of traffic congestion and the resultant effects which many cities and regions in Europe are experiencing. Technology can hold part of the answer but it is critical that transport telematics is deployed as part of an integrated transport strategy to obtain the maximum benefits.

Looking forward an important challenge in metropolitan areas will be to develop more sustainable transport measures, for example, those which allow present demand to be accommodated whilst giving increased priority to public transport vehicles and releasing road space for other uses (e.g. pedestrians) which do not generate additional volumes of private road traffic.

3. Introduction

The objective of the CARISMA-Telematics project is to present an analysis of current and planned use of Transport Telematics Applications in metropolitan areas of cities and regions across Europe, based on cities that have been leading the way in telematics deployment. The term transport telematics in this context is used in its widest sense, and refers to the application of telematics for the purpose of improving transport logistics, road safety and transport efficiency. The CARISMA-Telematics approach addresses the multimodal transport system in the urban context with the focus on passenger transport, considering commercial transport when affected.

3.1. Objectives, scope and audience for this report

This report is the **Final Deliverable** of the CARISMA-Telematics project, a support action in the Telematics Application Programme of the European Commission. It presents the main findings of the CARISMA-Telematics project, which essentially is an evaluation of how seven European cities and regions are adopting transport telematics in the management of their transport systems. The cities selected for study were all members of the POLIS network and each was chosen because it is leading in some key areas of transport telematics. Taken as a group, the cities provide a benchmark for best practice, though no one city is forward in all areas. The cities face many challenges of a financial, legal, and institutional as well as technical nature, and consequently their experience provides a fruitful basis for developing advice and guidance for other cities. The following are the cities and their regions selected:

- Barcelona, Spain
- Glasgow, United Kingdom
- Hampshire (Southampton), United Kingdom
- Paris (Ile-de-France), France
- Munich, Germany
- Trondheim, Norway
- Turin, Italy

The key transport telematics applications in each city/region area are summarised in Annex A, which also gives links to the relevant supporting documents. This report is supported by a series of project **Facts Sheets** which summarise key features of selected case studies in transport telematics deployment in 7 cities, all of which are well advanced in their use and deployment of telematics. In addition, a collection of **City Profiles** summarise the practical experience of the selected cities and regions on current issues with regard to transport telematics deployment. Annex B lists all of these Deliverables.

The audience for this report is seen primarily as politicians, senior managers and professionals involved in developing city transport and mobility programmes. They may already have some broad appreciation of Intelligent Transport Systems (ITS), but not detailed knowledge. The aim is to disseminate good practice, by offering concrete examples of how ITS can help deliver city/regional policy goals, through better management of urban mobility and transportation networks. The emphasis is on showing what ITS is offering as part of a package of measures, perhaps by providing new starting points for implementing urban/regional programmes. Examples from the seven cities included in the CARISMA-Telematics project are used to illustrate the text.

3.2. CARISMA-Telematics approach and methodology

The overall purpose of the CARISMA-Telematics project is to provide results which will help cities and regions with the deployment of near market transport telematics applications and services being developed in both the public and private sectors. It is concerned with Telematics applications developed under successive EU-funded R&D Framework Programs as well as national and local initiatives.

Specific objectives of CARISMA-Telematics include:

- to facilitate the further deployment of transport telematics applications and services by those local and regional authorities which are well-advanced in the use of Transport Telematics by providing a better appreciation of the role and scope of transport telematics
- to provide a state of the art review of the key practical results from European RTD&D project results in the field of transport telematics with an impact on/relevance to deployment in cities and regions;
- inter-alia, to identify what the prospects for deployment of transport telematics are for cities/regions and where further research is required in terms of facilitating widespread deployment, and to prepare advice and guidance notes for both 'leading' and 'follower' authorities;
- to help cities and regions extract added-value from the trans-European telecommunications infrastructure networks in the implementation of transport telematics applications and services;
- to highlight opportunities for complementarity of local, regional, national and trans-European transport networks in the implementation of transport telematics applications and services, in particular through liaison with the CARISMA-Telematics-Transport Concerted Action.
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The CARISMA-Telematics project involved three stages:
- fact-finding and reviewing the state of the art based on a sample of seven cities/regions which are in the forefront of deploying transport telematics,
- analysis of city-region requirements for transport telematics deployment and
- the production of advice and guidance notes.

Fact-finding was achieved by on-site visits, interviews with key personnel and a review of documents associated with each of the case studies. Together they provided a unique opportunity to understand the issues faced by those directly concerned with the deployment of transport telematics and learn from their experience.

The information collected from the on-site visits is brought together in the **City Profiles** and **Fact Sheets**. The particular approach of CARISMA-Telematics was to obtain input from case studies where individuals involved with deployment were interviewed and involved directly through workshops and on-site visits.

As a result of the dialogue with the CARISMA-Telematics cities, a number of topics have been identified which all cites and regions must address in considering whether to deploy transport telematics. In response, the more general lessons from CARISMA-Telematics have been brought together in the form of four generic **Advice and Guidance** (AG) notes:
- Planning ITS deployment
- Promoting a Partnership Approach to Deployment
- Intermodal Traveller Information Systems
- Private Sector Travel Information Services
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These advice notes provide a practical reference source for cities and regions that are considering how to set about the deployment of ITS. It is hoped that in future these will form the basis for a series of good practice notes, taken together with the results of other EU-funded projects.

3.3. Telematics in urban areas

Telematics is being introduced in the context of new priorities that are emerging for urban and regional development. Increasingly, a common objective for a growing number of urban regions is to guarantee sustainable mobility for persons and the supply of goods. At the same time city and regional authorities wish to avoid or reduce the negative effects of traffic. European RTD & D programmes seek to support these objectives.

The overall objectives of transport management measures in the cities/regions selected for this project are increasingly being directed towards achieving the following goals:
- Reducing the number and length of trips (reduce person-km and ton-km).
- Concentrating and reducing trips and goods in vehicles and in selected corridors (reduce vehicle-km).
- Optimising the performance of vehicle traffic on the existing road infrastructure.

Transport Telematics are seen as an important way of achieving these goals. In particular, it is expected that telematics-based technology and services will make a significant contribution to the objectives of improving:

- traffic safety
- transport efficiency
- energy consumption, and
- urban and environmental quality.

In addition, commercial transport telematics service providers are expected to play an increasingly important role in developing the market for transport telematics products and services in various ways, and in funding transport telematics projects either directly or through public/private partnerships. The automotive industry, equipment manufacturers, system designers and suppliers will spear-head developments in response to market opportunities and customer requirements. Universities and consultancies provide methodologies, tools and advice in the design and evaluation of planning measures, strategies and transport systems.

3.4. European context

National, regional and local administrations are major actors in securing effective deployment of transport telematics. Their support for and commitment to agreed common European goals will be important[2]. City and regional authorities also wish to harness the emerging information society and are considering their response to recent intiatives by the European Commission on behalf of the European Union (EU)[3].

In accordance with the principle of subsidiarity, EU responsibilities include technical harmonisation; concertation of research and development; concerted action on Road Transport Telematics implementation with Member States; the promotion of standards; financial support from R&D in appropriate fields of European interest, Trans-European Networks, etc., and whenever necessary, appropriate legislation.

Various examples of successful European collaboration and the constructive use of European funding are referenced in the fact sheets and city profiles which accompany this report.

3.5. Related work

The project team has made reference to results from other reports and studies on transport telematics, but principally the five detailed below.

3.5.1 ITS City Pioneers project 4

The ITS City Pioneers initiative was carried out by a consortium coordinated by ERTICO (http://www.ertico.com) and including the POLIS network of cities (http://www.polis-online.org) with funding from the EU-TEN-Transport budget. City Pioneers aims to tackle the challenges of ITS deployment in cities by increasing the awareness of ITS and stimulating structured planning of ITS deployment. The ITS City Pioneers project has produced three reports, each tackling one of the main questions on ITS implementation: the ITS Guidebook is aimed at decision makers in European cities. It explains what ITS is, gives examples of successful ITS deployments in a wide range of European cities and outlines the steps towards ITS deployment. The ITS Toolbox answers questions about which ITS tools to implement. This provides a comprehensive guide to ITS tools and their supporting systems and technologies. Finally, the ITS Planning Handbook sets out a generic planning framework, based on a model deployment plan, that cities may adapt to their own conditions.

2 COM(1997) 223 final: Community Strategy and Framework for the Deployment of Road Transport Telematics in Europe and Proposals for Initial Actions. European Commission, Brussels, 1997.
3 COM(1999) 687final: “eEurope: An Information Society for All”. European Commission, Brussels, 8 December 1999.
4 ITS City Pioneers Consortium. ITS Guidebook, ITS Planning Handbook; ITS Toolbox. ERTICO, Brussels 1998

These deliverables, in particular the ITS Toolbox, are a useful reference set and have provided the structure for reporting the current activities of cities/regions in Part 3 of this report.

3.5.2 CARTS Report [5]

The CARTS Project is a Concertation process for the Transport Sector of the Telematics Applications Programme (TAP) for the Fourth Framework Programme. The CARTS report provides an overview of the research and development activities and achievements in the domain of transport telematics including some general issues such as user needs, validation/evaluation, standardisation, etc. The CARTS report therefore helps to provide a context for the findings reported in Part 4 of this report. Of particular relevance to this CARISMA-Telematics project are the sections on Traveller Intermodality (Area 1) and Road Transport (Area 3). Individual area reports of the TAP-Transport Sector are available at http://www.echo.lu/telematics and http://www.trentel.org.

3.5.3 PIARC ITS Handbook[6]

Recognising the trend for ITS solutions to become an integral part of highway and traffic engineering, for solving the many problems of congestion, traffic accidents, and the environmental impact of transport, the World Road Association (PIARC) established a committee in 1995 to explore the application of ITS to surface transport problems. The work of the committee – which brought together representatives throughout the world – culminated in the publication of the ITS Handbook 2000. The book, which is mainly targeted at those responsible for implementing ITS, aims to provide a comprehensive body of guidance and practical experience of ITS. The handbook sections entitled “How do I plan and finance ITS?” and “How do I launch ITS?” provide the context for Part 5 of this report.

3.5.4 CARISMA-Telematics-Transport project

The CARISMA-Telematics-Transport concerted action aims to support consensus formation on a number of transport issues related to the interface and interconnection between long-distance transport networks – in particular the Trans-European Networks – and local/regional networks of all modes. The aim is to to establish a more systematic information flow between European, national and local/regional policy makers on issues central to the interconnection of multi-modal transport networks of different scales, addressing institutional, legal, design, planning, technical and deployment aspects. Thus there are important synergies between the CARISMA-Telematics and Transport projects which collectively should provide helpful guidance and practical experience for those reponsible for deploying transport telematics in cities and regions.

3.5.5 WELL-TIMED Study [7]

The WELL-TIMED study (West European Local Legal Arrangements for Transport Information Management and Exchange of Data) concerned the organisation and operation of advanced travel and traffic information services in across Europe. The study, carried out under the ANIMATE supporting measure funded by the Telematics Applications Programme, explored the legal and institutional issues associated with transport data exchange and information management, and has provided a useful source for preparing one of the CARISMA-Telematics Advice and Guidance notes.

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5 CARTS - Concertation and Achievements Report of the Transport Sector of the Telematics Applications Programme (TAP, 4th Framework Programme for RTD&D, 1994-1998) published in 1999 by the CODE (TR1103) TAP-Transport Accompanying Measure.
6 ITS Handbook 2000. Recommendations from the World Road Association (PIARC). PIARC Committee on Intelligent Transport. Artech House, Boston and London, 1999.
7 Legal and Business Frameworks for Traffic And Travel Information in Europe (WELL-TIMED Study) Miles J.C., Walker A.J. and Maes W., *Proceedings of the 5th World Congress on Intelligent Transport Systems,* VERTIS, Tokyo, 1998.

4. Transport management measures

Transport telematics systems that have been developed and/or implemented in the CARISMA-Telematics cities and regions have been classified according to the cities' transport problems and objectives. These applications are described in full in the CARISMA-Telematics City Profiles and Fact Sheets in a separate volume and are referenced under each heading. High-level objectives include the need to achieve sustainable mobility for citizens and encourage better use of public transport. It is expected that transport telematics and other information society technologies, will stimulate regional sustainable development. These systems have been identified as priorities by the cities themselves and the applications have been supported by politicians.

4.1. The ITS City Pioneers Toolbox

The framework of transport telematics systems contained in the ITS City Pioneers Toolbox for Intelligent City Transport, prepared by the ITS City Pioneers project is a useful starting point. The methods that are in use or planned by the CARISMA-Telematics cities under each transport management objective have been referenced to this framework. A list of the systems considered by the City Pioneers project is provided in Table 2.1. Summary descriptions of these systems are contained in the City Pioneers ITS Toolbox (see Section 1.5). The rest of this Part summarises the use of these systems in support of various transport management objectives that are being pursued in the CARISMA-Telematics cities.

Theme	**Transport Telematics Methods and Applications (ITS City Pioneers Toolbox)**	
Traffic management	Urban Traffic Control Intersection control Highway management Ramp metering Dynamic speed adaptation Access control	PARKING MANAGEMENT Incident management Vulnerable road user facilities Supervisory management Traffic regulations enforcement Environmental traffic management
Payment systems	Public transport payment Parking payment	Urban tolling Urban road pricing
Collective transport management	Fleet and resource management Public transport priority	Car pooling/sharing management Taxi management Demand responsive transport
Traffic and travel information	Public transport information Traffic information	Pre-trip journey planning Route guidance and navigation
Freight transport management	Hazardous goods management Fleet management	Freight management Coordinated city logistics
Security and emergency management	Rescue services Incident management Breakdown and emergency services	Public transport security

Table 2.1. Transport telematics methods and applications included in the ITS City Pioneers Toolbox

In the tables which follow here and in Part 4 of this report, the following conventions are adopted to indicate the current status of telematics deployment in the CARISMA-Telematics cities:

Key to current state of telematics deployment	
++	Full-scale deployment
+	Trials in progress
-	Not under consideration
blank	Information missing or not available

4.2. Improving regional public transport services

Advanced Transport Telematics for public transport covers all the activities related to collective transport of passengers. The key transport policy objective in the CARISMA-Telematics cities has been to generate a modal shift from private car to public transport and consequently reduce the number of vehicles needing to use the limited available road space.

Particular emphasis is given to the traffic problems at the fringe of the cities in the transition from the motorways to the urban street networks caused by commuter traffic. Attempts are being made by the cities to achieve a shift from car to public transport by improving the access to the mass transport systems in the region of the metropolitan areas and at the same time to restrict parking in the inner cities.

Telematics can support that objective in various ways e. g.:
- applications directly serving the public transport customer (e.g. fare collection, real-time information, etc.);
- systems which assist the operator to improve service quality (e.g. bus priority systems, advanced Vehicle Scheduling and Control Systems, etc.), and;
- functions which assist the market to supply coherent, cost-effective products (architectures, data models and interfaces, etc.).

CARISMA-Telematics REFERENCES PER CITY APPLICATION

Fact Sheet S5	TRIPlanner
Fact Sheet M2	Multimedia Traffic Information - Bayerninfo
Fact Sheet P4	Public Transport Information and Services
Fact Sheet TR4	Trondheim Integrated Electronic Payment and Ticketing Systems
Fact Sheet TU3	The Town Supervision Concept with the 5T System

Improving regional public transport services	**Barcelona**	**Glasgow**	**Hampshire**	**Paris**	**Munich**	**Trondheim**	**Turin**
Public transport information		++	++	++	++		++
Public Transport Payment	+	+		++	++	++	+
Pre-trip Journey Planning	+	+	++	++	++		+
Fleet and Resource Management	++	++		++	++	++	-
Demand-responsive public transport		++		++	++		

Table 2.2. Transport telematics methods in use or planned for improving regional public transport services. (See page 16 for symbol explanation)

Glasgow
- In the Greater Glasgow Area as part of the Scottish Executive's Public Transport Initiative a public transport priority information and control system called BIAS (Bus Information and Signalling system) is being designed an installed at 200 Traffic Signal sites.
- An AVL (Automatic Vehicle Location) System is being installed in parallel to the BIAS System that will initially track 300 buses through the first 3 quality bus corridors in the Glasgow Conurbation. This location information obtained by differential GPS will provide "virtual" loop demands to allow priority to late running buses throughout the controlled network.

Hampshire
- In Southampton and Winchester real-time public transport information is provided at selected stops. Information is displayed on service number, destination and the predicted number of minutes it will take for the bus to arrive. These systems cover mainly local services but some regional services are provided.
- There are approximately 25 kiosks (TRIPlanners in Southampton and Winchester providing pre-trip journey planning information for all modes of public transport in the area and for longer journeys to major destinations by coach, rail and air in the UK and Europe.

– Pre-trip journey planning can also be undertaken on the Internet via the ROMANSE On-line web-site, where an Internet version of the TRIPlanner system can be found. This enables journeys to be planned from the comfort of home or the office.

Munich

– In the Greater Munich Area, as part of the MOBINET project, demand oriented bus systems are being implemented making use of the information systems via GSM communication for users to order a bus and to direct the bus to these locations with the destination to the next rapid transit station. Park-and-ride and bike-and-ride systems are designed to support this approach.
– Electronic timetables (EFA) are available from the city's public transport authority, by the state of Bavaria's Traffic information Centre of the project BayernInfo, and by private service providers (J. Keller Verlag) via the Internet, in street kiosks and as a prototype by personal traveller assistants.
– For some light rail lines dynamic departure times are displayed at stops and in stations. Studies show that this information is highly valued by customers.

Paris

– INFOGARE (SNCF) is the SNCF system displaying dynamic information for travellers in the Ile-de-France regional stations.
– INFO@BORD (SNCF) is a project aiming at delivering automated on-board information in the regional trains of Ile-de-France.
– The RATP SIEL information system provides information on the RATP RER network.
– Although INFOGARE, INFO@BORD and the SIEL information systems are primarily of regional scope, they also provide information for nodes that are located in the urban areas.
– For many years the public transport network has benefited from an integrated payment mechanism that was triggered by the implementation of season tickets (Carte Orange). This is now being further enhanced through electronic payment.
– The web sites implemented by the PT operators give pre-trip information on regional as well as urban networks
– The Allobus system (not reported within the CARISMA-Telematics project) is a demand responsive bus service in operation around the Roissy Airport.

4.3. Improving urban public transport

Within the cities, collective transport systems help to shift people from car to public transport by providing services better tailored to demand, by improving public transport operations and by supplying better information for customers and operators. The following categories classify the systems available:
– On-trip information provides information to travellers using collective transport after they begin their trip (e.g. bus stop information).
– Collective transportation management automates operations, planning, and management functions of collective transit systems
– Personalised public transit offers flexibly routed transit vehicles to give a more convenient service to customers, especially those who are mobility impaired
– Public travel security creates a secure environment to travellers, patrons and operators of collective transport facilities

CARISMA-Telematics REFERENCES

Fact Sheet G4	Maryhill Road Route Action Plan - BUSTIME
Fact Sheet G6	TABASC0
Fact Sheet G4	Maryhill Road Route Action Plan - BUSTIME
Fact Sheet G6	TABASC0
Fact Sheet M4	Integrated Traffic Management
Fact Sheet P2	Electronic Ticketing
Fact Sheet P4	Public Transport Information and Services
Fact Sheet P6	Advanced Urban Traffic Control – SURF 2000
Fact Sheet S3	STOPWATCH (passenger transport information system)
Fact Sheet S5	TRIPlanner
Fact Sheet TR1	Trondheim City Profile
Fact Sheet TR4	Trondheim Integrated Electronic Payment and Ticketing Systems
Fact Sheet TU3	The Town Supervision Concept with the 5T System

Improving urban public transport	Barcelona	Glasgow	Hampshire	Paris	Munich	Trondheim	Turin
Public transport information	++	++	++	++	++	++	++
Demand responsive public transport		++		++	++		-
Public transport priority		++	++	++	++	++	++
Public transport payment systems	+	+		++	++	++	+
Public transport security				++			
Fleet and resource management	++	++		++	++	++	-
Car pooling/sharing management	+			+	-		-

Table 2.3. Transport telematics methods in use or planned for improving urban public transport

Barcelona

- Advanced public transport operators' (TMB) web-site is providing on-line route planning, incident-related information and general tourist information.
- Pilot projects are looking at car sharing, car pooling initiative, primarily via the Internet.
- Integrated payment exists which includes parking and public transport fares.

Glasgow

- Maryhill Road Route Action Plan, included the trial of Strathclyde PTE's BusTime real-time bus information system, dynamic information on bus arrival time (deregulated bus operation system). The BusTime trial was completed in 2000, to be superseded by BIAS: see next item.
- Development of a **bus information and signalling system** (BIAS) which enables road managers to control traffic congestion, bus operators to monitor their fleet operations and the transport authority to provide travellers with better information and a higher quality of service.
- Real Time Information will be provided at 50 "at stop" or "near stop" VMS via the AVL system.
- A management system will provide GIS (Graphical Information System) operator GUI (Graphical User Interface) to integrate the current CITRAC UTC, Car Park Guidance, Remote Monitoring and new BIAS Systems. It will allow the establishment of a common database that will present network performance indicators and information which can be readily output to the Web.

Hampshire

- In Winchester on-board displays provide the name of the next bus stop, for the park-and-ride service.
- Bus priority, within a dynamic urban traffic control system, using AVL, vehicle footprint (loop detector) and tags has been trialled in Winchester, Eastleigh and Southampton.
- Bus departure information systems have been installed in Winchester and Eastleigh. These provide bay number, service number, time of departure and destination(s). Current time and service disruptions are also displayed.

Munich

- Automated vehicle identification and fleet management is done in a conventional way with perspective of using new technologies.
- Public transport priority at signalised intersections is a major concept which is implemented on major light rail lines and will increasingly be used to provide efficient services for customers and service operators.

Paris

- Electronic ticketing is currently being developed in PARIS through a partnership between the two main operators RATP and SNCF, and the PT organising authority Syndicat des Transports Parisiens (STP). Several initiatives have taken place such as the European RATP led projects ICARE and Calypso (RATP), and the Francile (RATP) field test aimed at testing a re-loadable smart card that can comprise a travel pass and/or cash on the Parisian network.

- The ALTAIR (RATP) bus operation system is designed to optimise the network's operation, and make the generalisation technically and economically feasible, to inform users on the waiting time until the arrival of the next two buses, and their destination, as well as during their journey and to inform drivers on the distance time with preceding and following buses.
- The AIGLE system tackles safety issues in buses for both drivers and passengers, via centralised monitoring of bus security and central management of security patrols.
- Different experiments geared towards the development of car sharing have taken place in Paris: the Nestlé company succeeded in convincing its employees to car pool while SIER tried opening a service aimed at ride matching on the Sytadin web site, which to date has not yet been a huge success.

Trondheim

- In Trondheim, on-board computers on the buses are used for electronic payments with the TRON electronic payment card; on-board computers also store information on passenger numbers, calculate whether buses are keeping to schedule, and communicate with the control centre via microwave short range communication link.
- Displays at bus stops show expected arrival times calculated from the information provided by the on-board computers.

Turin

- As part the 5T project, dynamic departure times are displayed at public transport stops.
- Public transport priority at signalised intersections is integral part the 5T supervisor concept and implemented in major parts of the city.

4.4. Providing park-and-ride facilities at the fringe of the cities

Park-and-ride (including bike-and-ride, kiss-and-ride) is one way of encouraging more people to use public transport, particularly those who have access to rapid transit lines. This intermodal concept can be improved by information systems on the approaching motorways or highways and also by proving dynamic timetable information when approaching the public transport services. Park-and-ride is offered and pioneered in Glasgow, Munich and other cities all over Europe.

CARISMA-Telematics REFERENCES
Fact Sheet B4 Parking Management
Fact Sheet M3 MOBINET – Mobility in the Munich Metropolitan Area

Park-and-ride, bike-and-ride and kiss-and-ride facilities	**Barcelona**	**Glasgow**	**Hampshire**	**Munich**	**Trondheim**	**Turin**
Public transport information (for P+R)	++	++	+	++		-

Table 2.4. Transport telematics methods in use or planned in support of park-and-ride facilities at the fringe of the cities

Barcelona

- Park-and-ride services have been implemented in Barcelona to link the metro, bus systems and the Glories Car Park, creating the metroPark service.
- The Onaparcar web-site also gives information on where to park, and describes the payment offers linked to the park-and-ride services in the Las Glories car park.
- Experience of park-and-ride in Barcelona, suggests that if parking facilities are provided too close to the city centre (e.g. Glories) then the incentive given to park-and-ride is not sufficient to attract users without also restricting the access to the city. Once in the city centre, the temptation is too strong for the drivers to reach their final destination by car.
- In contrast, the parking facilities that are located outside of the city limits seem to be more successful in attracting users, providing them with real benefits.

Glasgow

– Next train departure times are displayed on VMS at park and ride sites with rail links into the city.

Hampshire

– In Winchester there are 330 spaces at two park-and-ride car parks. Space availability is provided on two car-park information signs, one of the signs is located on a motorway slip road, the other on the urban road network approaching the car parks.
– Once at the car park drivers can read the real-time bus information displays in the park-and-ride bus shelters.
– For pre-trip planning, in the home or office, real-time parking space availability is provided on the ROMANSE On-line web site. Forecast parking space availability is provided for half an hour and one hour ahead of the enquiry time.

Munich

– The park-and-ride facility at the Froettmaning underground station provides 1200 parking spaces at the fringe of the city. This concept has been enhanced by the implementation of a dynamic guidance system making use of variable direction signs on the approaching motorway. In addition, kiosks provide timetable information for the metropolitan public transport systems. This was part of the LLAMD/Munich COMFORT and TABASCO Projects.

4.5. Management of urban parking

Telematics applications in urban parking can support information on the availability and/or occupancy of parking spaces and the payment of parking fees using smart card systems. The main aim is to reduce congestion in city centres by reducing the time drivers spend looking for parking spaces.

CARISMA-Telematics REFERENCES
Fact Sheet B2 Smart Card Access Control
Fact Sheet B3 Management of Road Space
Fact Sheet B4 Parking Management
Fact Sheet M3 MOBINET – Mobility in the Munich Metropolitan Area
Fact Sheet S2 Romanse Project/Network Management
Fact Sheet TU2 The Integrated telematics Infrastructure of the 5T Project
Fact Sheet TU3 The Town Supervision Concept with the 5T System

Management of urban parking	**Barcelona**	**Glasgow**	**Hampshire**	**Paris**	**Munich**	**Trondheim**	**Turin**
Parking management	++	++	++	-	++		+
Advanced parking payment systems	++				+	++	

Table 2.5. Transport telematics methods in use or planned for the management of urban parking

Barcelona

– An automatic **parking guidance** system gives information on parking availability and guides the driver to parking facilities in the port area.
– The Onaparcar web site gives the users the best options for parking for a given destination and describes the integrated payment offers linked to the park-and-ride services in the Las Glories car park.

Glasgow

– **Car park guidance** has been implemented as the first part of a new UTMC (Urban traffic Management and Control) type system for overall control and management of traffic in the city.
– The car park guidance system current monitors three car park owned by Glasgow City Council (approx. 1950 spaces) and one car park owned by private developers (2000 spaces). Space availability is displayed on four strategically placed LED VMS. This information can readily be exported to the web.

Hampshire

- Parking guidance information through VMS has been successfully installed in Southampton, Winchester and Havant. Southampton (28 VMS) and Winchester (2 VMS) use flip dots to provide parking space availability. Winchester also has a comprehensive car park guidance system using rotating prism (9 VMS) providing space information and guidance (as the car parks fill) for short-stay and long-stay car parks.

Munich

- Parking guidance and/or information systems are present in most German cities. The city of Munich is just starting to implement **dynamic parking guidance** systems, showing the number of available free parking spaces and the shortest route to the parking lots, in particular to the sports stadium.
- Within MOBINET a model is being developed to forecast the probability of **parking space availability** within the city areas. Automated payment systems are also being considered which would also provide information on parking occupancy.

4.6. Improving commercial deliveries and goods transport

Mobile data communication links are increasingly being used between the driver or vehicle and a central controller using terrestrial and satellite networks. Electronic Data Interchange (EDI) between freight operators and shippers is also gaining ground. Real time information and automatic identification systems which monitor the movements of load units using electronically readable tags or Automatic Vehicle Location (AVL) can be used to warn traffic agents and their clients of any deviations or delays. EU research funds have supported testing and evaluation of mobile data communications for communications with drivers and EDI between freight operators and shippers or forwarders, in particular for their applicability and benefits to small and medium sized companies. Specific functional specifications have been demonstrated.

CARISMA-Telematics REFERENCES
The above activities are tested and implemented in European cities, but were not the focus of the activities of the CARISMA-Telematics cities. Barcelona and Turin are directly addressing the needs of commercial deliveries and goods transport in other ways.
Fact Sheet B2 Smart Card Access Control
Fact Sheet B3 Management of Road Space
Fact Sheet TU1 Turin City Profile

Improving commercial deliveries and goods transport	**Barcelona**	**Glasgow**	**Hampshire**	**Paris**	**Munich**	**Trondheim**	**Turin**
Coordinated city logistics	+	-	-	-	+	-	-
Freight management	-	-	-	-	-	-	-

Table 2.6. Transport telematics methods in use or planned to improve commercial deliveries and goods transport

Barcelona

- The smart card based access control system limiting vehicle access to 10 city districts of the municipality reduces through traffic and long-stay parking, and gives priority to important road users including delivery vehicles (**Fact Sheet B2**)
- The multi-use lanes in Balmes allow a same lane to be used for different purposes according to the time of the day: general traffic, loading and unloading and parking.
- The Balmes multi-use lane and access control represent positive answers to goods delivery, nevertheless further solutions are required.

4.7. Traffic calming in the CBD and residential areas

Traffic calming as a planning philosophy has the objective to improve urban quality in shopping streets, civic and residential areas. Particular emphasis is given to safety and noise effects of car traffic. This is achieved by zones within which maximum speed is restricted, e.g. 30 km/h or by access control adapted to support these objectives.

CARISMA-Telematics REFERENCES
Fact Sheet B2 Smart Card Access Control
Fact Sheet TR2 Trondheim Toll Ring: Planning Installation and Operation
Fact Sheet TU3 The Town Supervision Concept with the 5T System

Traffic calming in the CBD and residential areas	**Barcelona**	**Glasgow**	**Hampshire**	**Paris**	**Munich**	**Trondheim**	**Turin**
Access control	++	+	-		-		++
Environmental traffic management		-		++	-		++
Dynamic speed adaptation		-	-		-		

Table 2.7. Transport telematics methods in use or planned for traffic calming in the CBD and residential areas

Barcelona

– Access control to the city centre using automatic vehicle identification has been tested in the city of Barcelona based on digital images and licence number plate reading technology. The social reaction was found to be positive.

Glasgow

– Access control will be provided at key sites within the BIAS (Bus Information and Signalling System) corridors to restricted access for public transport vehicles.

Turin

– The town supervisor system seeks to address problems of congestion and pollution in the city centre.

Trondheim

– The Trondheim toll ring serves to reduce traffic volumes, especially truck traffic in the town centre, by financing new road links, and by differential pricing in peak hours.

4.8. Addressing problems faced by vulnerable road users

Vulnerable road users can be protected and supported within the transport systems by dedicated information services, such as information on specific qualities such as elevators at subway stations or e.g. acoustical warning and detection systems for pedestrians at signalised intersections.

CARISMA-Telematics REFERENCES
None of the above systems was part of the EC supported projects in the CARISMA-Telematics cities but there are other references.
Fact Sheet G4 Maryhill Road Route Action Plan
Fact Sheet P6 Advanced Urban Traffic Control – SURF 2000
Fact Sheet S1 Southampton/ Hampshire City Profile
Fact Sheet TR1 Trondheim City Profile
Fact Sheet TU1 Turin City Profile

Addressing problems faced by vulnerable road users	Barcelona	Glasgow	Hampshire	Paris	Munich	Trondheim	Turin
Vulnerable road user facilities		++	++	+	+	++	+
Dynamic speed adaptation					-		-
Environmental traffic management				++	-		++

Table 2.8. Transport telematics methods in use or planned to address the needs of vulnerable road users

Hampshire

– All pelican crossings in Hampshire have either audible or tactile (e.g. rotating knob) warning for when the green man symbol is displayed. 85% of these sites also have textured paving and flush drop kerbs. Approximately 75% of all signalised intersections with pedestrian facilities incorporate audible or tactile warning devices.

Paris

– Pilot projects that have tested acoustical warning systems at traffic lights for visually impaired citizens were successful and will be put in to normal operation in the future.
– In case of high pollution levels, restrictions are placed on motorists to limit the level of emissions and improve air quality, thus taking into account the elderly, infants, and people suffering from respiratory illnesses.

4.9. Improving safety and performance of the arterial road network

Alongside strategies to reduce motorised traffic and to shift car traffic to public transport a further task is to manage the remaining traffic in an optimal way to minimise its negative effects. Most transport telematics technologies can assist in reaching these objectives. The major strategies and tools are:
– Urban network signal control
– Information via VMS (Variable Message Signs)
– Route guidance and navigation
– Pre- and on-trip traffic information
– Traffic incident management

Several fully adaptive Urban Traffic Control (UTC) systems have been developed and tested, including a knowledge-based model. Particular strategies (gating, bus priority, off-peak speed control, pedestrian demand, etc.) have been assessed, and innovative systems to improve the UTC program using fuzzy logic and artificial intelligence have been developed. Where tested, benefits in terms of increased throughput and reduced delays have been encouraging.

Coordination of successive traffic lights on a corridor to enhance traffic throughput and driver comfort was found to be effective in cities with ”straightforward” street layouts (grid, large corridors). Other signal control strategies are being developed to give priority to collective transport services and emergency vehicles.

The technology of VMS for alternative routing, control or warning has progressed from illuminated signs and rotating planks/prisms to fibre-optics, Light Emitting Diodes (LED) and Liquid Crystal Display (LCD), and may be considered as mature. Information to drivers in cities and on peri-urban motorways through the use of VMS has been extensively evaluated by a number of local projects. Parking information systems using VMS (see Section 4.5) have been trialled as a part of an integrated urban traffic management strategy.

CARISMA-Telematics REFERENCES

Fact Sheet B3	Management of Road Space
Fact Sheet B5	Network Control and Traffic Information
Fact Sheet G2	Centrally Integrated Traffic Control - CITRAC
Fact Sheet G4	Maryhill Road Route Action Plan - BUSTIME

Fact Sheet G6 TABASC0
Fact Sheet M3 MOBINET – Mobility in the Munich Metropolitan Area
Fact Sheet M4 Integrated Traffic Management
Fact Sheet P6 Advanced Urban Traffic Control – SURF 2000
Fact Sheet S2 Romanse Project/Network Management
Fact Sheet TR2 Trondheim Toll Ring: Planning Installation and Operation
Fact Sheet TU3 The Town Supervision Concept with the 5T System

Improving the safety and performance of the arterial road network	**Barcelona**	**Glasgow**	**Hampshire**	**Paris**	**Munich**	**Trondheim**	**Turin**
Intersection control	+	++	++		++		++
Urban traffic control	++	++	++	++	++		++
Public transport priority		++	++	++	++	++	++
Route guidance and navigation		+	++	++	++		++
Traffic information	++	++	++	++	++	++	++
Urban incident management		+	++	++			
Supervisory management		+		++	+		++
Urban tolling		-	-	-	-	++	-
Urban road pricing	-	-	-	-	-	+	-

Table 2.9. Transport telematics methods in use or planned to improve the safety and performance of the arterial road network

Barcelona

- The Urban Traffic Control system centrally manages most signalised intersections in Barcelona.
- Multi-use lanes in Balmes: the alternative use of the same lane for different purposes according to the time of the day enables better traffic management (**Fact Sheet B 3**).
- Diagonal's tidal flow: three reversible lanes on the seven lane Avenida Diagonal, enables the management of peak hour traffic on one of Barcelona's main arteries.
- Automatic Parking guidance contributes to the network's performance by reducing the number of vehicles looking for a space (**Fact Sheet B4**).
- Micro-regulation with artificial vision: a recent demonstration project, aimed at enhancing traffic control on some critical intersections of the urban network.

Glasgow

- In Glasgow close linking of the urban and motorway systems is necessary and this has been evident since the 1980s when the UTC system was co-located with the motorway control centre.
- A key component of the Glasgow ITS Strategy is setting out the options for moving towards the next generation of Urban Traffic Management and Control (UTMC) system to replace the existing fixed time UTC system. The proposed approach is to control traffic in the appropriate manner for the specific network conditions in a given network area. For example, a corridor manager has been proposed to enhance the impact of the committed Route Action Plans (RAP) into the city (**Fact Sheet G4)**.
- An experiment was carried out to test the BALANCE UTC system including public transport priority transferred from Munich within the TABASCO project.

Hampshire

- Hampshire and Southampton first installed dynamic urban traffic control systems in the early 1980s. These SCOOT based Urban Traffic Control systems were primarily installed for signal optimisation but have benefited from usual additional facilities in UTC. For example, car park monitoring, count sites, equipment monitoring, fire routes and so on.
- Building on this, the system developed by ROMANSE has transformed the UTC system into an Integrated Traffic Management Computer (ITMC) system.
- The ITMC system forms the heart of a real-time traffic and travel information centre acting as the interface to systems and as a central log. Services provided beyond the usual UTC are:
    - Congestion and routing strategies
    - Public transport priority

- VMS strategies for driver information
- Links to inter-urban VMS strategies
- Traffic and travel information reports
- Incident management
- Parking space prediction
- Information for ROMANSE On-line web-site
- Congestion information displays
- Links to strategic information system (GIS)

Munich

- A new traffic adaptive control strategy with public transport priority was developed and demonstrated in Munich within the LLAMD/Munich COMFORT and TABASCO European projects and implemented within the MOBINET project. The strategy has demonstrated reductions in queue lengths and waiting times for public and private transport.
- Existing re-routing systems using VMS have been enhanced by new knowledge based control strategies such as VARIA and this in combination with automated incident detection algorithms. This provides an integrated approach to urban and regional control as implemented within MOBINET.
- Enabling systems such as a strategy and service centre has been developed within which a network traffic monitoring model (NEMO) has been implemented.

Paris

- In Paris, both SIER and the city of Paris have implemented systems that provide better performance for the management of their respective networks: arterial and the Boulevard Périphérique for the city, the Ile de France motorways for SIER.
- In the city of Paris, SURF 2000 is the urban traffic control system, comprising two major components: the first such centralised system in Paris, called SURF and the SAGE system for Système d'Aide à la Gestion des Embouteillages the traffic congestion management system. The City also manages the Boulevard Périphérique on which a VMS network has been set up. This VMS system was the first in the world to display travel times between two main points of the network. The travel times displayed inform users and decrease their stress and also contribute to a better allocation of the traffic flows.
- In départements outside of Paris other systems are developed such as SITER (Hauts-de-Seine), and PARCIVAL (Val de Marne) with the same goals of enhancing network performance.
- The ALTAIR bus operation (RATP) system also contributes to enhanced performance via better management of the buses.
- The Visionaute and Skipper services provide route guidance for road users who are able to access real-time traffic information via on board systems.
- The EU In-Response Image processing, incident detection on both Boulevard Périphérique and SIER network.

Turin

- With the 5T project a supervisory concept was implemented for an integrated multimodal information and control of public transport via information and priority at intersections and urban traffic signal control using the UTOPIA system in combination with an urban routing system via VMS.
- The supervisor provides a set of traffic models for dual mode OD-estimation and traffic assignment as well as control strategies so as to achieve a user equilibrium within the public transport and car traffic networks.

4.10. Handling of large scale events (exhibitions, sports, demonstrations)

Large-scale events tend to lead to congestion since traffic demand is often higher than can be supplied by the networks at any one time. Thus traffic information systems and any kind of re-routing and capacity enhancing system are valuable to relieve the situation. Transport telematics systems for monitoring, incident detection and multimodal information, control, and enforcement can help in these situations.

CARISMA-Telematics REFERENCES
Fact Sheet B2 Smart Card Access Control

Fact Sheet G1 Glasgow City Profile
Fact Sheet M2 Multimedia Traffic Information – Bayerninfo
Fact Sheet P5 Motorway Information and Management – SIRIUS
Fact Sheet S2 Romanse Project/Network Management

Handling of large scale events (exhibitions, sports, demonstrations)	**Barcelona**	**Glasgow**	**Hampshire**	**Paris**	**Munich**	**Trondheim**	**Turin**
Supervisory management				++	-		++
Public transport information	++	++	++	++	++	++	++
Traffic information		++	++	++	++		++
Intersection control for large scale events		++	++	++	-		++
Parking management	++	++	++		+		++
Traffic regulations enforcement		+			+	++	
Vulnerable road user facilities		-	+	+	+		+

Table 2.10. Transport telematics methods in use or planned for the handling of large-scale events (exhibitions, sports, demonstrations)

Barcelona

– The access control trials achieved (a) an 18% reduction in travel times in the "special events" controlled zone; (b) a one-third reduction in the number of people entering the special event zone; (c) strong public support for the pilot implementation; (d) an estimated 50% increase in public transport trips city-wide which led to a corresponding reduction in emissions.

Glasgow

– With the assistance of the Scottish Office, Glasgow City has carried out the initial feasibility investigation for a traveller information project known as TIME (Traveller Information for Major Events). It is planned that a public/private consortium will be formed to implement and operate TIME, but this has not yet developed.

Hampshire

– Hampshire and Southampton have a number of large-scale events, for example the International Boat Show on Southampton waterfront. ROMANSE transport telematics systems provide real-time multimodal traffic and travel information, parking (including park and ride) and driver information (using mobile VMS).

Paris

– Specific traffic management plans have been devised for major events – the most famous were related to the football World Cup in the Stade de France. They encompass information strategies that encourage people to take public transport.

4.11. Assistance to emergency services

A rapid response by the agencies responsible for road network management can save lives and minimise the spread of traffic congestion. Telematics can support more rapid incident detection and secure reliable data on the location of any emergency. Systems to automatically initiate an emergency response e.g. via in-vehicle GSM-based mobile phone systems providing details of the location and the severity of the accident, and to warn subsequent traffic have been tested. They use commercially available techniques such as Differential Global Positioning System (DGPS) and a Geographic Data File (GDF) map database.

In the CARISMA-Telematics cities these technologies have not been part of the EU projects but urban traffic control systems are often adapted to give very high priority to emergency vehicles on request.

CARISMA-Telematics REFERENCES
Fact Sheet G2 Centrally Integrated Traffic Control – CITRAC

Fact Sheet P6 Advanced Urban Traffic Control – SURF 2000
Fact Sheet TU1 Turin City Profile

Assistance to emergency services	**Barcelona**	**Glasgow**	**Hampshire**	**Paris**	**Munich**	**Trondheim**	**Turin**
Rescue service incident management		++	-	+	-		
Breakdown and emergency alert			-	++	-		

Table 2.11. Transport telematics methods in use or planned to assist emergency services

Glasgow

– Emergency Vehicle Priority is provided for Fire Appliances throughout the Greater Glasgow Area as part of the CITRAC UTC System. These fixed "Green Wave" plans are automatically requested from the Strathclyde Fire Brigade Command and Control System. An average of 1,000 Green Wave Plans are called per month.

Munich

– The roadside warning system COMPANION implemented and tested on the motorway between Munich and its airport is one core example of a network of emergency service systems. It provides immediate warning to drivers upstream of an incident by flashing lights facing the oncoming traffic on the guidance posts. Measurements taken within the TABASCO project showed that drivers reacted positively to these warnings and a harmonisation of traffic flow could be observed. Once the incident is detected a series of information (RDS-TMC, VMS) and service systems (police, medical help) can also be activated.

Paris

– Within the In Response project an image of the incident detected by SIER was made available to SAMU (one of the rescue services) in order to enhance response to emergencies.
– The Breakdown and emergency alert Odysline service proposed by Renault is actually available in the Paris region as throughout the whole of France.

Turin

– The Maximum Priority subsystem assists ambulances' navigation through the urban network and allows to clear traffic lights intersections along the chosen route. It operates over 15 ambulances of the regional emergency call number "118".

4.12. Improving intermodal travel and traffic information quality

Information systems are core tools of the information society technologies and are of significant importance for transport systems. For the traveller, multi-modal and inter-modal information systems are of highest importance because they allow for a comparison of time and cost of travel and this way influence travel behaviour and the use of the different transport systems over time and space.

The task of providing and maintaining accurate credible information is considerable. To achieve a significant modal shift a high level of resource is required. In order to keep the information at a level where the travelling public will come to rely on the service and trust it, a large investment of time is required. Any reduction in the quality and timeliness of this information could undermine this objective and regaining credibility with the travelling public will be a huge task.

The CARISMA-Telematics cities have made substantial progress in providing access to on-line information services, including route planning based on real-time traffic information, public transport schedules and estimated arrival times, parking availability and travel time forecasts, and connections with park and ride. Based on this experience an Advice and Guidance Note has been prepared on this topic (**Fact Sheet AG3)**.

European projects represented in CARISMA-Telematics have supported a threefold approach to satisfying user needs and requirements:

– to provide the means to receive better travel information to enhance route choice;
– to develop new sources of traffic information and data on the latest road and traffic/travel conditions, and;
– to prove digital map-based systems offering navigation and route guidance. In this context information includes details of current and forecast traffic and weather conditions, alternative transport options, including public transport, the availability of parking spaces and the location of hotels and restaurants, etc.

CARISMA-Telematics REFERENCES

Fact Sheet B5	Network Control and Traffic Information
Fact Sheet G3	National Driver Information and Control System – NADICS
Fact Sheet G4	Maryhill Road Route Action Plan - BUSTIME
Fact Sheet G5	Scottish Travel Information Association – SCOTIA
Fact Sheet M2	Multimedia Traffic Information - Bayerninfo
Fact Sheet M3	MOBINET – Mobility in the Munich Metropolitan Area
Fact Sheet M5	DAB-based services in Bavaria
Fact Sheet P3	Commercial Traffic Information Services
Fact Sheet P5	Motorway Information and Management – SIRIUS
Fact Sheet S3	STOPWATCH (passenger transport information system)
Fact Sheet S4	Traffic and Travel Information
Fact Sheet S5	TRIPlanner
Fact Sheet TU3	The Town Supervision Concept with the 5T System

Improving intermodal travel and traffic information quality	**Barcelona**	**Glasgow**	**Hampshire**	**Paris**	**Munich**	**Trondheim**	**Turin**
Traffic information	++	++	++	++	+		+
Public transport information	++	++	++	++	+	++	+

Table 2.12. Transport telematics methods in use or planned to improve intermodal travel and traffic information quality

Barcelona

– **Traffic website**: the supply of up-to-date information, congestion maps and images on-line, via the Internet (www.bcn.es).
– The TMB web-site (www.tmb.net) is a state-of-the-art site providing information and trip planning to public transport users in Barcelona.
– Onaparcar is a web site to help users find the parking facility which is closest to their destination, and displays available spaces: (www.onaparcar.bcn.es)
– The "How to go" site is a trip planner which indicates the best public transport route between a given origin and destination (www.transit.bcn.es). This site is common to the city and to the public transport operator.

Glasgow

– NADICS/FEDICS: the National Driver Information and Control System for Central Scotland provides pre-trip and in-trip information for drivers about road conditions across Scotland. **Fact Sheet G3)**.
– SCOTIA ATT is a joint private/public partnership initiative to promote the use of advanced transport telematics and associated techniques **(Fact Sheet G5)**
– A web site provides real time map-based information on congestion and travel times through links in the road network, route information, and details of road works and road closures www.nadics.org.uk
– Trials of automatic number plate recognition systems are taking place for collecting data for journey time estimation

Hampshire

- The ROMANSE Traffic and Travel Information Centre (TTIC) provides comprehensive real-time multi-modal traffic and travel information. Data is gathered from a variety of sources e.g. CCTV, traffic detectors, Police reports, events etc. This collated and disseminated widely through the media e.g. RDS radio, TV teletext, motoring organisations, on-street displays, VMS, etc.

Munich

- Multimodal information systems are developed in the BAYERNINFO projects which link several data bases within Bavaria to provide complete coverage of the motorway network and street networks in Nuremberg and Munich as well as the timetables of German Railways and local public transport systems. Value added information is produced on this basis and disseminated via the Internet and personal traveller assistants. This Bavarian funded project is linked to the European network via the INFOTEN projects providing multimodal information between regions in Northeast Italy, Switzerland and Austria.
- As part of the Bavarian DAB (Digital Audio Broadcast) and MOBINET projects an online communication link was established to transmit online information on the network level of service to a fleet of DAB equipped cars. The assessment of the projects showed high acceptance of this information by the drivers for re routing in the existing network.

Paris

- To a certain extent, electronic ticketing using Smart Cards will encourage inter-modal trips.
- Web sites are being developed in Paris: the Sytadin web site (www.sytadin.tm.fr), Cité Futé (www.sytadin.tm.fr/citefutee.htm or www.citefutee.com combining information from RATP and SIER, etc.
- Travel times are displayed on VMS for the SIER and city of Paris networks, new algorithms are tested to enhance information quality.
- The Visionaute and Skipper commercial services provide real-time traffic and travel information to motorists in downtown Paris and its suburbs **(Fact Sheet P3)**.

Trondheim

- ITS based information services comprising a parking guidance information system and a transport information centre. Systems operating to support these services include a digital road network database, digital public transport network database, on-line traffic monitoring, and a road and traffic data bank.

4.13. Urban/peri-urban motorway operation and control

Along with the measures that are applied to the urban street network and main arterial roads telematics is being deployed in peri-urban and urban motorway operation and control. The methods include incident management, VMS-based traffic management, ramp metering and short-term forecasting of journey times and traffic volumes. The possibilities have been studied as part of MAGIC and TELTEN (both initiatives of the EU Motorway Working Group). A broad consensus now exists amongst European road operators on three basic missions:

- Mission 1: to keep the roads available and safe
- Mission 2: to operate the traffic flows
- Mission 3: to assist users and provide travel services.

This framework allows traffic management services to be developed for the Trans-European Road Networks (TERN), for example, emergency response, winter maintenance, lane control, speed management, speed harmonisation, incident warning, ramp metering, event information, re-routing and network control.

Traffic control for urban motorway networks has concentrated mainly on strategies for the use of Variable Message Signs to control, give warnings, advice and information. Examples of services using VMS are lane control, speed management (or queue-tail protection), speed harmonisation, incident warning, event information and re-routing. In the CARISMA-Telematics cities various models have been developed to reflect different operating environments and used to test real time VMS control strategy selection and traffic prediction information.

CARISMA-Telematics REFERENCES

Fact Sheet B5 Network Control and Traffic Information
Fact Sheet G2 Centrally Integrated Traffic Control - CITRAC
Fact Sheet G6 TABASC0
Fact Sheet M4 Integrated Traffic Management
Fact Sheet P5 Motorway Information and Management – SIRIUS
Fact Sheet S2 Romanse Project/Network Management

Urban/peri-urban motorway traffic management, operation and control	**Barcelona**	**Glasgow**	**Hampshire**	**Paris**	**Munich**	**Trondheim**	**Turin**
Highway management	++	++	+	++	++		
Ramp metering	+	++	+	++	+		
Incident management		-	++	++	-		
Traffic regulation enforcement		++					

Table 2.13. Transport telematics methods in use or planned for urban/peri-urban motorway traffic management, operation and control

The CARISMA-Telematics cities Munich, Glasgow, Paris, and Southampton (Hampshire**)** are fully integrated with their regions with respect to the management of the transport systems. This is particularly reflected by their traffic information and/ or control centres such as the CITRAC traffic control and surveillance centre of the Scottish Office and Glasgow **(Fact Sheet G2)**.

Barcelona

- The Rondas traffic control system (for Barcelona ring roads): responsibilities for traffic management on this peripheral network are shared between the city council and the state police for their respective geographical areas. The unique transmission network allows a common access to the 26 cameras present along the ring roads. The equipment comprises data collection stations and VMS of different types, used to inform drivers, show the enforced speed limit, and re-route them when necessary.
- Traffic forecasting could be developed in cooperation with the traffic simulation specialists from the Catalan University of Barcelona using the AIMSUN 2 tool.
- Ramp metering may be implemented in the future.

Glasgow

- A successful experiment on a slip road control system turned into implementation integrating traffic control on the motorway and urban street network. This led to plans for installation of coordinated ramp metering at several sites across the city.
- Motorway control with VMS has a long history in Glasgow with the M8 motorway dissecting the city. In the context of regional network control linking the city with Edinburgh and CITRAC, the knowledge based network control strategy called OPERA was developed and implemented within the EC research activities QUO VADIS and TABASCO.

Hampshire

- The ROMANSE Traffic and Travel Information System operators can set individual messages or message strategies on the inter-urban/urban network – the first time a local authority has controlled motorway signs in England.
- Matrix signal settings are relayed from the Police Motorway Control Centre providing operators at the ROMANSE TTIC a countywide view of current motorway management strategies.
- Hampshire and the Highways Agency for England are involved in the largest ramp metering trial to be undertaken in the UK.

Munich

- The integrated traffic management system in Greater Munich provides dynamic route guidance on motorways and urban roads (using VARIA), and incident detection on urban roads (using AIDA). The two systems are being integrated so that traffic on the motorway can be diverted in response to incidents on the urban routes into the city from the motorway (**Fact Sheet M4)**

– The TABASCO project identified some lessons from the network control and re-routing application. First, it is important to ensure that the network in question has alternative routes of a high standard, with enough spare capacity to cope with diverted traffic, and second, clear, appropriate signs with messages presented in a timely manner are important to achieve good rates of compliance.

Paris

– Incident management has been developed through the In Response project and the automatic lane closure system ("BRA" = biseaux de rabattement automatiques) implemented on the A3-A86 section of the SIER network: barriers of increasing length are deployed when an accident is detected with a video AID system and validated by an operator, on this section where the emergency lane has been used to add extra capacity.
– SIER manages the SIRIUS system, the information and traffic management system of the Ile-de-France publicly owned motorway network (500 km), capable of congestion detection, equipped with ramp metering and other high performance systems.

5. Telematics infrastructure, technologies and methods

Telematics infrastructure, the technologies and the methods which support the transport management objectives discussed in Part 3, include all the systems need for data collection, data exchange and communications to the end user, as well as the control systems that are being deployed, e.g. for traffic management or electronic payment. The regional telematics infrastructure must be sufficiently well developed to support the services that the cities are planning to deploy. This part of the report indicates where the CARISMA-Telematics project team has identified examples of good initiatives and support actions.

5.1. Telematics infrastructure and key technologies

Many of the essential features of the future telematics infrastructure are now available or being developed, and are being put to use in the CARISMA-Telematics cities. The systems and their applications have been reviewed for the CARTS report for the Telematics Applications Programme and include:

- The data dictionaries for transport telematics services
- Digital mapping of road networks, geographical location referencing and the basis for navigational databases
- Use of Dedicated Short-Range Communications (DSRC) for electronic payment and access control
- Emergence of travel information and navigation services using mobile telephony based on digital cellular networks (GSM) and the Radio Data System Traffic Message Channel (RDS-TMC)
- Electronic data transfer between different organisations
- Deployment of multi-service/multi-payment applications using smart card and electronic payment mechanisms, including combined use with DSRC.
- Rapidly growing use of the Internet

The main components of telematics infrastructure and key technologies identified in this report are listed in Table 4.1. Summary descriptions of these technologies and methods are contained in the CARTS report and the ITS Handbook 2000 from PIARC (see Section 3.5).

Telematics Infrastructure	Components	
System Architecture Framework	Functional/Logical Architecture	Organisational Architecture Data dictionaries
Data Capture and Monitoring	Image processing Real-time modelling & forecasting	On-line Traffic Monitoring “Floating car” data capture
Data Transmission Standards and Protocols	Internet TCP/IP Protocols Internet Wireless Application Protocol (WAP)	DATEX protocols ALERT+; ALERT C
Navigation and positioning	Digital Map databases Satellite navigation (GPS/DGPS)	RDS-TMC Location Referencing
Communications Technologies	Digital Audio Broadcasting (DAB) Radio Data System Traffic Message Channel (RDS-TMC) Radio Paging	GSM digital cellphone services Dedicated Short-Range Communications (DSRC) ISDN
Control centres	Traffic Control Centres Mobility Management Centres	Traffic/Travel information Centres
User Interfaces	Electronic display boards Variable Message Signs	In-car Units User terminals & kiosks
Other Technologies and Techniques	Contactless Smart cards Video Enforcement	Contact Smart cards “Remote presence”

Table 3.1. Summary of technologies and methods used in transport telematics

5.2. ITS system architecture

The overall system architecture provides a framework for linking and integrating different applications of transport telematics so that one will benefit and support the other. The architecture considers both technical and operational requirements, for example, how the systems operated independently by control centres, public transport operators, road authorities and parking companies, etc., can be linked together in an efficient way.

All the CARISMA-Telematics cites are taking steps towards a more integrated approach to the deployment of telematics systems. Greater integration comes in support of citywide policies on congestion management, traffic and parking control and policies to achieve a change in travel mode. There is an increasing interest in open systems as a means of developing inter-operable systems and telematics services.

The requirement for multi-agency inter-operability (CONVERGE level 3) is generally being tackled on an ad hoc basis by adopting open systems and standards for data exchange as opportunities arise for different public agencies to work together and with the private sector. Examples are:

– Paris electronic ticketing systems **(Fact Sheet P2)**
– Turin 5T systems **(Fact Sheet TU2)**
– Munich BayernInfo organisational architecture **(Fact Sheet M2)**

Single Agency open systems (CONVERGE level 2) are notionally easier to achieve because they come entirely under the jurisdiction of the organisation responsible for procuring and operating the system. However it requires a firm commitment to open systems in the procurement method and system specifications, especially where older systems (typically traffic management systems) are being upgraded or modernised.

Different European countries have engaged initiatives aimed at developing national framework architectures, which should help regions and cities develop open and interoperable systems. The Karen project financed under the umbrella of the European Commission, tackled the problem on a European scale. The ACTIF initiative in France is currently devising the French Framework Architecture and received an interesting support from the stakeholders in the field of ITS. In the UK the UK government research programme the UTMC (Urban Traffic Management and Control) is investigating a system architecture initiative for urban ITS applications.

CARISMA-Telematics REFERENCES

Fact Sheet B5	Network Control and Traffic Information
Fact Sheet M3	MOBINET – Mobility in the Munich Metropolitan Area
Fact Sheet M4	Integrated Traffic Management
Fact Sheet S5	TRIPlanner
Fact Sheet TU2	The Integrated telematics Infrastructure of the 5T Project
Fact Sheet TU3	The Town Supervision Concept with the 5T System

System architecture component	Barcelona	Glasgow	Hampshire	Paris	Munich	Trondheim	Turin
Functional/logical architecture		++	++	+		++	++
Organisational architecture		+	++	++	++	++	++
Data dictionaries		++	-	++		+	++

Table 3.2 System architecture components in use or planned for transport telematics applications.

Paris

- The first part of the SIRIUS system **(Fact Sheet P5)** was developed with standards that were different from the ones that were chosen for SIRIUS Ouest.
- Some functional elements exist in SIER, but the need for voluntarily devising an architecture which would be imposed to suppliers was not identified early on. However an information system masterplan was produced in order to analyse SIER's organisation, the existing applications and the applications that could be enhanced, as well as some technical solutions. The masterplan then defines the strategy that will be adopted in order to reach the defined goals.
- No regional architecture common to different institutions exists in the Ile-de-France region, the multiplicity of actors makes the convergence difficult. However a national initiative (ACTIF project) that was initiated alongside the KAREN European project is currently tackling the problem on a national scope.
- In order to provide information to service providers and feed information into the wholesale server both SIER and Ville de Paris have agreed on common protocols and data dictionaries in order to exchange information.

Glasgow

- Upgrades to the Glasgow UTC system are being carried out taking maximum account of the UK system architecture initiative for ITS under the UK government research programme UTMC (Urban Traffic Management and Control).
- The integrated UTMC system uses common computer databases and includes three Glasgow systems: CITRAC, NADICS and BusTime (each described in separate Fact Sheets).
- Glasgow is also a member of the follower user group within the Infoville Digital Sites Project, which seeks to establish a standard integration platform for on-line access to a wide range of information.

Hampshire

- The ROMANSE project has developed a detailed description of its system architecture for the systems that provide services to the Traffic and Travel Information Centre. The architecture describes the functionality needed to implement the system and comprises functional elements and data flows which link these elements both to each other and to the outside world (see ROMANSE System Architecture Description RM07 Version 1.0 December 1997) .
- Hampshire is also involved in the UTMC programme, see section on Glasgow above, and will make use of the UTMC common data dictionary.

Turin

– The 5T system architecture is structured according to an open, modular architectural model based on complementary, interconnected subsystems. The subsystems cooperate as part of a hierarchically distributed structure under the coordination of the town supervisor, but they are also capable of performing their functions independently, each within its own specific application area. This entirely modular architecture, in which systems maintain a degree of functional independence, not only facilitates management of the whole system and its extension, but also ensures continued operation when one part of the system is not down.

5.3. Data capture and monitoring

5.3.1 Real-time traffic monitoring and forecasting

Systematic monitoring, often in real-time, of vehicle locations, operating conditions and the performance of transport networks is central to the task of delivering high-quality telematics-based services. The experience of the CARISMA-Telematics cities shows that collection and organisation of these data on an accurate and timely basis is central to the deployment of transport telematics. Data collection methods are improving hand-in-hand with the capability of the on-line systems to deliver this information.

Automatic incident detection based on loop detection or image processing is now accepted practice for congested sections of expressways and motorways. A variety of selective vehicle detection, access and classification systems are also utilised, for traffic census purposes but also at toll plazas.

Camera enforcement systems using vehicle licence plate recognition are now tried and tested (e.g. Trondheim), and attention is shifting to improving the reliability of the licence plate databases that support these systems.

An increasing number of vehicle fleets are being fitted with Automatic Vehicle Location systems. As they spread, they can be combined with mobile communications to provide "floating car data". Paris has the most advanced example of this amongst the CARISMA-Telematics cities (**Fact Sheet P3)**.

CARISMA-Telematics REFERENCES

Fact Sheet B5	Network Control and Traffic Information
Fact Sheet G2	Centrally Integrated Traffic Control - CITRAC
Fact Sheet G3	National Driver Information and Control System – NADICS
Fact Sheet G4	Maryhill Road Route Action Plan - BUSTIME
Fact Sheet M4	Integrated Traffic Management
Fact Sheet P3	Commercial Traffic Information Services
Fact Sheet P4	Public Transport Information and Services
Fact Sheet P5	Motorway Information and Management – SIRIUS
Fact Sheet S2	Romanse Project/Network Management
Fact Sheet TU2	The Integrated telematics Infrastructure of the 5T Project
Fact Sheet TU3	The Town Supervision Concept with the 5T System

Data capture methods	Barcelona	Glasgow	Hampshire	Paris	Munich	Trondheim	Turin
Image processing	+	+	++	++	+	++	
On-line traffic monitoring	++	++	++	++	+	++	++
"Floating car" data capture		-	-	++	+		
Real-time simulation and forecasting		++	++		+		++

Table 3.3 Data capture methods in use or planned for transport telematics applications.

Barcelona

– The urban traffic control centre, the Ronda TCC, and the Badals tunnel control centre all perform on line traffic monitoring.

– Image processing is being developed for a project aimed at enhancing traffic management in urban intersections; use on the ring roads is under consideration.

Glasgow

– Strathclyde Passenger Transport (SPT) coordinates public transport services in the region. The SPT aims to promote a greater use of public transport, in part by equipping buses with AVL systems in order to operate bus priority schemes and to provide real-time information at bus-stops.

Hampshire

– Siemens Traffic Control Ltd. (STCL) ARTEMIS video image processing system.
– On-line traffic monitoring through STCL UTC including ASTRID (SCOOT database) INGRID (incident detection) and live congestion maps on GIS (with information from UTC).

Paris

– On-line traffic monitoring is common to all traffic control centres in the Paris area: SURF 2000, IPER for the city of Paris and the different SIRIUS TCCs. Public transport operations centres also perform central on-line monitoring of their fleets of vehicles (SNCF TCC, RATP ALTAIR system and control centre…).
– The traffic information services such as Mediamobile and Skipper combine different information sources such as floating car data gathered from taxi fleets and public sources (SIER, Ville de Paris).
– New research projects are tackling traffic forecasting in order to take relevant traffic control actions and provide information.
– The IN RESPONSE project tested the efficiency of incident detection with video cameras on SIER and Ville de Paris' networks. AID is now in operation on several sites.

Trondheim

– Vehicles in the Trondheim tolling system are equipped with a 'read only' electronic tag in the windscreen which identifies the vehicle and its classification (bus, heavy goods vehicle, car/light van). The "Q-FREE" tags have been designed so they can be read in all weather conditions.
– Buses are equipped with tags that are used to identify them as exempt vehicles at toll stations. These tags also give buses priority at junctions controlled by traffic signals, by triggering a new green phase or extending an existing green phase as a bus approaches the signals.

5.4. Data transmission standards and protocols

Transport data collection and **exchange** is a prerequisite for most transport telematics services. Harmonisation, to ensure **interoperability and transferability** of functions and systems is thus a basic requirement for the development and deployment of transport telematics services. As travel information services evolve from local and regional to national and international services, pressures will also mount for conformity. The **DATEX-Net** specifications provide the framework for the exchange of traffic and travel data into an interoperable solution.

For services and functions – such as **RDS-TMC** – to be truly interoperable throughout Europe, consistent standards and protocols must be adopted. Each national implementation of the developing RDS-TMC services maintains a common functionality at the European level. This functionality, known as ALERT functionality, is the provision of products and services over a network of harmonised and interoperable international, national, regional and local RDS-TMC services across Europe, with subtle differences in content and quality.

Use of the Internet is making it easier to publish and share data, especially in support of public information services. Mobile telephony has demonstrated the potential to provide data transmission for traffic and transport applications. Developments such as the Wireless Application Protocol (WAP) aims to empower mobile users with wireless devices (mobile and smart phones, pagers, two-way radios, etc.) to access and interact with information services easily and quickly.

CARISMA-Telematics REFERENCES
Fact Sheet G5 Scottish Travel Information Association – SCOTIA
Fact Sheet M5 DAB-based services in Bavaria
Fact Sheet P2 Electronic Ticketing
Fact Sheet P3 Commercial Traffic Information Services
Fact Sheet TR3 Trondheim Toll Ring: Electronic Fee Collection System
Fact Sheet TU2 The Integrated telematics Infrastructure of the 5T Project

Data transmission standards and protocols	**Barcelona**	**Glasgow**	**Hampshire**	**Paris**	**Munich**	**Trondheim**	**Turin**
INTERNET TCP/IP PROTOCOLS	++	++	++	++	++	+	-
DATEX protocols		+	+	++	+		+
ALERT+; ALERT C		++	+	++	+		+
Internet Wireless Application Protocol (WAP)	+	+	+	+	+		+

Table 3.4 Data transmission methods in use or planned for transport telematics applications.

Barcelona

- Internet protocols are widely used for transferring information on to the web servers which provide traffic and public transport information.

Glasgow

- Glasgow is using Internet protocols to organise information for its travel information Internet site, and the ALERT set of protocols for RDS-TMC services.

Hampshire

- TCP/IP is widely used as the standard method of transferring files and data on local area networks, between control centres and the Internet.
- ROMANSE is currently trialling the use of NTCIP class E profile, with DATEX-ASN for centre-to-centre communications.
- ALERT-C protocol was used by ROMANSE in the DRIVE II project SCOPE for a RDS/TMC trial in Southampton. Messages were encoded into the Automobile Association's BIGTIME System which in turn generated messages in the required ALERT-C format.

– Trials of public transport information via WAP will be conducted in the INFOVILLE (Digital Sites) project.

Munich

– Digital Audio broadcasting (DAB) is being developed as a fast data channel which can be used to transmit travel and traffic information to vehicles equipped with a suitable receiver. DAB uses the technical organisation developed RDS-TMS services but DAB transmissions have 1000 times the data carrying capacity of RDS-TMC. This will allow multimedia applications (sound, text and graphics). In particular, the method of network referencing for RDS-TMC is too simplistic for urban networks and DAB can provide a solution. The travel information content of DAB services will be developed through links to MOBINET (**Fact Sheet M5)**.

Paris

– Web-based applications such as Cité Futée, SYTADIN make full us of all Internet standards.
– The Visionaute system (mobile graphical display) combines numeric mapping with real-time data transmission of traffic conditions via RDS-TMC and makes use of the ALERT-C and ALERT+ protocols.
– The Webraska company recently opened new services providing traffic information via WAP Traffic Maps in Paris via GSM. According to the web site (www.webraska.com) the services also include optimum route and journey-time based on current traffic conditions. A reference is also made to a call centre providing information to all subscribers. New developments centre on information to the users on parking availability at their destination.
– The protocols used by the city of Paris for data exchange evolved progressively from FTP and TCP/IP to SEDT (Standardised Traffic Data Exchange system) which is more reliable and adapted to traffic. SEDT is actually based on IP and uses API (Applications Programming Interfaces).
– New projects (e.g. TRIDENT) in France are currently tackling the extensions of DATEX to multimodal transport: RATP is one of the partners interested in the topic: work will namely focus on the localisation of PT nodes and the extensions of data dictionaries to PT incidents.

Trondheim

– The company supplying toll tags is taking part in trials aiming at interoperable fee collection systems for Europe and is represented in the development of European standards in this field.
– The electronic tags used in the Trondheim are also being used in other European cities, such as the Barcelona access control system, and in Dublin.

5.5. Navigation and positioning

Many transport telematics applications require information about vehicle location, for example, drivers want to know where they are in order to navigate or obtain location relevant information and bus companies need to track vehicles for fleet management purposes and to provide real-time information to users waiting at bus-stops.

Digital maps are needed by all modes as they allow automatic location referencing and have opened up opportunities for a variety of transport telematics applications such as in-car navigation, route guidance and information systems. The Geographic Data Format (GDF) has been agreed as the international standard for exchanging digital map data.

Implied by digital maps is the need for an unambiguous **location referencing system**, which enables the transfer of location-referenced information between different kinds of databases and spatial data handling systems so that transport telematics services will work seamlessly across administrative or functional boundaries. Thus location referencing rules are being developed for RDS-TMC to ensure that problems can be accurately located for drivers.

The **Global Positioning System (GPS)**, originally developed for military applications, is a well known navigation technology. The main applications in transport are for tracking and tracing vehicles for operational control purposes, for dynamic route guidance, and for response to emergency situations. Data from successive readings can be used to compute speed and direction of travel. Location accuracy of the normal system is typically less than 100 meters but with corrective software **Differential GPS** allows accuracy of less than 10 meters. Differential techniques provide a fixed receiver, and hence a reference point in the infrastructure, which can then be used to improve the accuracy for mobile GPS receivers. Two vital parameters for safety critical operations such as 'search and rescue services' are signal availability and integrity. The European Union is building its own satellite navigation service that will be fully owned and operated by civilians. The second generation system called GALILEO will offer land mobile, air waterborne and many other user communities a position reading of within a few metres, In addition, a guarantee of continuity of transmission of the signal will provide a fully reliable system, which GPS does not.

CARISMA-Telematics REFERENCES
Fact Sheet P1 Ile-de-France / Paris City Profile
Fact Sheet P4 Public Transport Information and Services
Fact Sheet TU1 Turin City Profile

Navigation and positioning technologies	**Barcelona**	**Glasgow**	**Hampshire**	**Paris**	**Munich**	**Trondheim**	**Turin**
Digital Map databases	++	++	++	++	++		
RDS-TMC Location Referencing		++	+	++	++		
Satellite navigation (GPS/DGPS)		++	+	++	+		

Table 3.5 Navigation and positioning technologies in use or planned.

Hampshire

– ROMANSE uses a comprehensive geographic information system for the integration of spatially referenced data and real-time information.
– 300 RDS-TMC location codes were used in Southampton for an urban trial of RDS-TMC (see above section).
– DGPS is likely to be used for the future expansion of bus automatic vehicle location systems in Hampshire.

Paris

– ALTAIR - The vehicle location principle is based on the GPS system linked to dead reckoning calculated through vehicle gyroscope, and odometer data. This system determines bus location to the nearest 10 metres. The bus then transmits its position to the RATP central data positioning centre through a radio link. radio communications network specialised in data transmission.
– The Visionaute system (mobile graphical display) combines numeric mapping with real-time data transmission of traffic conditions via RDS-TMC.
– Digital maps are used across modes in order to clearly localise the fleets of vehicles (public transport and taxis), traffic conditions, and for navigation purposes (Visionaute).

5.6. Wireless communications technologies

The rapid take-up across Europe of GSM digital mobile telephones, which provide voice, a mobile Internet connection, and the Short Message Service (SMS), provides a very accessible carrier for telematics-based information services. Full-scale RDS-TMC (Radio Data System Traffic Message Channel) traffic information services are also getting started in France, Germany, Spain and the UK, covering arterial roads.

CARISMA-Telematics REFERENCES
Fact Sheet M2 Multimedia Traffic Information - Bayerninfo
Fact Sheet M5 DAB-based services in Bavaria
Fact Sheet P3 Commercial Traffic Information Services

Wireless communication technologies	**Barcelona**	**Glasgow**	**Hampshire**	**Paris**	**Munich**	**Trondheim**	**Turin**
Digital Audio Broadcasting (DAB)			-		+		
Radio Data System Traffic Message Channel (RDS-TMC)		++	+	++	+		
GSM voice and SMS			+	++			
GSM Packet data services							
Dedicated Short-Range Communications (DSRC)				++	+	++	
Radio Paging		++	++	++			-

Table 3.6 Wireless communication technologies in use or planned for transport telematics applications.

The CARISMA-Telematics cites are recognising the need to collaborate with private sector service providers and broadcasters which are using both GSM and/or RDS-TMC transmission systems. Paris and Munich both provide well-developed examples. In Munich Digital Audio Broadcasting, which has a much greater capacity than RDS-TMC is also being trialled. DSRC (Dedicated Short-Range Communications) applications are in use for electronic tolling in Trondheim.

Applications using the GSM short message service (SMS) radio paging and low power radio transmission are also present in CARISMA-Telematics. Pagers are being tried in Paris for delivery of personalised information on public transport. Both paging and low power radio beacons are used by the private sector company, Trafficmaster, in the UK for their commercial traffic information services including Glasgow and Hampshire.

Hampshire

- RDS/TMC (see information about trial in previous sections)
- GSM/SMS considered as part of INFOVILLE Project (see section on WAP)
- Radio paging is used to transmit bus arrival information to on-street displays, and to both fixed and mobile variable message signs.

Paris

- Fixed network communications: ISDN and other high-capacity fixed networks are to be found in use for the transmission of CCTV images, for some data exchange between control centres and for internet access.
- RDS-TMC (see information about Mediamobile in previous sections).
- DSRC standards are used for electronic tolling on the A14 motorway in the Ile de France region.
- The GSM based Webraska service competes with other services offered by different providers such as France Telecom which include a synthetic information within their general service.
- Pagers have been developed in the region (Infobus system) like in other French areas, but have failed to attract a substantial portion of the clientele. This service is likely to be discontinued.

Trondheim

- The Trondheim tolling system was one of the first in Europe to use short range communication between a tag in the vehicle and a roadside reader as a method of charging against a registered account. The system uses a communication frequency of 856 MHz.
- Trondheim is investigating a new system using 5.8 GHz technology, and based around CEN DSRC standards, is to be procured as part of a Norwegian national strategy to create an interoperable system for all toll locations within the country.
- Toll stations are connected to the toll company’s control centre using ISDN lines and a dial-up connection. ISDN integrates the various services (telecommunication, text, data, video and alarms) for transmission of the transaction data (tag identity, time, place) and digital pictures of violators’ number plates.

5.7. Control centres

Travel and Traffic Information and/or Control Centres form the core of the urban traffic management in many city/regions and are based on the integration of data from different sources by a central processor or network. Typically, data is collected from a variety of sources such as traffic loops, weather and pollution monitors, public transport control systems, static route and timetable systems, incident detection systems, and other available sources. The processed data is disseminated to the appropriate receiving systems such as traffic control systems, VMS units, travel information centres, incident management systems, bus priority systems, in-home or third party terminals, RDS-TMC systems and route guidance systems.

Mobility management centres aim to provide multimodal information about roads as well as public transport opportunities, and increasingly they must communicate with neighbouring centres which may be across national boundaries. The messages and protocols for communication are defined by DATEX, and the framework for operations is provided by the Systems Architecture work.

CARISMA-Telematics REFERENCES
Fact Sheet B5 Network Control and Traffic Information
Fact Sheet G3 National Driver Information and Control System – NADICS
Fact Sheet M2 Multimedia Traffic Information - Bayerninfo
Fact Sheet M3 MOBINET – Mobility in the Munich Metropolitan Area
Fact Sheet P5 Motorway Information and Management – SIRIUS
Fact Sheet S1 Southampton/ Hampshire City Profile
Fact Sheet S4 Traffic and Travel Information
Fact Sheet TU2 The Integrated telematics Infrastructure of the 5T Project

Control centre function	**Barcelona**	**Glasgow**	**Hampshire**	**Paris**	**Munich**	**Trondheim**	**Turin**
Traffic Control Centre	++	++	++	++	++		++
Traffic/Travel information Centre		++	++	++	++		
Mobility Management Centres			++				

Table 3.7 Control centres in use or planned.

Barcelona

- Traffic control centres in Barcelona include the Urban TCC managing the urban network, the Ronda TCC operated by the city on the network it is responsible for, the TCC operated by the DGT (Dirección General de Tráfico) on the rest of the peripheral network, the Badals Tunnel control Centre.

Glasgow

- SCOTIA Functional specification for Traffic Information Centres (TICs) (**Fact Sheet G5)**
- Platforms for frequently updated and real-time information delivery.

Hampshire

- ROMANSE established one of the first fully integrated, multi-modal traffic and travel information centres in the United Kingdom in 1993/94. Whilst the centre both controls traffic and manages the transport network it also collects, collates and disseminates traffic and travel information providing travellers with accurate and timely information for them to make informed decisions about their travel.
- Hampshire County Council is part of a consortium involved in setting up a call centre as part of the United Kingdom's Central Government PT12000 initiative to establish a national bus enquiry line.

Paris

- Traffic control centres in the Paris area include the 4 TCC part of the SIRIUS system, the Lutèce and IPER TCC monitoring traffic conditions on the urban network and the Boulevard Périphérique. Other road information and coordination centres focus on the provision of information to users on a wider scale and are vested with the role of coordination in serious problems: the CRICR (regionally) and CNIR (nationally).
- Several attempts have been aimed at creating call centres, but to date no existing centre is operational.

5.8. User Interfaces

An essential part of the telematics infrastructure is the Human Machine Interface, through user terminals and electronic displays. The CARISMA-Telematics cities show the full range of possibilities, serving a wide spectrum of telematics services.

In-vehicle systems are now in common use for route guidance and navigation, real-time traffic information, electronic payment, and for real-time passenger information on buses. Personal digital assistants and other hand-held devices are still at the demonstration phase, most notably through the PROMISE project, where Glasgow is represented.

Examples of information screens for kiosks, Internet and other computer-based services will soon be widespread, though there is little attempt at standardisation yet. Work has been done (INFOPOLIS I and II projects) and a committee is working on standardisation of public transport information interactive kiosks and at stop dynamic information at the European level (CEN TC 278 WG3). The operator interfaces at Traffic Control Centres and Travel Information Centres are also designed largely on an ad hoc basis.

Electronic variable message signs (EMS) showing text messages are in widespread use for highway traffic management, information displays at bus stops, etc. The use of EMS pictograms is not so common and there is therefore an opportunity to establish European standards, so that the signs can display a common set of graphics.

The CARISMA-Telematics Fact Sheets cover the full range of the interfaces mentioned above, particularly the use of VMS in various forms. In addition voice recognition and speech synthesis are being trialled for users of public transport in Paris (multi-media kiosks Fact Sheet P4) and Southampton (Talking Stopwatch Fact Sheet S3).

CARISMA-Telematics REFERENCES

Fact Sheet B3	Management of Road Space
Fact Sheet B4	Parking Management
Fact Sheet B5	Network Control and Traffic Information
Fact Sheet G3	National Driver Information and Control System – NADICS
Fact Sheet G4	Maryhill Road Route Action Plan - BUSTIME
Fact Sheet M2	Multimedia Traffic Information - Bayerninfo
Fact Sheet M3	MOBINET – Mobility in the Munich Metropolitan Area
Fact Sheet M5	DAB-based services in Bavaria
Fact Sheet P3	Commercial Traffic Information Services
Fact Sheet P4	Public Transport Information and Services
Fact Sheet P6	Advanced Urban Traffic Control – SURF 2000
Fact Sheet S1	Southampton/ Hampshire City Profile
Fact Sheet S2	Romanse Project/Network Management
Fact Sheet S3	STOPWATCH (passenger transport information system)
Fact Sheet S4	Traffic and Travel Information
Fact Sheet TR2	Trondheim Toll Ring: Planning Installation and Operation
Fact Sheet TU3	The Town Supervision Concept with the 5T System

User Interface	Barcelona	Glasgow	Hampshire	Paris	Munich	Trondheim	Turin
Electronic display boards	++	++	++	++	++		++
Variable Message Signs	++	++	++	++	++		++
User terminals, web sites and kiosks	++	++	++	++	++		++
In-car units (private operators)		++	++	++	++		

Table 3.8 User interfaces in use or planned for transport telematics applications.

Barcelona

- VMS on the motorway network are used to provide information on speeds, congestion, accidents, etc.
- Information kiosks were installed in metro stations for trip planning, as well as in some parking facilities to enable users to buy their combined parking-PT ticket.
- Web sites provide information on public transport, parking and traffic conditions.

Hampshire

- ROMANSE uses electronic displays for bus arrival times, bus departure information and on street traffic and travel information.
- Variable message signs for car parking information, traffic information to drivers in urban area, traffic information to drivers on motorways and mobile trailer mounted signs.
- Trip planning kiosks.
- ROMANSE web-site www.romanse.org.uk
  - traffic and travel information
  - real time parking, travel news, congestion reports and trip planning by public transport

Paris

- VMS on the motorway network (SIER and Ville de Paris) provide information on travel times, congestion, accidents and forthcoming events.
- Electronic displays can be found in the city for general information, bus arrival times, bus departure information.
- Web-sites comprise SYTADIN, Cité Futée, the RATP and SNCF web-sites.

5.9. Other key technologies and techniques

Certain technologies are central to the effective deployment of transport telematics services – so called enabling technologies. Ideally deployment of transport telematics applications should focus on those enabling technologies which collectively will deliver the best package of applications for the stakeholders.

Automatic enforcement techniques such as video enforcement are becoming an essential component of automatic control and detection transport telematics systems. Without proper enforcement users will violate these systems which will subsequently fall in to disrepute. Digital enforcement images of violations are nearing acceptance in court, and new systems have been developed to enforce not only speeding and red-light offences, but also toll evasion and bus lane misuse and thus support multimodal transport policies in urban settings. The La Ribera access control scheme in Barcelona uses self-enforcing retractable bollards to provide a physical deterrent against infringements.

5.9.1 Electronic payment

Electronic payment services can link all modes of transportation under one simple, convenient payment system (intermodality). This new system – extensively showcased in Paris, but also being developed for Trondheim – will help reduce delays in fee collection and provide accurate data for systems management. It will go beyond the application in the transport sector.

Integrated payment and toll collection systems are crucial for encouraging intermodality and a modal shift to public transport. Fully integrated payment systems and services include the cooperation of different public transport users assuring a multimodal approach to the seamless door-to-door journey. Concepts like the electronic **purse concept** have also engaged the banking sector which has advantages for both the transport and banking sectors. All systems are based on **smart cards** – the contactless version has the preference for its ease of use, especially for public transport.

CARISMA-Telematics REFERENCES
Fact Sheet B2 Smart Card Access Control
Fact Sheet P2 Electronic Ticketing
Fact Sheet TR2 Trondheim Toll Ring: Planning Installation and Operation
Fact Sheet TR4 Trondheim Integrated Electronic Payment and Ticketing Systems

Telematics technology	**Barcelona**	**Glasgow**	**Hampshire**	**Paris**	**Munich**	**Trondheim**	**Turin**
Contactless Smart cards			-	++			
Contact Smart cards			-	++	+	++	
Video Enforcement	++	+	-			++	
"Remote presence"	++						

Table 3.9 Other technologies in use or planned for transport telematics applications.

Glasgow

- Bus Lane Enforcement, both fixed and mobile, will be established at various strategic points within the network.

Paris

- The FRANCILE system for buses and metro uses a re-loadable smart card that can comprise a travel pass or cash. The card is pre-paid and can be reloaded at vending points located at bus and metro stations. The card communicates with the on-vehicle ticket machine or the ticket gate without requiring contact, making it very convenient to use. Key objectives are to make public transport easier by increasing the transaction speed, especially in the buses; providing a common tool for every passenger on all transit modes; and requiring only one hand for validation.
- Electronic tolling is also being developed in the Paris region as well as in the whole of France. A multi-company project is scheduled to be deployed in the year 2000 throughout the country by the toll motorway companies.

Trondheim

- Non-stop automatic tolling systems are an established feature in Trondheim, and were the principal reason for including that city in CARISMA-Telematics. These systems – based on the use of smart cards and an on-board unit managing the short-range communication link – can also be used for on-street and off-street parking payment and urban road pricing and congestion charging schemes. As such they represent a promising new approach to demand management for congested roads (**Fact Sheet TR3)**.
- In developments planned for 2001, the national AutoPASS specification for Norway will cover not only the roadside to vehicle link but also the total system architecture, including the roadside to central system links, the links between road operators, tag issuers and other bodies, the security system, and the possibility of a common subscription base for the whole of Norway.

6. Institutional and legal issues

Deployment of transport telematics in cities and regions is not simply a question of securing the most appropriate technology. There are also institutional and supporting issues to be considered. In this Part innovative approaches to overcoming the legal and institutional obstacles to deployment of transport telematics are reported under four headings: strategic planning, institutional and organisational innovation, legal and procedural innovation and innovative finance. This Part draws on workshop results as well as the city case studies.

6.1. Strategic planning

For strategic planning it is essential that the policy goals and objectives should be defined first of all and the role of transport telematics developed in relation to those goals. The consideration of transport telematics needs to be integrated into the city planning process, acknowledged as delivering benefits in relation to specific policy objectives. There are clearly two ways to establish strategic planning: either create a specific plan for ITS (Intelligent Transport Systems: e.g. Glasgow), or try and insert ITS solutions in existing planning methods showing the benefits of telematics and its contribution to the policy objectives (more the current French trend).

In order to achieve benefits of synergy and integration some reorganisation in the transport management functions may be needed to exploit the opportunities. Achieving this re-orientation involves a transition from Research and Technological Development (RTD) Consortium to an operationally oriented organisation. The Advice and Guidance Note “Planning for Deployment of ITS” goes into details on this topic (**Fact Sheet AG1).**

CARISMA-Telematics REFERENCES

Fact Sheet AG1	Planning ITS deployment
Fact Sheet G1	Glasgow City Profile
Fact Sheet M1	Munich City Profile
Fact Sheet M3	MOBINET – Mobility in the Munich Metropolitan Area
Fact Sheet P1	Ile-de-France / Paris City Profile
Fact Sheet S1	Southampton/ Hampshire City Profile
Fact Sheet TR2	Trondheim Toll Ring: Planning Installation and Operation
Fact Sheet TU2	The Integrated telematics Infrastructure of the 5T Project

Glasgow

Glasgow has recently developed an ITS strategy, which is a fundamental part of the city’s transport policy. The strategy provides a blueprint for the development, deployment and operation of ITS. It has three dimensions.

- It indicates the policies that can be expected to be supported by ITS;
- It indicates the organisational and institutional arrangements that need to be adopted for procuring and managing ITS, and;
- It identifies the technical requirements for individual systems and sub-systems.

The strategy involves a number of agencies investing and operating within a geographic area and provides a basis for planning the deployment in an integrated way.

Recognition of the need to integrate systems in Glasgow came about through two factors: the growing importance of managing the road network in a pro-active way, and the need to find ways of increasing the capacity of the road network.

Trondheim

In the planning stages, obtaining public acceptance of the toll ring involved a major effort on the part of the County Roads Administration, involving consultation, information, and incentives in the form of discounts for use of electronic tags.

Barcelona

The major innovative projects were funded in the framework of the PICASSO projects, a 4 year budgetary program voted by the city, specifically dedicated to the use of new technologies. The PICASSO programme received approximately 600 million Pesetas (4 M€). The need for a specific ITS strategic plan has not been identified.

Paris

In France, the 1996 law on air quality requires major cities to design urban mobility master plans (in French: Plan de Déplacements Urbains PDU). These set out the general principles governing travel within the urban transport perimeter as applied to the different modes of transport (including pedestrian), the management policies for road and rail networks, and public transport, and the development plans for these systems.

The trend in Paris and in France in general hasn't been to develop specific strategic plans for ITS, but to try and find where ITS can offer concrete solutions to a set of policy objectives.

6.2. Organisational innovation

Setting up a new body to run telematics services, often with the private sector involved, can sometimes be easier than achieving inter-agency cooperation since the institutional engineering involved in securing inter-agency agreements is time consuming. This has to be decided on a case by case basis. A generic Advice and Guidance Note has been prepared in relation to Private sector travel information services (**Fact Sheet AG4**).

Defining what is public sector responsibility and what is commercial is central. The public sector role is perhaps the easiest to define - namely safety and traffic management. For example the roads authorities are charged with providing the necessary roads infrastructure. Similarly with collective transport, the requirement for passenger safety is a public obligation which all operators – public and private – must honour. Other policy objectives also come into play in determining what is commercial and what is a public sector requirement.

There has been a tendency for both the public and private sectors to become involved in a waiting game where one waits for the other to move and vice versa. Public agencies need to define what they wish to do on their own account and what they are prepared to delegate to the private sector for commercial opportunities.

One area which has proved difficult in practice has been to achieve an understanding of how to move risk around in a project between the different partners. This in turn is linked to the degree of control that the individual partners play. Therefore it is necessary to link risk to the level of responsibility. Complications arise for private companies when the public sector wants to retain control. If the private sector is asked to finance a project this means handing over some level of control to the private sector operator.

Commercial operations necessarily have the customers as their key focus. In general if customers are not prepared to pay then it is questionable whether the service should be provided at all. Therefore the question of what the customers want has to drive ITS otherwise the initiatives will not succeed. Fundamental questions are: What is my investment? What is my return? What is my risk? The project will not happen if it is not commercially viable.

CARISMA-Telematics REFERENCES

Fact Sheet AG4	Private Sector Travel Information Services
Fact Sheet G1	Glasgow City Profile
Fact Sheet G5	Scottish Travel Information Association – SCOTIA
Fact Sheet M2	Multimedia Traffic Information - Bayerninfo
Fact Sheet M3	MOBINET – Mobility in the Munich Metropolitan Area
Fact Sheet P2	Electronic Ticketing
Fact Sheet P3	Commercial Traffic Information Services
Fact Sheet TR2	Trondheim Toll Ring: Planning Installation and Operation
Fact Sheet TU1	Turin City Profile
Fact Sheet TU2	The Integrated telematics Infrastructure of the 5T Project

Glasgow

- The objectives of the Traffic Controller (Scotland) are to determine accurate and timely driver information; make effective use of existing road capacity; contribute to the safe and efficient operation of the road network; monitor traffic operations on trunk roads; and to respond to incidents and traffic alerts. The responsibilities relate to 1500 km of the trunk road network across Scotland.
- Scottish Office was instrumental in encouraging the formation of the SCOTIA public/private partnership to evaluate the potential use of road transport telematics by the commercial sector.
- Glasgow was one of six European wide test sites within the PROMISE project, led by British Telecom, which sought to establish the market potential for the provision of transport information via personal digital assistants (PDAs). The project partners included some of Europe's leading companies in telecommunications, car manufacturing and digital map technologies.

Munich

- The Munich Co-operative Transport Management concept (COMFORT) has been developed for the Munich Greater Area to contribute to the solution of transport problems. Early on it was realised that any effective measures could only be undertaken by a joint effort on the part of those responsible for transport. This led very early on to close cooperation between all the project partners focussing on:
  - the regional cooperation of decision makers across administrative and geographical border lines of cities, villages, counties and states;
  - the integration of transport systems, i.e. cooperation of infrastructure owners for road transport and public transport systems;
  - public and private partnership models to develop new concepts for transport management and financing.
- This approach required an analysis of the institutions' respective responsibilities and institutional innovation to establish these cooperations. A major achievement was a contract between the State of Bavaria, the City of Munich, the Public Transport Authority and the industrial partners of the project to test and implement the transport telematics applications (**Fact Sheet M1**).

Paris

- The structure selected for the smart card electronic ticketing project is interesting. A steering committee steered by STP ensured that common harmonised specifications were put forth by the different operators. (**Fact Sheet P2**).

Trondheim

- The Trøndelag Toll Road Company is responsible for operating the tolling system, on the toll ring and the E6 motorway. It is a joint venture between the city and county authorities, and is a public-private partnership, with 60 per cent of the equity held by the public sector. It is non-profit making, with all revenues being passed to the local authority to provide part of the funding for transport infrastructure and other related investments.(**Fact Sheet TR2**).
- Trøndelag Toll Road Company, was established as a joint venture between the municipality and the county, managed by the private sector. The company provides the finance, administers the toll ring system, and developed the data system.
- The Public Roads Administration is responsible for management and maintenance of the electronic equipment at the toll stations, and this is coordinated with the management of other electronic equipment in the road system, providing cost-effective use of staff and equipment.

Paris

- The key to the success of commercial services in the Ile-de-France Region has been the establishment of a “wholesale server” of traffic information. Essentially this concept provides a comprehensive, seamless compendium of urban, regional and inter-city traffic data available from one source as far as the service provider is concerned (**Fact Sheet P3**).
- The emergence of Mediamobile required the State and City authorities to organise themselves as harmonised data providers and to adopt a common policy for the commercialisation of public data. In return for supplying public data, public authorities receive data free of charge from the service providers, for example from taxis, so as to better exert their responsibilities for traffic management.
- The *Skipper* service first using entirely private data, extended its coverage to public data concerning the Parisian motorways managed by SIER, and signed the same type of contract as Mediamobile.

Turin

- The way forward in Turin will most likely involve setting up a new public sector company, which will publish a call for tenders for new partnerships and shareholdings in the combined operation. The public transport operation and the energy company are likely to be the majority shareholders in this new public company and the initial set of services will be to outsource fleet management (public transport, fleet logistics and AVL), traffic light control and environmental monitoring. (**Fact Sheet TU2**).

6.3. Legal and procedural innovation

Organisational arrangements often need to be supported by new administrative procedures, laws and regulations. The following are examples from the CARISMA-Telematics cities.

CARISMA-Telematics REFERENCES

Fact Sheet G2	Centrally Integrated Traffic Control - CITRAC
Fact Sheet M1	Munich City Profile
Fact Sheet M4	Integrated Traffic Management
Fact Sheet P3	Commercial Traffic Information Services
Fact Sheet TR2	Trondheim Toll Ring: Planning Installation and Operation
Fact Sheet TU2	The Integrated telematics Infrastructure of the 5T Project

Glasgow

- In terms of public procurement the use of a design and build type contract for the modernisation of the CITRAC Traffic control system **(Fact Sheet G2),** placed with the company SERCO Systems was highly innovative.

Paris

- For road information previously no legislation or regulation existed so the information chain concept was developed to define the roles of all the actors involved in the production and broadcasting processes. Authorities in the Ile de France Region now collaborate as an “Agence de presse” which acts as a wholesaler of traffic information to commercial service providers. **(Fact Sheet P3)**.
- Model contracts cover various aspects of data handling including: control and liability, procedures for forwarding information and data exchange protocols. Contracts must also be set up between each service operator and public authority to determine the terms and conditions of the supply of road traffic information. At the dissemination stage, broadcasters are required to make contracts with the original supplier(s) of information and the public authority.
- In parallel, two committees have been set up for the Greater Paris area: the Public Authorities Coordination Committee (CCCP) and the Consultative Committee on Road Information Broadcasting (CCDIR) for the service providers. The CCCP’s role is to harmonise the work of all the parties, to ensure the users services get established and to supervise their impact on road safety and traffic.
- The type of procurement used for the extension of the SIRIUS system “on performance” remains unusual: performance levels are indicated to the selected vendors who have to demonstrate they can reach the given performance. The best solution (other criteria are also taken into account) is then selected and the contract is awarded.

Trondheim

- The toll company is a non-profit making public-private partnership. The public sector share of equity in the tolling company amounts to 60 per cent. Revenues are passed to the local authority.
- The concession to operate the tolling system is for a fixed period, and there are separate agreements for the motorway and the toll ring.
- Privacy legislation requires that the toll company cannot store information about where and when individuals enter the toll ring. Unless documentation is requested in advance, time and place data are deleted once a charge has been entered in the subscriber’s account.
- The development of the national standard and the use of the joint procurement exercise for the new electronic fee collection system are likely to yield economic benefits for each of the areas involved, providing savings in procurement, capital and operating costs.

Barcelona

- The projects implemented used traditional procurement procedures but the need was expressed in Barcelona to explore more imaginative financing methods. Other fields can help design new solutions like the example of a recent program for facade restorations: “Barcelona: Por ser guapa[8]” that proved to be successful in its use of scaffoldings to display publicity and finance some of the expenses.

6.4. Innovative finance

One of the major deployment challenges for cities and regions is to secure the necessary funding. Whilst funding can be obtained from central government, local government and developers contributions it is unlikely that these will meet the demand that is necessary. It will be necessary therefore to seek alternative funding mechanisms to fund the infrastructure that will be required. As the deployment of ITS is extended there will be an increasing number of players that will become involved and there are potential deployment problems if the institutional barriers cannot be overcome. Working together with other organisations and stakeholders to achieve a common goal will be crucial to the success of ITS.

Authorities need to understand the possible funding mechanisms for Transport Telematics to put alongside the organisational models that are being developed. In the road transport sector there needs to be a reallocation of funds from provision of physical (highway) infrastructure to telematics infrastructure. This means that politicians must be convinced of the benefits of transport telematics to understand why the budgets have to be adapted.

Authorities also need to explore innovative ways to harness private capital to secure the infrastructure and finance for new services, as we have seen above. When considering the type of private investment in transport telematics there are three stages.

- The first begins with public investment in data collection systems which increasingly is also done by contracting in the private sector and semi-private investment (e.g. GERMANY). These can be managed by a private commercial company operating under contract.
- A second stage is the public/private partnership which will be different in each case according to local circumstances, but will commonly include a contract between the companies and the authorities which the industry guarantees to achieve.
- A third stage is to develop commercial market-driven services and here a strong business case is needed to justify initial investment and to develop a durable and clear partnership between the key players.

Private finance comes in at stage three of this process. Innovative finance and sharing of risk between the public and private sectors can also feature in the first and second stages, for example to cover the costs of setting up the data collection infrastructure (technology e.g. loops, Video observation etc.).

It is a commentary on the Fourth Framework programme that projects are still not addressing the problem of how to finance deployment and the revenue streams. The important issues to be resolved are: Who benefits? Who pays? and where are the revenue streams?

In this area of transport telematics it can be difficult to find the revenue streams to pay back up-front investment. Electronic payment certainly offers greater possibilities for levying a charge on users, but in most countries there is a question whether the public sector is able to keep the revenue stream to pay for its own costs. The example of Trondheim below shows what can be achieved when this is secured. The experience of project finance in the other CARISMA-Telematics cities is also summarised.

CARISMA-Telematics REFERENCES
Fact Sheet TR1 Trondheim City Profile
Fact Sheet TR2 Trondheim Toll Ring: Planning Installation and Operation

[8] Barcelona: to be beautiful

Barcelona

- The access control project demonstrates that authorities should not expect authorised users to purchase or rent the identification equipment. But whether it is the user or the authority that has to take on this cost, a low-cost card system is preferable.
- Funding for innovative projects was secured through the PICASSO 4-year budgetary program voted by the city, specifically dedicated to the use of new technologies. The PICASSO programme received approximately 600 million Pesetas (4 M€). In the future, a new program should be approved for the next 4-year period.

Glasgow

- In Glasgow the Scottish Office (now Scottish Executive) has provided the majority of the funding for the modernisation of the CITRAC system, including the equipping of the National Network Control Centre which opened in June 1996 and the establishment of a national network controller to work with the local police forces in achieving effective traffic control on the motorways.

Paris

- As far as the funding of the "wholesale server" is concerned, the intention is to recover the set up and running costs of the operation at least in the longer term. The tariff for obtaining information from the "wholesale server" is based on the reimbursement of operational costs and the amortisation of the "wholesale servers" (**Fact Sheet P3**). The implementation of invoicing will be progressive, as public authorities are keen to ensure that the cost of public data provided by public authorities does not hinder the creation of these services.
- The SIRIUS project, like many major transport-related projects involving different financing sources, found its way in the discussions with the Ile-de-France Region for the State-Region investment plans that determine the major investment funding over a five-year period. Both the extension of SIRIUS and the deployment of ramp metering will be funded through this investment plan.
- A new way of sharing some of ITS costs in France is to sign agreements with Telecommunications operators interested in using existing infrastructure. A law on the deregulation of telecommunications sets the financial levels that must be followed. The law makes it difficult for authorities to prohibit the use of their infrastructure, but given its cost, both parties usually find common interests and benefits to co-operating.

Trondheim

- Trondheim provides a successful model for financing a transport investment package as well as creating and operating the tolled road infrastructure. The Trøndelag Toll Road Company arranged finance through agreements with the banks and finance companies, they managed the construction and they then handed over the new facilities for maintenance by the public road authority. After paying off the interest and capital costs any surplus will be paid back to the road authority.
- The Trondheim Package was conceived as a phased investment programme over a 15 year period, with 60 per cent of the funds coming from tolling revenues and 40 per cent of funding from central government.
- The scheme generates NOK 80 million each year for investment in transport infrastructure. Benefits outweigh the costs by several million NOK each year.
- The original reason for raising revenue was to fund the building of an eastern by-pass and other road improvements to expand the capacity of the road network. The improvements were designed to address the traffic problems associated with heavy flows of traffic through the city centre, which resulted in high accident levels and traffic noise and pollution.
- The speed with which these improvements have been introduced, and their success in improving traffic conditions in the city have been a key feature in gaining public acceptance of the toll ring.
- Although most of the revenue was to be spent on the road network and the eastern by-pass was completed, there was provision to spend 18 per cent of the toll revenues on public transport, environmental and safety measures.
- Revenue projections show that the capital costs will have been repaid by 2005.

Turin

- The 5T telematics application reflects the partnership between the public sector (68%) and specialised private companies. The Consortium has seven partners – the biggest player is ATM, the Public Transport Company, with an overall participation of 66.6%. The remaining third of the Consortium is shared among Italtel (8.2%), Tecnost (7.4%), Fiat (6.9%), Solari (6.8%), Mizar (2.6%) and AEM, the Turin Energy Company (1.5%).
- Having set up the integrated network a business case for a coordination agency will be developed for continuing the ongoing coordination and maintenance of the 5T network. For such an autonomous business unit there is the need to develop revenue streams based on agreements to provide other agencies with outsourcing of telematics systems.

7. Urban and regional issues

This Part considers some of the strategies which, in the experience of the CARISMA-Telematics cities, have been valuable in achieving successful deployment of transport telematics as an integral part of the ongoing city/region programme. Deployment strategies need to take account the political context and the importance of demonstrating to local politicians and to the public at large the clear benefits that can be derived from investing in telematics. There is a need for greater public awareness of these benefits in order to secure support for any public investment. There is also value in achieving a partnership approach between the main actors in telematics deployment.

7.1. Securing political support

Support for transport telematics objectives is necessary at the highest local government level in order to achieve successful deployment. Without the support of the town/city mayor/representative, many projects would fail to gain the necessary resources both in financial and staff terms, to complete their work. Whilst the private sector will invest in new systems given a sufficiently strong business case, when the return on investment is not so positive, political support is needed. Furthermore public acceptance of transport telematics applications is essential for success and without political backing for a given scheme, the general public is also unlikely to be convinced.

The frequent changes in local government officials means that these situations will remain an ongoing institutional and political challenge for future projects.

CARISMA-Telematics REFERENCES

Fact Sheet AG1	Planning ITS deployment
Fact Sheet B1	Barcelona City Profile
Fact Sheet G1	Glasgow City Profile
Fact Sheet M1	Munich City Profile
Fact Sheet P1	Ile-de-France/Paris City Profile
Fact Sheet S1	Southampton/Hampshire City Profile
Fact Sheet TR1	Trondheim City Profile
Fact Sheet TR2	Trondheim Toll Ring: Planning Installation and Operation
Fact Sheet TU1	Turin City Profile

Glasgow

Politicians have been involved from the start and consider the systems as their own. Political commitment for the ambitious programme in Glasgow has been a very noticeable feature. Partly this is due to continuity and political control of the city but professional interest in the development of telematics also has played a part. Scotland generally has tried to look forward on ITS. This is shown in the activities of SCOTIA (**Fact Sheet G5**), in the proactive involvement of the city, the Strathclyde Passenger Transport and the Automobile Association, with others, in European projects, and a willingness to upgrade and build on existing legacy systems which have a long history. A close working between the different agencies was clearly an advantage.

There is political interest in developing concepts of sustainable transport through an alliance with commercial interests. Telematics has a part to play in this but is largely seen by the politicians as being invisible. Nevertheless, those projects which are visible, namely variable message signs on the motorways and the bus time project, have attracted a high degree of public acceptance.

Demonstration projects can raise awareness and an important policy goal is to show that the private car and public transport systems can work together in providing travellers with seamless journeys. High quality information has an important part to play. ITS and telematics is regarded as a tool for delivering these policies.

Trondheim

The Trondheim toll ring has been carried through by a combination of leadership from the main local politicians, working with officials and the Norwegian Public Roads Administration. The organisational structures have remained constant and have supported the scheme, while the people involved, particularly the politicians, have often changed.

Political commitment for the Trondheim scheme was gained by ensuring that it provided a range of benefits, and could thus be viewed positively by those with different political perspectives. A public forum was set up as a platform for debate and consultation, rather than for decision making. The Mayor of Trondheim gave it political support. A political decision will need to be made as to whether to continue the toll ring after its original planned end date of 2005. Both main political parties state that they will end the scheme then.

Paris

The major challenge that threatened the deployment of **electronic ticketing** was the commitment of all the stakeholders to a single project, enabling a single technology to be used on different networks, in order to make public transport easier and improve the overall service to the user. On these grounds there was a strong need for cooperation, and a strong leader was needed in order to bring together all the actors. STP played this role in Paris, financing and piloting the FRANCILE experiment and all of the key players were involved in the management authority.

The SIRIUS project came about owing to strong support from the Ministry of Transport, which actively promoted the idea of managing the heavily congested highway network in the Ile-de-France region. The SIRIUS project found its way in the discussions with the Ile-de-France Region for the State-Region investment plans that determine the major investment funding over a five-year period.

The city of Paris has always been present in the field of ITS: it had to cope with traffic difficulties very early on compared to other French cities. The systems that were developed in the city were strongly promoted by technicians, engineers and specialists, with political involvement coming at a later stage. Finally, Paris as a capital city must demonstrate the French know-how in many fields, and this is probably why there is political support for ITS in the area.

Turin

Political commitment for the development of telematics in Turin is very strong at all institutional levels (the City, the Province and the Region), the City being still the main player on the transport telematics scene and that other administrative services could be involved to a bigger extent. Nonetheless, the long-standing interest and commitment of other actors, namely the Public Transport Company and the private partners involved in the 5T consortium have been able to catalyse efforts around a common project and success.

Barcelona

It must be underlined that political commitment for the development of telematics in Barcelona has always been very strong. The image of the city is traditionally associated with development and new technologies and the city engineers evolve in an atmosphere conducive to innovative initiatives. Barcelona City has a long history of involvement in EU RTD projects. Some pertinent examples of telematics projects are: INTERCEPT, CONCERT, ANTARES and GAUDI.

7.2. Demonstrating benefits

One underlying theme in the CARISMA-Telematics cities is the importance of improving the means of assessing the benefits of telematics applications particularly given that most of the benefits that accrue from ITS remain invisible to the general public. Politicians and finance people need the justification in order to invest time and money into a project. The means of assessing benefits is a key area to drive investment. But often it is difficult to perceive the necessity of telematics-based services. However, some areas of application are a “natural” for ITS for example electronic payment using smart cards. In the longer term, some applications of telematics may well prove to be accepted as a public service in the long run much like street lighting and street cleaning are now.

The opportunities for transport telematics need to be analysed in terms of public services and private goods. In the grey area between the two there is an overlap and it is useful to focus on the public service requirements. Evidence of consistent benefit and utility will be important in achieving this. But additionally, the enhanced technology increases the expectation of customers for a better service. An example is the use of VMS. Over time people will tend to demand higher levels of service from VMS and the authorities will come under increasing pressure to deliver this.

The following are examples of cities and regions working to establish the benefits of telematics.

CARISMA-Telematics REFERENCES
All CARISMA-Telematics Fact Sheets contain a section summarising the project benefits. Quantified results are contained in:

Fact Sheet B2	Smart Card Access Control
Fact Sheet G2	Centrally Integrated Traffic Control - CITRAC
Fact Sheet G3	National Driver Information and Control System – NADICS
Fact Sheet M4	Integrated Traffic Management
Fact Sheet M5	DAB-based services in Bavaria
Fact Sheet P3	Commercial Traffic Information Services
Fact Sheet P5	Motorway Information and Management – SIRIUS
Fact Sheet P6	Advanced Urban Traffic Control – SURF 2000
Fact Sheet TR2	Trondheim Toll Ring: Planning Installation and Operation
Fact Sheet TR4	Trondheim Integrated Electronic Payment and Ticketing Systems
Fact Sheet TU2	The Integrated telematics Infrastructure of the 5T Project
Fact Sheet TU3	The Town Supervision Concept with the 5T System

Barcelona

- The access control system has achieved positive results in terms of traffic reductions and overall public acceptance. The reduction of through traffic in La Ribera has been a stimulus to urban regeneration and has boosted commercial activity.
- About 70% of residents in the La Ribera zone were in favour of measures limiting vehicle access. However, following a very effective information campaign, people had higher expectations of what impacts the system would achieve than occurred in practice.
- Parking space occupancies were reduced inside the zone and increased outside, as was intended. The changes in patterns were more marked for visitors than residents, suggesting that visitors are less likely to violate the system than locals.
- A staged introduction of access control, demonstrating benefits at each stage, is likely to be successful, although the overall effects on traffic reduction and environmental improvement may be small at first. A trade-off exists between the size of the implementation zones and the potential for achieving traffic impacts.

Glasgow

- The benefits of the urban motorway control system in Glasgow have been seen in reduced congestion, reduced journey times, and fewer accidents. Journey times have been reduced for public transport as well as private cars.
- The built in procedures for evaluation in NADICS mean that the overall benefits can be measured and demonstrated, while operational details can be refined to improve performance. The evaluation can therefore support further expansion and development of the system.
- The cost-benefit analysis carried out in the TABASCO project showed savings in time and vehicle operating costs from the automatic ramp metering, with greater savings when dynamic urban traffic control was introduced in addition to the ramp metering.

Munich

- The motorway traffic control system to the north of the city has resulted in a 30% reduction in personal injury accidents.
- The field trials for network control and re-routing in TABASCO showed that drivers responded to the diversion signs and diverted onto the recommended alternative routes at an average rate of 15%. This led to an improvement in road network capacity, and the average traffic flow (vehicle hours per km) on the road network as a whole improved by 7%.

Trondheim

- A key to the success of the Trondheim toll ring has been that users have seen clear benefits, as congestion has disappeared. The main traffic problems have been solved as a direct result of the investments made possible by the toll ring.

Paris

- Before implementing the contactless smartcard in Paris, the partners agreed to carry out an extensive field trial, FRANCILE, which helped identify the best solutions, and measure the expected benefits: alleviating fraud, faster validation, general improvement of PT, seamless multimodal trips.
- Different cost-benefit analyses have been carried out either on the SIRIUS system as a whole (Fribourg, Orselli 1996) or on sub-systems (Ramp metering, SIER 1999) reporting substantial benefits, especially on travel times savings, resulting in interesting cost-benefit ratios.

7.3. Creating public awareness and acceptance

Experience in the CARISMA-Telematics cities suggests that officials have to work hard to publicise the positive benefits of transport telematics projects, given that any efficiency gains achieved are often eroded in the medium term by traffic growth. CARISMA-Telematics cities have worked to ensure that the public are always fully aware of transport telematics strategies and the extent of investment.

CARISMA-Telematics REFERENCES

Fact Sheet B2	Smart Card Access Control
Fact Sheet G1	Glasgow City Profile
Fact Sheet S1	Southampton/ Hampshire City Profile
Fact Sheet TR2	Trondheim Toll Ring: Planning Installation and Operation

Barcelona

- Barcelona has always regarded public awareness of any proposed transport projects as central to the achievement of transport policy goals. This is why the city has put strong emphasis on the communication with the public, to inform on the transport strategies, and involve the public from the onset of the projects that were to be implemented in the city. These new technologies are even less understood when they are used with the goal to manage demand, and create apparent limitations to the citizens' freedom.
- It is only by working with associations, and residents that the access control project and the Balmes multi-use lane became a reality.

Glasgow

- In Glasgow the media know about CITRAC and the new national network control centre provides a backdrop for media pictures with its bank of screens.
- However, media attention concentrates on the occasions when efficient operation of the network breaks down for example if there are long queues to use Kingston bridge, which carries 155,000 vehicles per day.

Glasgow regards it a real challenge to make people aware of the origins of the transport problem and the need to make changes in the way people use the personal freedom given by the car. To a great extent this means making telematics photogenic so that there can be visuals to illustrate media coverage.

Trondheim

- Implementation of the toll ring occurred successfully despite being unpopular with a majority of the general public. Six months before the opening, two thirds of people were negative or very negative about the idea, but within two months of opening, this proportion reduced to half.
- The County Road Administration funded a NOK 5 million (approx. 615,000 €) multi-media information campaign over a two year period to promote the idea of improving the transport network.
- Electronic tolling was presented as a necessary expedient, the only way to fund road building. A key selling feature for the package was that tolling would be for a limited period of time.
- Social acceptance of the tolling scheme has been gained through the clear link between the toll revenues and the transport, safety and environmental improvements that have been made in the city during the life of the project.
- The budget for promotional activities amounted to 10 per cent of the Toll ring implementation costs.

Paris

- The motorway network in the Ile-de-France and the Boulevard Périphérique suffer from heavy congestion and some of the applications deployed have made SIER and city of Paris' work highly visible (travel times displays, provision of information via VMS or the Internet). No communication was really necessary to advertise these achievements, however other unnoticed activities or failures during bad weather conditions showed the need to keep the public informed of the work being undertaken.

7.4. Promoting a partnership approach

Regions must work on organisational issues and address inter-agency cooperation problems in order to secure the full benefit of telematics. An important dynamic is to improve the relationships between agencies particularly between national roads authorities and regional roads authorities. This is also true for the agencies involved in intermodal transport where interconnection between different modes of collective transport is necessary, and also interchange with private transport.

Getting the different actors convinced of the benefits of implementing telematics is the main task. Demonstrations are needed before a programme can be devised. There is a local, regional, national and European dimension to this. CARISMA-Telematics shows that the European focus could be to share better practice of regions in achieving collaboration between the sector actors.

Experience in the CARISMA-Telematics cities shows that good Inter-Agency cooperation can be achieved if there is clarity about the role and responsibilities of each player. Coordination arrangements should not be unduly complex. The lesson is not to be over-ambitious.

CARISMA-Telematics REFERENCES

Fact Sheet AG2	Promoting a Partnership Approach to Deployment
Fact Sheet B2	Smart Card Access Control
Fact Sheet G1	Glasgow City Profile
Fact Sheet G3	National Driver Information and Control System – NADICS
Fact Sheet G5	Scottish Travel Information Association – SCOTIA
Fact Sheet M1	Munich City Profile
Fact Sheet M3	MOBINET – Mobility in the Munich Metropolitan Area
Fact Sheet M4	Integrated Traffic Management
Fact Sheet P1	Ile-de-France / Paris City Profile
Fact Sheet P2	Electronic Ticketing
Fact Sheet P3	Commercial Traffic Information Services
Fact Sheet P4	Public Transport Information and Services
Fact Sheet S1	Southampton/ Hampshire City Profile
Fact Sheet S2	Romanse Project/Network Management
Fact Sheet TU1	Turin City Profile
Fact Sheet TU2	The Integrated telematics Infrastructure of the 5T Project

Barcelona

- The split of responsibilities between lower and higher tier local authorities was a great barrier to achieving citywide implementation of the access control system with technical interoperability. A partnership is required between lower and higher-tier authorities so that the responsibilities for street works and traffic regulation are not divided. Partnerships with the operators of car parks and parking garages are also necessary.
- Although the peripheral motorway network (Rondas) is jointly operated by the city and the police (DGT), there is no real cooperation between the two entities.

Glasgow

- Optimal implementation of integrated systems which have differing responsible authorities can only be achieved through consensus. In Scotland the basis for such consensus has been achieved, where all the responsible institutions (the Scottish Office, Glasgow City Council and the police) have been actively involved in depth during the development of operational procedures for the NADICS system (NAtional Driver Information Control System for Scotland).
- NADICS provides pre-trip and in-trip information for drivers about road conditions across Scotland. It brings road network operators and managers together in a common system for traffic management and information provision.

- Some of the crucial factors in the success of NADICS are seen as the commitment of the sponsors of the project and the fact that institutional issues were addressed from the start, with the consultation and involvement of the relevant organisations in planning and developing it.
- The success is also linked to the manageable scale of the initial system, with built-in plans for later expansion. In Scotland the strategic road network is small enough to include most of it in one contract, while the small number of police forces and local authorities involved has also facilitated the collaborative efforts involved in developing the system.

Paris
- The electronic ticketing in Paris is a good example of successful cooperation between organising authorities and different operators in order to reach a common goal.
- SIER and Ville de Paris have also formed a public partnership in order to provide information through a common traffic information wholesale server: contracts with private providers could be called public-private partnerships as each entity agrees to abide by the rules stated in the contract.

Trondheim
- Agreement on the integrated payment system for transport services in Trondheim has provided a significant challenge, involving ten competing public transport operators as well as a number of other operators and organisations. The expected benefits of additional revenue through increased patronage have served to encourage participation and cooperation, as the Fact Sheet on the electronic payment scheme shows (Fact Sheet TR4).

Turin
- There is no doubt that the application of telematics in Turin is the result of partnership between the public sector and private companies. Nonetheless future developments imply a wider participation by the public sector such as the Province of Turin and the Region of Piemonte to set up the Mobility Agency in the Turin Metropolitan Area. Once established, the Agency will be in charge of the coordination and management of the relationships between the public and private sector. Despite the fact that one of the peculiar characters of 5T is the independence of each agency within the systems architecture, the Mobility Agency will in fact be the body ensuring the provision, management and coordination of telematics services to the Metropolitan Area.

8. Conclusions

The Final Part of this report draws together the main findings and conclusions of the CARISMA-Telematics project in relation to its objectives, presented in Section 1.2. They concern the role and scope of telematics in cities/regions, the current position on deployment and future prospects, and the value of cooperation at the European level. These conclusions are current at the time of writing this report (Spring 2000).

8.1. Deployment of transport telematics

The picture presented by the CARISMA-Telematics cities/regions is one of deployment confined to a few important areas, with considerable scope for much wider deployment of transport telematics.

Those applications that have been implemented most widely and successfully are the ones that will improve inter-modal travel information and traffic information quality (see Table 2.12). The CARISMA-Telematics fact sheets contain a richness of examples to illustrate this. There is a healthy mix of public and privately operated information services, and some good examples of how to get organised. Glasgow (Fact Sheet G3, G4, G5), Munich (fact Sheet M2, M3, M5), Paris (Fact Sheet P3, P4, P5) and Southampton (Fact Sheet S3, S4 S5) illustrate very well the possibilities. Public transport information systems have been developed largely as a result of public sector initiatives. Developing multi-modal travel information services can be a complex and an Advice and Guidance note is available. (AG3 Intermodal Traveller Information Systems)

A second objective commonly served is to improve the safety and performance of the arterial road network through a variety of methods (see Table 2.9). Urban Traffic Control (UTC), public transport priority measures and traffic information all feature very strongly, with interesting developments in all seven CARISMA-Telematics cities/regions (See Fact Sheets B5, G2,S6, P6, M4, TR1, TU3). This is often supported by parking guidance information systems (see Fact sheets B4, S1, TU1). In contrast, urban road pricing and tolling are comparatively rare, but the highly successful example of an urban toll ring in Trondheim suggests it is only a matter of time before these methods catch on (TR1, TR2). Based on Trondheim's experience, the key to success is to develop a political consensus for these schemes and go all out to win over popular support. A sound legal and institutional basis for the scheme is also essential. The Trondheim experience also shows how strong the pressure is to move towards inter-operable electronic tolling between one city-region and another. This is already happening on a national basis (Fact Sheet TR3) and European efforts to achieve harmonised systems must also move quickly.

A third objective well served by transport telematics is that of improving urban public transport (Table 2.3). Better information services, fleet management and public transport signal priority are all playing their part. All of the cities are investing in better public transport information services using telematics (Fact Sheets B4, G4,M2, P4, S3, TR1, TU3). Particularly notable are the Route Action Plans in Glasgow (G4) which are supported by a bus information and signalling system (BIAS). Advanced signal control strategies are also being developed in Munich (Fact Sheet M4) and Turin (Fact Sheet TU3). Paris has far-reaching proposals for electronic ticketing for public transport services across Ile de France region based on contactless smart cards which can serve as an electronic purse for other small purchases (Fact Sheet P2). This is one area where transport can play a leading part in the roll-out of information society technologies.

The other major application of transport telematics which is becoming well established are route guidance and navigation systems, often at the initiative of the private sector, as in Paris.

In contrast to wide take-up of telematics in these four main areas, a number of applications included in the ITS City Pioneers Toolbox are not yet widely deployed. They are:

- Access control, of the kind Barcelona is pioneering using smart card access control;
- Breakdown and emergency alert systems, including rescue service incident management and urban incident management;
- Car pooling/ car sharing booking systems;

- Coordinated city logistics for commercial deliveries and goods transport;
- Dynamic speed adaptation;
- Environmental traffic management and traffic control of the kind that is being trialled in Turin (fact sheet TU);
- Freight management using electronic data interchange to service the logistics chain;
- Public transport security;
- Advanced electronic payment systems, such as the ICARE electronic ticketing system in Paris (fact sheet P2) and the Barcelona integrated park + bus payment magnetic card (fact sheet B4) or the Trondheim integrated electronic payment and ticketing initiative (TR4);
- Telematics applications for cyclists, pedestrians and other vulnerable road users;
- Town supervisor concepts, of the kind being trialled in Turin, through the 5Ts project (fact sheets TU1,TU2, TU3);
- Traffic regulation enforcement using telematics;
- Urban road tolling and road pricing, of the kind Trondheim has adopted successfully with the urban toll ring (fact sheets TR1, TR2, TR3).

Based on the discussions with CARISMA-Telematics city officials, the next wave of deployment is likely to be in electronic payment, pollution monitoring and further development of real-time travel information services. There are as yet in CARISMA-Telematics cities/regions very few transaction services which exploit potential for interactive communication with the user, whether over the Internet, DSRC link or other wireless link such as GSM. One interesting example is the use of a two-way video link to the control room in Barcelona, to provide a form of "remote presence at the access control points (fact sheet B2).

The volume of real time information content in transport telematics is certainly increasing, covering parking, traffic conditions, and public transport. The universal availability of the Internet, provides cities with excellent possibilities to distribute this information using a client/server architecture (fact sheet B5, P3, S5). The rapid take up of web sites by the agencies and authorities suggests that provision of these services will grow rapidly, hand in hand with the progress in the functional capabilities of the technology to provide convenient ways to distribute the information. For example, some web sites already carry CCTV pictures from traffic cameras such as the cities of Barcelona and Glasgow, for instance. The increasing capability of mobile telephone hand sets, personal digital assistants (PDAs) and other hand-held terminals also offers many new possibilities (fact sheet M2, S5).

Electronic Variable Message Signs showing text are an almost universal means of information delivery. Less common are VMS which show point-to-point travel times as in Paris (fact sheet P5) or which incorporate graphics (currently under research in the Netherlands and already operational in Korea). On the other hand, real-time information through RDS-TMC services is becoming well established. (fact sheet G4, M3, P3) This may turn out to be the forerunner to a more feature-rich service of broadcast digital information using DAB channels (fact sheet M5). "How to go" and "Where to park" type services, as implemented in Barcelona (fact sheet B5) and Southampton (fact sheet S4) show how the information can be packaged as a user-friendly interface.

Other technologies which are being taken up are smart card based applications as seen in Barcelona (fact sheet B2), Paris (fact sheet P2) and Trondheim (fact sheet TR4); and GPS used for fleet management (fact sheet S3) or as the basis for probe vehicle positioning systems (fact sheet P3).

A general observation based on what is happening in the CARISMA-Telematics cities/regions is that the delivery of services often requires new organisational structures with an emphasis on customer support, and this cannot be achieved by the provision of technology and system integration alone. Trondheim provides an excellent example with the "back office" systems that support the electronic payment (fact sheet TR2). Other examples are the development of Traffic and Travel Information Centres like those in Southampton (fact sheet S4) and Munich (fact sheet M2), which can deliver personalised traveller information, and new organisational arrangements such as those in Glasgow (fact sheet G5) and Paris (fact sheet G3) which can exploit the full potential of the technologies (fact sheet S5) or that will assist special groups like cyclists or the visually impaired (fact sheets M2, S3).

8.2. The role of city authorities and administrations

As a general observation, there is perhaps a cultural issue to be addressed in many local and regional authorities which the CARISMA-Telematics cities have worked hard to overcome. Research and development activities have been concerned with the technical possibilities of transport telematics and consequently this is often seen as the domain of the technical experts rather than being mainstream to the delivery of transport policies. All seven CARISMA-Telematics cities illustrate how a corporate approach to transport telematics is needed which goes well beyond an appreciation of what is technically possible. For example, in the Munich area, great impetus for the implementation of transport telematics projects is given by the 'Inzeller Kreis' (Inzell Circle), a public/private partnership between the City, the State of Bavaria, and other planning authorities in the region as well as partners from industry and science (fact sheet M2). The theme of building partnership approach is developed in the Advice and Guidance Notes (AG2 - Promoting a Partnership Approach to Deployment).

Relying on very strong public innovative potential has been one very good way of progressing deployment in all the CARISMA-Telematics cities. However other cities, particularly if they are smaller and do not have the same financial and technical resources as Paris or Munich, will need to be cautious in their approach, and will need to select the deployment process very carefully. The institutional context for investment in intelligent transport systems is often complex and putting deployment on a sound organisational basis is the key. As an example, the transformation of the original 5T Consortium into a new public-private partnership represents both a key to the success of telematics in Turin and the starting point for future developments.

The main lessons for city authorities and administrations are:

- Cities need to secure strong political commitment to transport telematics as well as sound technical leadership.
- Cities need to steer the deployment of telematics in ways which meet the project sponsors' goals but also serve wider city objectives.
- Investment of time by the lead agency in securing cooperation between key agencies and authorities in the region is important to realise the synergies possible between different telematics applications.
- Attention to all aspects: financial, technical, institutional and political is important.
- Telematics often requires innovative public procurement and deployment methods (e.g. a design, building and maintenance contract).

One politically sensitive issue concerning information society technologies in general and transport telematics in particular is to ensure that high technology solutions will serve all sectors of society and not merely the well-off. For example this is a key motivating force in Glasgow and is one reason why information for bus passengers has been given a high profile (fact sheet G4). It also suggests that, once the public service requirements have been satisfied, the more advanced value-added services and premium services will be more readily developed through private sector initiatives, as in Paris (fact sheet P3).

Developments in the private sector may demand a response from the public authorities. Fopr example the emergence of Mediamobile required Paris City authorities to organise themselves as harmonised data providers and to adopt a common policy for the commercialisation of public data. In return for supplying public data, the public authorities receive data free of charge from the service providers, for example from taxis, which improves their ability to carry out their responsibilities for traffic management. The various public authorities which are in charge of traffic management in the Greater Paris Region have worked together under the sponsorship of the State to define the principle of a coherent tariff and a common specifications framework which they will apply contractually to all service operators. Policies on tariffs, formats and exchanges of data, conditions of data transfer, etc. are harmonised through agreements between public authorities (see fact sheet P3). Local authorities and the State together have established a "wholesale server" for traffic information which has been the key to the success of these commercial services in the Ile-de-France Region. Essentially the "wholesale server" concept provides a comprehensive, seamless compendium of urban, regional and inter-city traffic data available from one source as far as the service provider is concerned. An Advice and Guidance Note has been prepared on this topic (Private Sector Travel Information Services).

Based on the experience from across the seven CARISMA-Telematics cities, there are a number of strategies the public authorities and agencies can take to minimise the risks that many perceive transport telematics.

- Develop a strategy for deployment and address ways of publicising this strategy with the media.
- Demonstrate how transport telematics can benefit a city/region.
- Evolve effective methods for systems specification and procurement.
- Progress innovative finance and public/private partnerships.
- Consider the value and purpose of the system architecture framework for transport telematics the region.
- Secure inter-agency cooperation through sound contractual relations.

These results are encapsulated in the Advice and Guidance Note Planning ITS deployment.

8.3. Future prospects

On their own, transport telematics and intelligent transport systems will not solve the increasing problems of traffic congestion and the resultant effects which many cities and regions in Europe are experiencing. Technology can hold part of the answer but it is critical that transport telematics is deployed as part of an integrated transport strategy to obtain the maximum benefits. For example the motto of Trondheim's ITS programme is: 'Improved transport services for more people and at lower

In metropolitan areas the challenge is to develop transport measures and ITS in such a way that improved traffic capacity and effectiveness in using the road network does not simply generate additional volumes of private car traffic. Instead, telematics needs to supply sustainable solutions, for example to allow present demand to be accommodated whilst giving increased priority to public transport vehicles and releasing road space for other uses.

Goods delivery is one of the key issues which arises in a number of the CARISMA-Telematics cites. For example loading and unloading goods creates problems in Barcelona, and although the Balmes multi-use lane (fact sheet B3), and access control (fact sheet B2) represent positive answers, they have not solved the problem entirely, and there is no doubt that this highly sensitive topic will receive closer attention in the future.

8.3.1 Electronic payment

Electronic Tolling has been successfully implemented in Norway, even though motoring costs are relatively high. The success of the Trondheim scheme was due in part to the eagerness of the city authorities to support the city's involvement in new technology, and to promote it as the technology capital of Norway, building on the experience and expertise of local industry. Political support has also been vital in promoting the schemes and gaining public acceptance for them, despite the inherent unpopularity of the idea of charging road users to enter the city centre. Once tolling became operational, the clear benefits seen in terms of removing congestion have won public support for continuing the scheme.

The experience of electronic ticketing in Paris is also encouraging and provides lessons for other cities tackling the problem of developing an interoperable electronic ticket without the need to raise the prices charged to customers. The cost of the contactless card is still considered to be too high (50 FFR/8 EUR) compared with cost of a magnetic card (which costs a few centimes). Production on a commercial scale has already brought the costs down, and standardisation will contribute to further cost reductions in the next few years. The technology for electronic ticketing seems to be ready, but in France, banks have been reluctant to take part in the process, mainly because of concern over security. The FRANCILE experiment clearly demonstrated that all key players have to be involved in a management authority in order to ensure the success of the initiative in Paris and to develop it further. The same concept needs to be applied to the whole country and to all of Europe. The creation of CLUB (ContactLess technology User Boards) involving 20 federations representing over 50 public transport networks in eight European countries, has the potential to provide a framework for developing a pan-European system.

8.3.2 Public image

An area that sometimes proves difficult for some urban regions to address is the public profile and public awareness of transport telematics. Although Intelligent Transport Systems deliver benefits, ITS is often "invisible" or viewed negatively by the public. For example in Glasgow (fact sheet G1) the new national network control centre with its bank of CCTV screens presents a positive image and often provides a backdrop for media pictures. However without a pro-active effort by Glasgow city, the media reporting of the CITRAC system could easily dwell on the occasions when the systems cannot cope, for example if there are long queues to use Kingston Bridge, which carries 155,000 vehicles per day. This kind of negative publicity had to be tackled positively in Trondheim, where public opposition to electronic tolling in the early stages was forestalled and the scheme could go ahead. (fact sheetTR1)

8.4. The European dimension

All seven CARISMA-Telematics cities/regions are at the forefront of developments in transport telematics and are leading the way in national and European deployments. All are active members of the POLIS network of European cities/regions and have been benefactors of European funding in the Third and Fourth Framework programmes for RTD&D.

The value of these European links is especially important for a small and remote city like Trondheim, which has been active in several EU projects on electronic tolling and demand management, notably GAUDI and CONCERT. Barcelona also participated in GAUDI and CONCERT as a part of the smart card access control project. Larger urban regions have also benefited greatly from European links, like Glasgow and Munich, for whom the TABASCO project was significant in investigating a range of telematics-based network management methods. In Paris, CALYPSO and ICARE were significant projects for the electronic ticketing systems. In Turin the QUARTET and QUARTET+ projects provided the basis for proving the Town Supervisor concepts which are no operated through 5T (fact sheets TU2, TU3). Hampshire secured European funding to develop its ROMANSE demonstrator in Southampton through the SCOPE and EUROSCOPE projects, and has since developed projects through he Integrated Application of Digital sites (IAD) programme. Other European funding sources include the Trans-European Transport Network budget (Munich) and the European Regional Development Fund (Glasgow).

The practical significance of European funding and its impact on the deployment of telematics in cities and regions should not be under-estimated. European RTD projects can lever significant funding from other sources as well as being a catalyst for obtaining political commitment to a project. Notable examples are ROMANSE in Southampton (S2 and BAYERNINFO in Munich (fact sheet M2). At the same time the sums involved from the EU are usually small relative to the total investment required and it is important not to over-play expectations about what will be achieved.

CARISMA-Telematics cities provide ample evidence that European projects have been instrumental in helping the cities develop their ideas about integrated and intelligent transport systems. Examples are standards for tolling and electronic payment, and the systems for network control and traffic information. Individuals from the CARISMA-Telematics cities who are directly involved have commented on the value of these European forums in bringing different actors together to exchange experiences, learn from one another and for consensus-building, especially during the latter stages of development of specific telematics application.

One general conclusion is the need for complementarity between local, regional, national and trans-European transport networks in the implementation of transport telematics applications and services. Telematics applications could play a major role in door-to-door route planning promoting seamless travel between the local and international corridor networks. This is also the conclusion arising from the CARISMA-Telematics-Transport, the sister initiative to this one. The European Commission therefore has an important role, in working with the Member States and other key players to provide clear direction and guidance to cities and regions on the overall strategy on the use of transport telematics, especially the trans-European telecommunications infrastructure networks. Part of this is an advisory role to urban regions that has still to be fully developed. Cooperation should be developed between the European Research programs and the national ones, at the appropriate levels.

8.5. Main achievements of this project

The focus of the CARISMA-Telematics project has been very much towards the non-technical aspects of the use of the technology, covering political support, public awareness, consensus formation etc. The project set out to provide an overview of current position regarding deployment of telematics in seven leading city- regions and how this has been achieved. The approach taken by the project team was to analyse, through on-site visits, the deployment situation of selected city regions. The project visits have been important in understanding how transport telematics can serve the cities transport and mobility policies and the part the cities can play as a facilitator for deployment. These have been documented in the seven city profiles and 32 project fact sheets. With reference to European Community instruments and the implementation of the Trans- European Telecom Networks (TEN-TEL) in particular, it was felt that the cities themselves did not actively seek to avail of funds. In the case of TEN-TEL, the reason is thought to be the fact that the instrument is mainly accessed through service providers and telecom companies and many city authorities have yet to adjust to this new approach. In summary, CARISMA-Telematics has identified the reasons for the cities' successes and touch on one or two the failures. There has been direct contact and open discussions with top level actors. The leading applications and gaps in deployment have been identified. Four advice and guidance notes have been prepared to distil some of that experience and it is hoped this will provide useful hands-on guidance for the cities which have not already engaged in deployment. The project has provided help to other European cities in their telematics endeavour.

May 2000

9. Acknowledgements

The CARISMA-Telematics project team would like to thank the following organisations and their staff for their cooperation in the project.

- Ajuntament de Barcelona
- Glasgow City Council
- Hampshire County Council
- Syndicat des Transports Parisiens
- City of Trondheim
- City of Turin

ANNEX A

Key transport telematics applications in CARISMA-Telematics cities and regions

City/region	Key transport telematics applications	Fact sheet number
Barcelona SPAIN	Smart card access control (SICAV) with rationalised Goods delivery Urban traffic control Multi-use/ Tidal flow lanes Park and Ride, Automatic parking guidance Traveller information Major event planning (1992 Olympic Games)	**B2** **B3** **B3** **B4** **B5** **B2**
Glasgow UK	Urban traffic control (urban + motorways) (CITRAC) Ramp metering National Driver Information and Control System (NADICS) Real-time bus information/ Route Action Plans Public/private partnership promoting transport telematics (SCOTIA) Public transport information } TABASCO validation Public transport priority } of various transport VMS for Park and Ride } telematics systems	**G2** **G2** **G3** **G4** **G5** **G6** **G6** **G6**
Munich GERMANY	Multi-modal transport information (INFOTEN, BAYERNINFO) Multi-modal transport telematics applications (MOBINET) Integrated traffic management (VARIA, AIDA) DAB-based travel information services	**M2** **M3** **M4** **M5**
Paris/ Ile de France FRANCE	Electronic ticketing (FRANCILE) Traffic management and Information (SIRIUS) Commercial traffic information services (MEDIAMOBILE, SKIPPER) Real-time travel information (INFOGARE.INFOTRAIN) Mobile radio bus positioning (security – AIGLE, at-stop info – ALTAIR) Urban traffic control with VMS (SURF)	**P2** **P3** **P4** **P4** **P5** **P6**
Southampton Hampshire UK	Urban traffic control with VMS for route guidance & car park information Strategic traffic management (EMS - Enhanced Message signs) Traffic and Travel Information Control Centres (ROMANSE) Real-time public transport information (STOPWATCH) Trip planning terminals (TRIPlanner)	**S2** **S2** **S2/S4** **S3** **S5**
Trondheim NORWAY	Automatic road tolling (Tag Automatic Vehicle Identification system) Electronic fee collection Integrated multi-modal payment system Bus priority at signal-controlled junctions	**TR2** **TR3** **TR4** **-**
Turin ITALY	Large scale 5T telematics projects with 10 co-operative subsystems; Urban traffic control Environmental monitoring & control Route guidance, VMS Emergency response Public transport information, management and priority Supervision concept within 5T	**TU2** **TU2** **TU2** **TU2** **TU2** **TU2** **TU3**

ANNEX B

List of CARISMA-Telematics deliverables

Advice and Guidance Notes:	
Planning ITS deployment	AG1
Promoting a Partnership Approach to Deployment	AG2
Intermodal Traveller Information Systems	AG3
Private Sector Travel Information Services	AG4
City Profiles and Fact Sheets:	
Barcelona City Profile	B1
Smart Card Access Control	B2
Management of Road Space	B3
Parking Management	B4
Network Control and Traffic Information	B5
Glasgow City Profile	G1
Centrally Integrated Traffic Control - CITRAC	G2
National Driver Information and Control System – NADICS	G3
Maryhill Road Route Action Plan - BUSTIME	G4
Scottish Travel Information Association – SCOTIA	G5
TABASC0	G6
Southampton/Hampshire City Profile	S1
Romanse Project/Network Management	S2
STOPWATCH (real-time passenger transport information system)	S3
Traffic and Travel Information	S4
TRIPlanner	S5
Network Management	S6
Ile-de-France/Paris City Profile	P1
Electronic Ticketing	P2
Commercial Traffic Information Services	P3
Public Transport Information and Services	P4
Motorway Information and Management – SIRIUS	P5
Advanced Urban Traffic Control – SURF 2000	P6
Munich City Profile	M1
Multimedia Traffic Information - Bayerninfo	M2
MOBINET – Mobility in the Munich Metropolitan Area	M3
Integrated Traffic Management	M4
DAB-based services in Bavaria	M5
Turin City Profile	TU1
The Integrated telematics Infrastructure of the 5T Project	TU2
The Town Supervision Concept with the 5T System	TU3
Trondheim City Profile	TR1
Trondheim Toll Ring: Planning Installation and Operation	TR2
Trondheim Toll Ring: Electronic Fee Collection System	TR3
Trondheim Integrated Electronic Payment and Ticketing Systems	TR4