Federal Ministry
of Transport, Building
and Housing

Transport Telematics

Developments and Success Stories in Germany

As at: August 2004

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Tel.: + 49 (0)1888 – 300 – 3060
Fax: + 49 (0)1888 – 300 – 1942
e-mail: buergerinfo@bmvbw.bund.de

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Preface

After 1998 and 2001, this is already the third progress report on activities and success stories in the field of transport telematics. Today, a wide and diverse range of promising and interesting telematics applications is available.

- Numerous national and international projects that were described in the previous reports and were still at the development or experimental stage have since been completed, and some of them have already been put into successful practical application. Others have been expanded or augmented and are providing valuable findings for the development of future telematics systems and services for all modes of transport.

- However, it is also evident that the enormous sales volume on the telematics market, which was still being predicted in the late 1990s, has not materialized. Thus, for instance, although there is a steady rise in the number of passenger cars being equipped with navigation systems, it is apparent that motorists are not automatically willing to spend a lot of money on a terminal plus the basic costs for the service and the costs of mobile communications. One exception to this is dynamic navigation systems which, by giving motorists free-of-charge access to RDS-TMC (Radio Data System –Traffic Message Channel), enable them to optimize their route. This is especially true of the retrofit market.

- The individual modes of transport have to be interlinked, both nationally and internationally. Only solutions of this nature can control and decongest traffic in an intelligent manner. Here, too, further efforts have to be made.

- In the past few years, however, there have also been new technological developments that can provide a new stimulus to the telematics market:

  - Mobile communications technology has developed at an undreamt-of pace. Today, the mobile phone is already a versatile multimedia terminal throughout the world. The use of new mobile communications standards such as UMTS (Universal Mobile Telecommunications System), WAP (Wireless Application Protocol) and GPRS (General Packet Radio Service) will make it possible to provide new services in the field of transport telematics, too. Thus, for instance, WAP enables users to download information from the Internet to the display of their mobile phone. This makes it much easier to use the Internet as a medium of information for door-to-door journey planning.

- On the telematics market, there appears to be a move away from fixed terminals towards small, mobile and versatile terminals (thanks not least to UMTS and WAP), which can be used not only in passenger cars but everywhere during a journey. It remains to be seen how these opportunities are exploited by service providers and users.

- A trend is emerging whereby telematics systems are being integrated into vehicles rather than into transport infrastructure and act from the vehicles (e.g. driver assistance systems in motor vehicles, radio signalling used by DB AG).

- New information and communications technologies (such as e-commerce) are facilitating new marketing and sales channels and new forms of trade. Innovative transport telematics systems can help people to make better use of the opportunities presented by electronic commerce. The Federal Ministry of Transport, Building and Housing has been proactive in quantifying and qualifying the impacts of new information and communications technologies on the volume of traffic, and agrees with all players that e-commerce creates new quality requirements that transport and logistics have to meet. These requirements are due to the ever-increasing use of just-in-time procurement systems and to the fact that consignments are getting smaller and being sent more frequently. On the other hand, e-commerce also means that some new transport movements are not necessary. It is apparent that electronic commerce will, in the foreseeable future, have only a minor impact on the volume of traffic.

- A major building block for Europe-wide telematics services is a highly accurate and reliable positioning and navigation system. For this reason, the European Union has decided to establish a global, civil satellite navigation system, including the ground infrastructure. The “Galileo” system is expected to be operational by 2008/2009.

On the whole, it can be said that the potential inherent in transport telematics has not yet been exhausted.

Summary

- Both the public and private sectors believe that the use of new information, communications and guidance technologies in the transport sector (transport telematics) has the potential to make **mobility**, in its many different forms, **sustainable**, **efficient** and as **environmentally friendly** as possible, for both industry and individuals. Transport telematics provides intelligent technological solutions for managing the high volume of traffic. Recent years have seen a multiplicity of telematics systems and services coming onto the market. Experience has shown that although the deployment of transport telematics at the federal government, federal state and local authority levels is not a universal panacea, it has nevertheless proved itself as an additional tool supplementing the traditional transport policy instruments of "investment and regulatory policy". In addition, numerous telematics systems are being developed and marketed by the private sector.

- Transport telematics is an essential prerequisite of an **integrated overall transport system** in which the modes of transport are interlinked more closely and, as a result, much better use is made of the advantages of the more environment-friendly means of transport, in particular. The new technologies will help make transport infrastructure as a whole more efficient and enhance traffic safety. **Intermodal telematics systems and services** are thus of prime importance.

- The deployment of transport telematics in Germany is based on a clear allocation of responsibilities and tasks, coordinated between policymakers, the individual modes of transport, industry and service providers. Leading representatives of all stakeholders from the political and business spheres have agreed to adopt a coordinated public-private cooperation approach:

  The public and private sectors agree that the planning, organization and operation of telematics systems and services are **primarily the responsibility of the private sector**. The **state's task** is to shape the necessary **outline conditions**, depending on the progress made in the development of telematics services and on the current needs. In Germany, the outline conditions required for private-sector transport telematics services have been created over the past few years in close cooperation with industry.

- Today, there are many instances where **transport telematics** is already **everyday practice**, including in the public sector:
  - Almost all major transport operators have for a long time been using computerized operational control systems in local public transport.
  - In most regions, customer-focused electronic local public transport information systems are in operation.
  - On federal motorways, traffic control systems help reduce accidents and congestion.
  - Dynamic parking guidance and information systems are standard in almost all large cities and help improve traffic conditions and the quality of life in city centres.
- Deutsche Bahn AG employs computerized train control to improve transport operations and uses electronic reservation and information systems.
- In urban agglomerations in several federal states, integrated traffic management systems, traffic information centres and mobility networks have been established, or are in preparation, in cooperation with industry, the transport sector, scientific institutions and private-sector service providers. They include:
  - Baden-Württemberg: MOBIN, M 21
  - Bavaria: BAYERNINFO
  - Hesse: Regional traffic management for the Rhine/Main region (in preparation)
  - Hamburg: traffic information for the Hamburg region
  - Lower Saxony: Move
  - North Rhine-Westphalia: Ruhrpilot (in preparation)
  - Berlin: traffic management centre
  - Saarland: traffic management in the Saarbrücken metropolitan area

  In many large cities, comparable systems and services are either already in operation or are being established (e.g. Braunschweig, Bremen, Cologne, Dresden, Frankfurt/Main, Potsdam, Munich, Stuttgart).

- In Germany, as in almost all other European countries, automated real-time traffic information is broadcast nationwide by means of the digital **TMC** (**Traffic Message Channel**). This service, which is provided in Germany by a public-private partnership, has led to an improvement in the quality of traffic information and has also promoted the take-up of dynamic navigation systems.

- In Germany, private-sector operators of telematics services provide nationwide mobile communications-based **individual, dynamic traffic information and route guidance services** that use real-time traffic data collected by both the public and private sectors.

- The use of **logistics and fleet management systems** (freight transport telematics) to minimize empty journeys and make freight transport operations more efficient has already become everyday practice, especially in large haulage companies. The same is true of consignment tracking, which is used by freight forwarders and courier and express parcel services. In **combined transport**, too, telematics is in wide-scale use to simplify logistic processes. At **ports**, which are **intermodal transport interfaces**, telematics is used for efficient initial and terminal haulage and for transhipment operations.

- In **shipping**, transport telematics can significantly enhance **productivity** and **safety**. The world's largest coherent radar-based vessel traffic services system is in operation in the inner German Bight and adjacent maritime waterways.

- In **air transport**, telematics applications have reached a very advanced stage, for instance in air traffic control and airport operations as well as in their use by airlines.

- **Satellite navigation** is the basis for numerous applications, for instance in the spheres of agriculture and geodesy, but one of its principal users is the transport sector. Today, already, positioning and navigation systems are in operation in all modes of transport and on an intermodal basis. In road transport, they are used, for example, for route guidance, breakdown/emergency calls and for protection against theft; in public transport, for example, for planning vehicle deployment and providing customer information; in maritime and inland waterway transport, for example, for safe navigation in conjunction with electronic charts; in air transport, for instance, during the en route phase and approach-to-land procedures, with the exception of precision approaches; and in intermodal transport, for instance, in the carriage of dangerous goods and for container management. To bring about even greater use of satellite navigation, Germany is actively involved in the EU project to establish **“Galileo”**, a global satellite navigation system under civil control.

- Only interoperable telematics applications will provide the maximum benefit for transport users in **Europe**. For this reason, Germany advocated, at an early stage, an EU policy paving the way for telematics systems and services that can be used internationally.

- The deployment of telematics systems and services is also expected to provide a significant impetus to the labour market and German competitiveness in the global economy.

- **Compared with other European countries**, Germany has, on the whole, reached a high level both in research and in the deployment of telematics systems. This applies to all modes of transport, although road transport assumes a prominent position because of the numerous opportunities for traffic control that it offers.

- Despite all these success stories, it also has to be said that the potential inherent in transport telematics has not yet been exhausted. This statement refers not only to the technological possibilities, but also to the fact that some of the players are not always willing to cooperate.

I. Public-Private Cooperation

1. Strategies for the introduction and use of transport telematics

Managing the existing and continuously increasing demand for transport while ensuring sustainable mobility is one of the major social and technological challenges and one of the central tasks of transport policy. In this context, the principal tools of transport policy, namely investment and regulatory policy, are being effectively supported and augmented by the possibilities of modern information, communications and guidance technologies in the transport sector (transport telematics). Experience so far has shown that transport telematics can help enhance the efficiency of and optimize the transport system as a whole.

Since 1993, therefore, the Federal Government has intensively addressed the issue of the wide-scale introduction of transport telematics, in order to achieve the following objectives:

- to make more efficient use of existing transport infrastructure, especially by reducing and avoiding congestion, empty journeys and traffic in search of its destination;
- to better exploit the inherent advantages of the road, rail, waterborne and air modes by interlinking them to form an integrated overall transport system;
- to enhance traffic safety;
- to reduce traffic-related pollution, especially CO_2 emissions, by exploiting the new technological possibilities for transport organization and management.

It is obvious that a speedy and wide-scale introduction of transport telematics will not be successful unless the private sector can be encouraged to become involved in establishing telematics services. This requires close cooperation between the Federal Government, the federal states, local authorities, industry, the transport sector and service providers.

In 1995, the then Minister of Transport reached agreement with senior transport policymakers from the Federal Government, the federal states and local authorities, and with leading representatives from the public transport sector, the freight transport sector, the automotive, electrical and electronics industries and the service sector on the following principles:

- The planning, organization and operation of telematics services are subject to competition and are primarily the task of the private sector. The provision of transport policy guidance remains the responsibility of the appropriate local or regional authorities.
- Priority has to be given to regional and supraregional telematics services that strengthen the overall transport system and not just parts thereof.
- Telematics services have to be designed such that they are interoperable and meet uniform European standards.
- Telematics services and systems have to comply with current and any future European and national legislation.

2. Agreements between transport policymakers and industry

On the basis of this approach, transport policymakers and industry representatives agreed that:

- industry would develop modular and ergonomically designed terminal equipment to enable telematics users to choose individually the basic services they require, thereby promoting wide-scale competition between technologies, system components and intermodal services;
- the public sector would provide its data for telematics services, to the extent that they are required for transport telematics to improve the overall transport system, and develop, together with industry, models for the intermodal management of public and private sector traffic data as a precondition for more advanced telematics services;
- industry would take the initiative to market telematics services, either by itself or in cooperation with the public sector;

- all the parties involved would elaborate a joint concept to expedite the ongoing European standardization activities, with the aim of establishing a range of customer-friendly telematics services.

On this basis, public-private cooperation has developed which supports the process of introducing telematics services. In this context, the main focus is the creation of the necessary outline conditions for private-sector telematics services.

II. Outline Conditions for Private-Sector Telematics Services – Prerequisites for entering the Market

The outline conditions, especially with regard to the technological, organizational and legal aspects of telematics services, have been created in a speedy and unbureaucratic manner.

They include:

1. Model permission contract for private-sector telematics equipment on federal trunk roads

Some of the private-sector services providing dynamic (i.e. real-time) traffic information require facilities and equipment for the collection and transmission of data which have to be installed on or in the vicinity of the transport infrastructure, e.g. roads. Under road law, the installation of such facilities by the private sector is subject to permission to use the road infrastructure.

For this purpose, a “model road use contract on the co-utilization of federal trunk roads and Government-maintained bridges for the establishment and operation of a transport telematics system with the objective of providing services for road users” has been elaborated, coordinated with the federal states and recommended for use. This model contract regulates, for instance, the right of use, questions of road safety (during the installation, operation and maintenance of this equipment) and liability, follow-on obligations and costs as well as user fees.

The Federal Government has thus laid the foundation to ensure that the legal form of such contracts for the use of its road infrastructure is uniform throughout the Federal Republic of Germany. Implementation and conclusion of the individual contracts with private-sector enterprises on the basis of the model contract are the responsibility of the highway authorities of the federal states, acting on behalf of the Federal Ministry of Transport, Building and Housing. The Ministry has since evolved this model contract in the light of the experience gained in recent years.

On the basis of this contract, the installation of private-sector traffic data collection sensor technology on federal motorways is now making good progress. The installation of traffic information transmitters on federal motorways has almost been completed.

2. Data provision contracts

Real-time information on the traffic situation is the basis for numerous telematics services providing dynamic traffic information and/or dynamic route planning in all modes of transport. The establishment of private-sector infrastructure to obtain traffic data requires substantial investment and takes time. Service providers are therefore interested in having access to data that is already available, especially at the various local and regional authorities.

The public sector has agreed in principle to allow private-sector telematics service providers to access this existing traffic data. The aim is the combined use of traffic data collected by the public and private sectors. As far as federal trunk roads are concerned, this work is substantially complete.

In 1988, a "model contract on the provision and sale of traffic data from federal traffic control centres" was prepared in coordination with the federal states. This contract covers the transmission of federal trunk road traffic data from the federal traffic control centres to private-sector telematics service operators. It regulates details concerning, for instance, the nature and volume of the data, work relating to the provision of the interface, authorizations and approvals required, the extent to which the data may be used and user fees. The conclusion of individual contracts with private-sector enterprises on the basis of the model contract is, in turn, the responsibility of the federal states, which are already making great use of this opportunity.

At the end of 1998, a "model contract on the provision of traffic-related data", based on the federal contract, was prepared by the Permanent Conference of German Municipal Authorities and industry (represented by the Confederation of the Electrical and Electronics Industry). On the basis of this contract, local authorities can conclude individual contracts on the provision of the data they collect to private-sector transport telematics service providers and on the exchange of data between public-sector and private-sector bodies.

In 2000, the Permanent Conference of German Municipal Authorities prepared a "model contract with manufacturers on the provision of traffic-related data". Under this contract, the municipal authorities can provide manufacturers of digital road databases with traffic-relevant data from the spheres of traffic control and management and road construction.

3. Guidelines for public/private cooperation in telematics services

The main focus of the guidelines is on traffic information services and route recommendations. The guidelines reflect the requirements of the competent authorities (Federal Government, federal states and local authorities) and the police. They are based on the classification of the road network in order of importance, the official designation of diversion routes and the competent authorities' transport strategies for regulating diversion routes. The traffic information and recommendations disseminated by traffic information services must not be inconsistent with statutory requirements. The bodies responsible supply the private-sector service providers with the statutory requirements in an appropriate form.

4. Guidelines for the design and installation of in-vehicle information and communications systems

If the development of transport telematics affects, for instance, private and public interests that do not require contractual regulation right from the outset or are not amenable to such regulation, special agreements between the public and private sectors are possible in the form of voluntary commitments. One example is the "guidelines for the design and installation of in-vehicle information and communications systems", which were agreed in November 1996. Work is continuously underway to update them.

The in-vehicle telematics applications that exist or are at the development stage are designed to assist the driver without distracting him in such a way that he poses a danger to road safety. For this reason, it is necessary that the design of this equipment meet certain requirements in terms of road safety and ergonomics.

In this context, transport policymakers, vehicle manufacturers and system providers have a common interest in ensuring a high level of road safety throughout Europe, which at the same time takes account of the rapid technological developments on an innovative market.

5. Act on Information and Communications Services

Special statutory instruments for private-sector transport telematics services are not considered necessary. The only instrument is the Act on Information and Communications Services[1], which contains general legal provisions governing multimedia services going far beyond the transport sector. They include new legal regulations governing the use of teleservices, data protection in the use of such services, digital signatures and provisions amending the Penal Code, the Act on Administrative Offences and the Copyright Act.

The Act on Information and Communications Services reflects the profound changes in information and communications technologies. Its objective is to provide, within the framework of federal competencies, a reliable basis for shaping the dynamically developing range of information and communications services and to strike a balance between free competition, user interests and public interests.

The need for legal action is met in two ways. On the one hand, obstacles to the free development of market forces in the sphere of the new information and communications services are to be dismantled and uniform economic outline conditions for the provision and use of these services are to be guaranteed. To ensure maximum freedom to provide services in this field, teleservices, for instance, do not require special licences.

On the other hand, the Act on Information and Communications Services has created regulations that are needed in the fields of, for instance, data protection, data security, copyright, youth protection and consumer protection.

For data protection in teleservices, the principles governing the processing of personal data, the obligations of service providers under data protection law, users' rights of access and the checking of data protection, inter alia, have been extended

[1] Federal Law Gazette 1997, Part I, No 52, pp. 1870 - 1880

beyond the previously applicable provisions of the Federal Data Protection Act. All new regulations also apply to transport telematics services, which means that special regulations governing the transport sector are not required. Moreover, practical experience with the services established so far has shown that traffic data is collected and transmitted without reference to persons. Given the sensitivity of this issue, the Federal Ministry of Transport, Building and Housing attaches great importance to ensuring that the provisions of data protection law are complied with in the field of telematics. However, practice to date has revealed that the providers have so far handled personal data very carefully and have complied with the existing regulations.

6. Research projects as a basis for commercialization

6.1 EU framework research programmes

It is essential that a policy of applied research be pursued if transport telematics systems and services are to be developed in a market-oriented manner and potential applications and the impact of telematics systems on transport are to be explored.

Telematics projects were thus priority areas of the 4th and 5th EU Framework Research Programmes (1994-1998/1998-2002).

The EU's activities in the field of transport telematics research focused specifically on:

- multimodal trip planning, travel and traffic information;
- telematics services for freight transport;
- telematics for network management, operation and control;
- telematics for fleet operations;
- telematics for vehicle control;
- validation of an integrated transport telematics infrastructure and the related services at test sites.

The Federal Government supported the objectives of the 4th and 5th EU Framework Research Programmes and did everything it could to ensure that an appropriate share of research funds was allocated to German research contractors. The Federal Government has stepped up its efforts in this sphere in the 6th EU Framework Research Programme (which covers the period from 2002 to 2006).

As a result, this programme, like its predecessors, will continue to promote telematics projects, which is an important issue for the Federal Government.

The 6th EU Framework Research Programme has the following three priority thematic areas:

1. Information Society Technologies (IST)
2. Aeronautics and space
3. Sustainable development, global change and ecosystems

The first call under the IST programme contains the "eSafety for road and air transport" action line. The objective of this action line is to develop, test and assess an integrated and global approach to intelligent road vehicles and aircraft which offers higher safety and value added services.

The activities in this action line focus on:

- advanced sensors and communications systems as well as highly dependable software and interfaces to integrate on-board safety systems that assist the driver in road vehicle control;
- advanced airborne collision avoidance systems for aircraft;
- distributed intelligent agents (e.g. beacons, loops) for road transport, secure communications and advanced positioning and mapping technologies and their integration for supporting the provision of location-based value added services;
- vehicle and information infrastructure management systems with emphasis on safety and efficiency.

The research activities of this action line of the IST programme are coordinated with the work in the other two thematic areas of the 6th EU Framework Research Programme.

In the "aeronautics and space" thematic area, the focus in "aeronautics" is on action to increase the capacity and safety of the air transport system, in support of the "Single European Sky" (air traffic control and management systems).
As far as "space" is concerned, the priorities are as follows:

- the Galileo project for the field of civil satellite navigation;
- the Global Monitoring for Environment and Security (GMES) platform;

- advanced research needed to integrate the space segment and the ground segment in the field of communications.

Projects in the “intelligent transport” field of the “sustainable development, global change and ecosystems” thematic area are designed to bring about a general improvement in traffic flows in all modes of transport.

The focus is on:

- efficient cross-border control and safety systems;
- interlinking the traffic management systems with the creation of compatible traffic data collection;
- seamless intermodal information, communications, navigation, payment and logistics systems.

6.2 Trans-European Transport Network (TEN)

The trans-European transport network comprises the transport infrastructures of the road, rail and waterway modes, including their interconnection points, and the increasingly important transport telematics systems for the intelligent use of existing infrastructures.
These systems have to be evolved, and will make transport in Europe safer, more efficient and more environment-friendly.
They comprise the following spheres:

- satellite positioning and navigation systems;
- management and information systems on the road and rail networks;
- coastal and port shipping management systems;
- vessel positioning systems:
- reporting systems for vessels transporting dangerous or polluting goods;
- communications systems for distress and safety at sea;
- airspace reserved for general aviation, airways, air navigation aids, the traffic planning and management systems and the air traffic control system.

On the basis of the TEN (trans-European network) guidelines and the TEN financial aid regulation, the European Community has, since 1995, granted substantial financial aid to the transport telematics sector, especially in the following spheres:

- road traffic management;
- rail management systems for high-speed lines;
- air traffic control;
- satellite navigation.

The assistance provided by the EU is granted to national, multinational and EU-wide projects and studies. The financial aid is usually 10 % in the case of projects (20 % in the case of projects for satellite positioning and navigation systems).

6.3 European Regional Development Fund (ERDF)

In accordance with a decision of the Commission of the European Communities of 16 March 2001, "transport telematics and intermodal transport" has been included in the "Transport Infrastructure" operational programme of the European Regional Development Fund (ERDF) as funding priority 4. In the period from 2000 to 2006, a total of € 10 million is available for studies and pilot projects for the so-called Objective 1 regions in Germany (the new federal states), provided that national co-financing is assured.

6.4 National research programmes

The Federal Government provides great support to the development of telematics systems and services for transport applications by granting financial assistance to research and development activities.

The efficient and resource-conserving organization of transport in economic centres is one of the major challenges that we will face in the future. The Federal Ministry of Education and Research has launched the "Mobility in Conurbations" research initiative to address this key issue. This initiative is designed to support transport policy-makers, the transport industry and the freight transport sector in solving the increasingly complex transport problems. A competition was organized in 1998 and five regions (Munich, Stuttgart, Frankfurt/Main, Dresden and Cologne) were identified in which sustainable organizational forms and technologies were to be developed and tested. The objective was to develop, for each conurbation, a coordinated traffic management concept that takes all transport systems and regional requirements (trade fair traffic, links to long-distance transport, et al) into account. New services, e.g. for commuters, help improve the occupancy rates of passenger cars and make public transport easier to use. The efficient matching of supply to demand, especially in public transport, by introducing new operating procedures was another key area. The competence of local public transport operators, local and regional road traffic authorities, long-distance transport operators, the automotive industry and IT service providers plus research institutes was pooled in the research networks.

The "Mobility in Conurbations" project networks are not, however, defined only by technology and traffic management. Their success depends to a great extent on whether new kinds of transport services in conurbations are accepted by the individual transport users. Demonstrating the solutions developed and evaluating them in terms of transport have thus been an integral part of the projects right from the outset.

The Federal Ministry of Education and Research, in close cooperation with the Federal Ministry of Transport, Building and Housing, provided assistance totalling around € 75 million to the five key projects that make up the "Mobility in Conurbations" initiative. The project consortia, comprising representatives from industry, research institutes, the transport sector, service enterprises and pressure groups, are contributing the same sum from their own resources.

Research funding for the five key projects, namely

- WAYflow (Frankfurt/Main),
- Stadtinfo (Cologne),
- Mobinet (Munich),
- Mobilist (Stuttgart) and
- Intermobil (Dresden),

has concluded, with the exception of the Intermobil project.

An initial review reveals that the findings of the key projects have laid the technological and organizational foundations for public-private traffic management strategies, which will be one of the major challenges of the future.

The following list contains just a few examples from the multiplicity of functionalities developed and new organizational structures:

- real-time information and services on the current traffic situation and for predicting future conditions, using radio, teletext, the Internet, mobile phones, etc. for motorists and public transport users;

- parking management systems with the following functions: “real-time information, reserve/book, pay”;
- real-time monitoring and prediction of traffic conditions for conurbation networks;
- traffic management modules for sectoral, circular and neighbourhood control by means of traffic control signals, variable direction signs and variable message signs;
- multimedia information services on the entire sphere of mobility in relation to traffic control objectives (e.g. parking, city information);
- multi-application smart cards for analyzing public transport patronage and as an accounting medium in public transport;
- Internet-based services provided by Deutsche Bahn AG (multimedia information, advanced timetable information, booking tickets on the Internet);
- operator models for future traffic management centres;
- systems that provide information on connections in public transport, especially when services are disrupted or delayed;
- intermodal services in mobility centres;
- core application for e-ticketing in public transport;
- incident management for rapid transit systems;
- CCTV systems and city floating car data for monitoring traffic conditions as a basis for road traffic management.

The results of the key projects are examples of best practice for a more wide-scale implementation in the Federal Republic of Germany. The objective of all the key projects – albeit in different forms – is to develop integrated traffic management concepts, which have been launched organizationally and institutionally with substantial funding from federal states and local authorities, e.g.:

- establishment of an integrated traffic management centre in Stuttgart (investment of € 35 million);
- creation of a central “transport telematics” organization unit in Munich with permanent establishment of the “Mobinet centre”;
- Integration/cooperation of Cologne City Information with the large-scale “Ruhrpilot” project and with the Rhine-Sieg Integrated Transport Association;
- foundation of a traffic management company (investment of € 15 million) and a mobility services company (investment of € 15 million) for the Rhine-Main region;

- development of the standard for a nationwide/Europe-wide electronic fare management system based on the outcomes of the “Intermobil Dresden” and “Wayflow-Rhein-Main” projects;
  These activities have led to the development of a new composite project entitled “core application” under the overall control of the Association of German Transport Operators.

More information on the key projects sponsored by the Federal Ministry of Education and Research can be found at www.mobiball.de .

The results of the MoTiV (Intermodal Mobility and Transport) research project are, inter alia, the basis for the aforementioned applied demonstration projects in conurbations and for mobility services.

The “INVENT” (Intelligent Transport and User-Friendly Technology) research initiative is a continuation of MoTiV. It involves numerous German vehicle manufacturers, component suppliers and other companies from the transport sector as well as some institutions of higher education and research institutes, and is designed to provide solutions, primarily with the help of telematics, which relieve the pressure on road networks in conurbations, reduce congestion and help motorists to reach their destinations more quickly.

The initiative is subdivided into the following component projects:

- monitoring and interpretation of the driving environment;
- anticipatory active safety;
- congestion assistance;
- driver behaviour and human-machine interaction;
- traffic performance assistance;
- network equalizer for private transport;
- traffic management in freight transport and logistics;
- transport impact, legal issues and acceptance.

“INVENT” was launched in 2001 and is to run for four years, with financial assistance being provided by the Federal Ministry of Education and Research (see www.invent-online.de).

Other research programmes sponsored by the Federal Ministry of Education and Research are the "DIRECT network" (Seamless Intermodal Trip Planning with Real-Time Information) and "Traffic Management 2010".

In the Federal Ministry of Transport, Building and Housing's departmental research, too, telematics plays an important role. Here, major research and development projects include:

- the potential impact of transport telematics for improving transport infrastructure and the capacity utilization of transport systems;
- information system for railway rolling stock on a telematics basis (used in the transport of dangerous goods);
- telematics applications and other innovations in the transport of dangerous goods;
- operational concept for telematics systems to incorporate all modes of transport in an operating area that can be delimited in terms of transport;
- possibilities for deploying mobile advice, development of models for the provision of location-based and target group-oriented mobility advice;
- concept for the use of transport telematics systems in conurbations, taking the Halle/Leipzig conurbation as an example;
- benefits and impact of real-time passenger information systems at stops, on the move and at home, to increase people's willingness to use local public transport;
- intermodal and multimodal telematics services (markets, products, solutions and organizational models for passenger transport);
- telematics in local public transport in Germany – documentation of the state of play and prospects for the future;
- definition of a uniform platform for the interfaces of telematics-based functionalities in public transport;
- status of transport telematics in Germany compared with other European countries;
- case studies on the impacts of e-commerce on freight lifted, changes to transport and logistics systems in the business to business (B2B) and business to consumer (B2C) segments;
- guide on the planning and use of telematics for local authority planners to improve traffic conditions in towns, cities and districts.

7. Outline conditions for transport telematics at the federal state and local authority levels

The wide-scale introduction of telematics systems and services onto the market will only be successful if they can be used throughout the Federal Republic of Germany and are not restricted to sections of the transport infrastructure. For this reason, the federal states and local authorities are involved in the telematics commercialization strategy in their respective areas of responsibility and taking into account their transport policy interests.

More and more federal states are laying the groundwork for an optimum range of public-sector and private-sector telematics services that meet regional and local requirements. Building on the experience gained from numerous pilot projects, structures for mobility information networks and traffic information and traffic management centres are developing, at which traffic data and other information required for traffic information, trip and freight transport planning and traffic management are pooled, processed if necessary, and made available for dissemination via various information channels.

These include, for instance, the aforementioned projects of some federal states:

- BAYERNINFO: information centre, inter alia for dynamic traffic analysis and forecasts in Bavaria (www.bayerninfo.de);
- MOBIN: mobility information network in Baden-Württemberg (www.mobin.de);
- Traffic control centre in Hesse (www.vz.hessen.de);
- MOVE: traffic management and mobility centre in Lower Saxony (www.move-info.de)
- Traffic management centre in Berlin (www.vmzberlin.de)

Within the framework of these projects and comparable programmes in most large cities, system architectures are being created for numerous different services which will promote market access, widen the range of services and facilitate funding.

8. Outline conditions at European level

As a result of the increasing volume of cross-border traffic, transport telematics is also an important European issue. If the potential applications of transport telematics are to be deployed and used in an optimum manner for transport as a whole, account has to be taken of this cross-border traffic. Information, communications and guidance technologies must, therefore, be designed in such a manner that cross-border services are possible.

The resolution on telematics in transport, adopted by the EU Council of Transport Ministers back in October 1994, highlighted the need to promote interoperable telematics applications by creating the necessary European outline conditions. This is a major task facing the European Community, for only interoperable telematics applications will provide maximum benefit to transport users – especially on the trans-European transport network –, support Member States and the European Community in their transport policy objectives and open up to European industry a common market for the manufacture of telematics systems and the operation of telematics services.

Activities at European level have so far focused on the fields of road transport telematics and satellite navigation plus the Central Flow Management Unit (CFMU) in the field of air traffic control. A more recent addition has been the eSafety initiative, which is designed to reduce the number of road accidents and their consequences in the European Union.

ERTICO (European Road Transport Telematics Implementation Coordination Organization) was established in 1991 as a company under Belgian law with its headquarters in Brussels. The aim was to create a European organization comparable to the ITS America (USA) and VERTIS (Japan) transport telematics organizations. In 1996, ERTICO added the words “Intelligent Transport Systems and Services Europe” to its name, thereby reflecting the notion of intermodality in transport telematics. ERTICO members comprise service providers, users, infrastructure managers, industry representatives and public authorities. ERTICO’s mission is to pool the interests of its members in order to progress the introduction and application of transport telematics in Europe. In addition to very intensive public relations work, ERTICO focuses its activities on participating in European and worldwide standardization, conducting European research projects and programmes of its own for the promotion and commercialization of transport telematics in Europe. The advantage of ERTICO is that the public and private sectors can act together under the same roof (public-private partnership).

To achieve its objectives, ERTICO has established various working groups and fora: The following are some examples of ongoing projects:

- driver assistance by improving electronic maps in the ActMAP project:
- development and testing of safety-related in-vehicle telematics applications in the PReVENT project;
- safe intermodal freight transport in the SIMTAG and SIT projects;
- promotion of satellite navigation and its introduction in intelligent transport systems in the EMILY and SAGA projects;
- electronic vehicle identification in the EVI project;
- satellite-based train protection in the LOCOPROL project;
- cooperation with the People's Republic of China in the field of transport telematics in the PEACE and BITS projects.

8.1 Road transport telematics

In 1997, the Council of the European Union approved a Community strategy and framework for the deployment of road transport telematics in Europe. The priority actions proposed therein have since reached an advanced stage:

- traffic information services (RDS-TMC);
- electronic fee collection;
- exchange of traffic data/information management;
- human-machine interface;
- system architecture.

To implement this Community strategy, the EU Member States and the Commission agreed to largely refrain from using the rigid tool of European regulations and directives, and instead to conclude memoranda of understanding (MoUs) on a European framework for transport telematics among themselves and with the involvement of European industry. Such MoUs have since been concluded for RDS/TMC and the international exchange of data.

The European Parliament and the Council of the European Union have agreed on the text of a directive on the interoperability of electronic road toll systems. This directive entered into force on 20 May 2004. The objective of the directive is to ensure the interoperability of existing and new electronic toll systems by removing new technological barriers. This will make it possible to avoid problems and obstacles in international road transport which would arise if technically incompatible toll systems continued to be introduced. The directive provides for two basic technologies: 5.8 GHz microwave technology and satellite positioning in conjunction with mobile communications technology. It recommends that satellite positioning and mobile communications technologies be used for new electronic toll systems.

In the key area of system architecture, a European research project called KAREN (Keystone Architecture Required for European Networks) was concluded in 2000, which involved creating a basic framework for the production of a system architecture. The project, headed by the Dutch Ministry of Transport, has formulated a framework architecture for European transport telematics. This is designed to support standardization, development plans and medium-term investment. KAREN focuses on road transport telematics, but does not lose sight of the interfaces with other modes of transport.

Regarding the introduction of telematics onto the European market, the development of European and international standards is also an important prerequisite for the cross-border interoperability of services provided Europe-wide. Since the early 1990s, therefore, transport telematics has been included in the activities of the European standardization organizations: the “Comité Européen de Normalisation (CEN)”, the Comité Européen de Normalisation Electrotechnique (CENELEC)” and the “European Telecommunications Standards Institute (ETSI)”. At international level, transport telematics is part of the work of the “International Organization for Standardization (ISO), which deals with it in many fields in close coordination with the European organizations. Standardization activities are primarily the responsibility of industry and the service sector. By 2003, basic European standards had been adopted in the fields of traffic information services (RDS-TMC) and communications media, which provide industry with a sound basis for planning in the technological implementation of telematics systems.

To ensure that German industry remains competitive, the standardization process has to be continued and intensified, and the stakeholders have to exert an active influence on it.

8.2 Information and communications technologies for safe and intelligent vehicles ("eSafety initiative")

In 2002, the European Commission, together with the automotive industry and other stakeholders, established the "eSafety" Working Group and mandated it to propose a strategy for accelerating the research, development, implementation and use of ICT-based intelligent systems for improving road safety in Europe.

In December 2002, the European Commission issued recommendations to the Member States, the road and safety authorities, the automotive industry, service providers, automobile clubs, insurance companies and other stakeholders.

The recommendations focus on three priority areas:
- action to develop building blocks for integrated safety;
- action to introduce legislation and standards;
- action to remove societal and business obstacles.

The working groups that were established to implement the "eSafety" initiative address the following issues:
- the human-machine interface;
- traffic data transmission and route guidance systems;
- automatic emergency calls;
- development of road maps to improve the road networks and the infrastructure information.

Other issues relate to accident causation databases, international cooperation and questions of research and development.

In continuation of its "eSafety" initiative, the Commission issued, on 15 September 2003, the "Communication from the Commission to the Council and the European Parliament on Information and Communications Technologies for Safe and Intelligent Vehicles" (COM(2003) 542).

The relations between the telecommunications industry, the automotive industry and infrastructure investments are to be intensified and updated.

The aim of the "European Road Safety Action Programme – Communication from the European Commission" of 2 June 2003 is to make a contribution, through the deployment of electronic systems, to halving the number of road deaths in the EU by 2010.

One of the main issues addressed by the "eSafety" initiative is the updating of existing and the introduction of new driver assistance systems, which are designed specifically to use in-vehicle electronic equipment and, wherever possible, to communicate with the infrastructure (see also Chapter III, section 1.5). In this context, the question of the driver's responsibility arises in a new form.

8.2.1 Human-machine interface

The Communication on the "eSafety" initiative states that the human-machine interface (HMI) is an especially important key to improving road safety. This aspect is of particular significance in view of the efforts that are being made to step up the introduction of the exchange of information by means of modern information and communications technology between the infrastructure and vehicles/drivers. The requirements to be met by the HMI are contained in the European statement of principles on human machine interface, published in 1999, and in the 28 recommendations made by the "eSafety" Working Group. It is likely that, as a result of an initiative by the Commission for greater use to be made of electronics for road safety, and on the basis of the findings of research carried out in the meantime, these requirements will be updated in 2005.

8.2.2 Traffic data transmission and route guidance systems

The transmission of traffic-related data via analogue RDS/TMC radio is only possible to a limited extent, because of the nature of the system. If the information, which has so far been collated primarily for the motorway sector, is to be extended to cover city centres and real-time data (constantly updated) is to be transmitted, this will mean that considerable amounts of data will have to be handled. This will only be possible using a digital radio network. The ideal solution here is digital audio broadcasting (DAB), which, because of the bandwidth available, can transmit greater volumes of data. It also improves the possibilities of supplying route guidance systems with real-time information, by providing traffic information from within built-up areas to enable the systems to calculate optimum routes based on the prevailing traffic conditions.

For this reason, a European-level working group is addressing the issue of adapting the information systems used so far to the new requirements. In addition to improving dynamic route guidance, information on connections is also to be taken into account.

8.2.3 Automatic emergency calls

In situations where help is required, an emergency call can be generated in the vehicle, either automatically by means of sensors or by the vehicle occupants pressing a button. Contact is established with an “emergency call centre” via mobile communications. The exact position of the vehicle is transmitted automatically and a voice link is established. At the same time, additional technical information and a precise indication of the site of the accident ensure that aid is provided in an efficient manner. Such telematics-based systems can help to significantly reduce the response time of the emergency services.

The national guideline of the safety authorities and organizations forms a framework for the rapid and smooth provision of assistance throughout Germany[2].

At European level, work is currently underway to develop, together with the automotive industry and mobile communications providers, a uniform European standard for in-vehicle automatic emergency call systems. This is especially important to ensure that the same technical equipment and functions are provided in vehicles and at the public safety answering points and that assistance can be also provided across national borders.

8.2.4 Development of road maps to improve road networks and infrastructure information

At European level, a wide range of players are engaged in developing innovations for improving the road networks and infrastructure information that are of interest to road safety. This also involves considering measures that are to be introduced after 2010.

[2] Emergency calls with data and voice transmission via mobile communications networks to public safety answering points operated by the police, fire brigade or emergency services – automatic emergency call/emergency taxi call; as at: 7 March 2000

8.3 Satellite navigation

Reliable satellite-based positioning and navigation systems are important for Europe-wide telematics services. They are increasingly becoming a key element for interlinking the individual modes of transport to form an integrated overall transport system and for optimizing logistics at the national and European levels. This technology makes it possible to meet the growing requirements that have to be met by a real-time positioning system. Interaction between the ground and space infrastructure opens up prospects for high-quality applications and value-added services, for instance in conjunction with digital geodata. Today, already, transport telematics systems that use satellite navigation are used in all modes of transport.

Since the two currently existing satellite navigation systems – the Global Positioning System (GPS) of the United States of America and the Global Navigation Satellite System (GLONASS) of the Russian Federation – are controlled nationally and can thus be deactivated at any time, satellite navigation reaches its limits where a high degree of reliability and accuracy is absolutely essential, especially for reasons of safety, as is the case in civil aviation, maritime shipping and on the railways.

For this reason, the European Union is developing a global, civil, state-of-the-art satellite navigation system, including ground infrastructure, with the name of “Galileo”. Galileo is designed to make Europe independent of nationally controlled systems, thereby creating possible applications in safety-critical and statutory areas of responsibility and strengthening the competitiveness of European industry on this market. According to estimates made by the European Commission, the installation of the infrastructure for satellite navigation and its operation will secure many thousands of jobs. In the sphere of applications (hardware and services), too, there will be opportunities for numerous new and highly skilled jobs.

During the development phase, Galileo is a joint project of the EU and the European Space Agency (ESA). The “Galileo Joint Undertaking”, comprising the European Commission and the ESA as founding members, has been set up to manage the development phase and prepare the subsequent phases. The Undertaking has entrusted ESA with the task of awarding the contracts for the technological development of the system, in particular the construction of test satellites and putting them into orbit, including installation of the ground infrastructure. One of the major players in the technological development is the Galileo Industries consortium, with headquarters in Ottobrunn and Rome. The German partner in Galileo Industries is the European Aeronautic Defence and Space Company (EADS) – Astrium

After the conclusion of the development phase in 2006/2007, the system is to be established in the years that follow within the framework of a public-private partnership (PPP). The Galileo Joint Undertaking will issue a call for tenders for the Galileo concession.

Galileo is scheduled to be operational by 2008/2009. The total cost of the system has been put at € 3.5 bn. The development phase is being financed from public funds, with one half coming from the EU and the other half from ESA. The EU's financial contribution is taken from its budget. The ESA funds are raised by the ESA member states. Germany is making funds amounting to some € 100 million available.
(see http://europa.eu.int/comm/dgs/energy_transport/galileo/index_en.htm)

8.4 German Radio Navigation Plan

Since 1996, the Federal Ministry of Transport, Building and Housing has published the German Radio Navigation Plan, which provides an overview of the major radio navigation systems, the user requirements they have to meet and the potential for future development. The plan identifies any action that needs to be taken and constitutes the basis for the strategic evolution of radio navigation systems in Germany. (see www.bmvbw.de)

8.5 Air traffic flow management

The Central Flow Management Unit (CFMU) controls air traffic with the help of slot times or re-routing in such a way that the capacity values of the area control centres or airports affected are not exceeded. The CFMU is operated by EUROCONTROL for Europe in Brussels. Flow management positions (FMPs) at the area control centres form the interface between the CFMU and the regional control services.

8.6 River Information Services (RIS)

The River Information Services (RIS) concept has been developed in international cooperation. RIS are the harmonized information services to support traffic and transport management in inland navigation, including interfaces with other transport modes. Each service is either primarily traffic-related or primarily transport-related, depending on the support task it has to perform. Services are made available by providers, e.g. the waterway authorities or the freight transport industry. RIS make it possible to collect, process, assess and disseminate waterway, traffic and transport information in one chain of processes.

In its resolution on the Commission White Paper “European transport policy for 2010: time to decide”, the European Parliament called on the Commission to submit a proposal for harmonized technical provisions towards the implementation of RIS. Germany supports this initiative and has been actively involved in the preparation of a proposed directive. The directive will create a uniform basis for the introduction of RIS. The draft European RIS Framework Directive provides not just for the introduction of technologically binding standards but also for the definition of minimum requirements for European inland waterways of Class IV or higher. These include, among other things, the production of electronic navigational charts to the Inland ECDIS standard and the provision of electronically usable waterway data.

The introduction of RIS on European inland waterways has three main objectives:

1. to protect transport against accidents and their consequences;
2. to make transport economically efficient by making optimum use of the capacity of waterways and vessels, reducing voyage times, reducing the workload on the individuals involved and interlinking the modes of transport;
3. to make transport environmentally friendly.

III. Existing Systems and Services - Development Prospects

1. Enhancing traffic safety

One of the central tasks of transport policy is to enhance traffic safety. To this end, it uses the tools of investment and regulatory policy on the one hand, and recent technological developments on the other hand. Transport telematics, too, offers a wide variety of applications to achieve this objective. A number of measures are included in the European Road Safety Action Programme (Commission Communication of 2 June 2003), the objective of which is to halve the number of road deaths in the EU by 2010 (see also Chapter II, section 8 – Outline conditions at European level).

1.1 Traffic control systems on federal trunk roads

The modern computerized traffic control systems introduced over the past 15 years, which control traffic by means of dynamic variable message signs, have proved to be an effective means of enhancing road safety and improving the flow of traffic.

There are several different systems:

- systems that indicate a maximum permissible speed depending on the traffic situation and warn drivers of congestion or weather-related hazards such as fog, rain or slippery road surface (route control systems);
- systems that use dynamic direction signs to inform drivers of congestion and recommend suitable diversions or alternative routes (network-based traffic control systems);
- systems that close lanes to traffic or make them available, depending on traffic volume (lane control systems);
- systems that control the flow of traffic at busy junctions (ramp metering systems);
- systems that indicate that the hard shoulder is available for use by moving traffic.

The data required for control of the systems is collected by traffic and environmental data collection sensors. Route control systems can reduce accidents by up to 30 %, with the number of serious accidents being reduced by up to 50 %.

The use of such systems can raise the level of road safety on busy, accident-prone sections of motorway to the high average level of safety on German federal motorways.

Traffic control systems help to decongest traffic and also, by harmonizing the flow of traffic, to reduce traffic-related pollution.

To enhance road safety and improve the flow of traffic on critical sections and at critical junctions on the federal motorway network, the Federal Government will make available around € 200 million within the scope of the current programme (2002 – 2007) to install traffic control systems on federal motorways. By the end of 2003, the Federal Government had invested a total of just under € 600 million in traffic control systems.

Around 900 km of motorway (in both directions) has now been provided with route control systems. In addition, there are sections of the network, especially in and between conurbations, on which variable direction signs are used to distribute traffic flows depending on traffic conditions. This means that in 2003, there was automatic traffic data collection on just under one quarter of the entire German motorway network.

The considerable efforts being made by the Federal Government and the federal states to install dynamic traffic control systems on busy federal motorways will be continued in the future. Dynamic systems are also being installed on particularly accident-prone sections of federal highways

The Federal Ministry of Transport, Building and Housing has used the activities connected with traffic management during the 2006 FIFA World Cup as an opportunity to reprioritize the traffic control measures contained in the ongoing programme. This is designed to ensure that areas particularly susceptible to disruption and identified accident blackspots on motorways in the vicinity of the venues have been addressed by 2006.

1.2 Road condition and weather information systems

To ensure a safe and, above all, efficient flow of traffic on motorways in winter weather conditions, the Federal Government is financing the establishment and operation of the road condition and weather information system (SWIS).

The SWIS system is a telematics aid for planning routine road maintenance operations, especially winter maintenance, and is based on weather and road condition information that is as accurate and up-to-date as possible. The aim of winter maintenance is to prevent ice from forming or to minimize the period during which road conditions are critical as a result of ice (preventive measures). The data processing operations required for this purpose are performed by a computerized information and data exchange system that uses telecommunications systems to provide on-line connections between SWIS monitoring sites on motorways, SWIS computer centres at the motorway maintenance depots and the meteorological offices of the German Meteorological Service. PC displays of updated values measured on the motorways are permanently available to the motorway maintenance depots for planning their maintenance operations. The meteorological offices combine the same values with large-area weather forecasts and regularly prepare special forecasts of road conditions, which are then transmitted to the motorway maintenance depots. These depots can thus also be alerted to any short-term deterioration in the weather.

The nationwide installation of the SWIS system on motorways began in 1994. So far, the Federal Government has provided around € 20 million for this project, with these funds being used by the highway authorities of the federal states acting as agents of the Federal Government. SWIS is almost entirely operational throughout the old federal states, whereas the system is still being established in the new federal states.

1.3 Traffic Message Channel (TMC) – the digital traffic information service

Since the autumn of 1997, German broadcasting corporations have transmitted the TMC digital traffic information service nationwide. TMC-capable car radios are available on the market, and are becoming less and less expensive. This digital traffic information service marks a further important step along the road towards enhancing traffic safety and making more efficient use of the trunk road network, for instance by decongesting traffic. The Federal Government, federal states and public broadcasting corporations, together with industry and the automobile clubs, have strongly advocated the introduction of this new traffic information service. The system is currently being evolved (see Chapter II, item 7.2.2).

In addition to providing free-of-charge warnings of incidents, congestion and weather-related hazards to road traffic, TMC also makes it possible to provide an enhanced target group-oriented information service on a commercial basis.

The advantages of TMC are:

- users can select information on their radios quickly and in a targeted manner, i.e. specific information on the section on which they are driving and the direction in which they are travelling;
- drivers can receive messages in their own language in any European country;
- the messages are available at all times and can be repeated as often as the driver wishes.

TMC allows up-to-the-minute traffic messages to be automatically processed and permanently transmitted and enables the user to individually select messages, without the radio programme that is being broadcast having to be interrupted, as is the case with traditional traffic messages. This traffic information service is thus tailored much more clearly to the needs of road users and, in this respect, the potential usefulness of traffic messages has been significantly improved. Thus, road users can obtain specific information at any time and as often as they want on individual sections or regions – in some cases information is now available in their own language. The permanently updated traffic information is based on traffic data from police traffic information centres, traffic control centres, traffic management centres and congestion reporters (e.g. those employed by broadcasting corporations and automobile clubs).

The Federal Government is continuing to actively support the new service by assuming responsibility for the amendments and additions to the location code list (LCL – local data for traffic disruption reports) used to update this list and by making it available to all parties involved in the traffic information service. The LCL is one of the major bases of TMC. Without the encoded indication of location, a traffic message cannot be allocated to a place. To enable this reference to a location to be made, areas, lines (i.e. road/road segments) and points are encoded. The more detailed the portrayal of the network in the LCL is, the easier it is to delimit the area to which a traffic message applies.

Adapting the LCL to reflect changes in Germany, especially the multiplicity of changes to the road network such as the construction/upgrading of motorways, federal highways and bypasses, is essential for the provision of reliable traffic information. It has to be periodically updated, roughly once a year. The most recent versions of the LCL are to a very large extent “backward compatible” with the previous version. However, in order to prevent TMC messages from being misinterpreted and to ensure that traffic disruption is portrayed as clearly as possible, users of dynamic navigation systems are advised to update the digital maps for their navigation system at around the same time as the LCL is updated.

The digital traffic information service is based on European standards (Alert C protocol) and agreements, which means that the cross-border use of such services is possible. Parties involved in the traffic information service from many countries cooperate in the European TMC Forum to jointly develop standards and to adapt the contents and functionalities of RDS/TMC to the requirements and technological developments. Industry supplies mainly navigation systems with which the information transmitted by TMC can be displayed or used for route guidance.

1.4 In-vehicle emergency and breakdown call systems, vehicle anti-theft systems

Private-sector service providers are increasingly using the new possibilities of transport telematics, including satellite positioning and navigation systems, to help motorists quickly in emergencies or if their vehicle is stolen. The permanent transmission of signals via satellite means that the position of a vehicle can be calculated at any time.

In the event of an emergency, a button in the vehicle can be pressed to establish direct contact with a control centre via mobile communications. The control centre informs the ambulance service and the police and guides them directly to the scene of the accident. In addition, there is already a system that triggers an emergency call as soon as an airbag is activated, i.e. the police and emergency services are informed even if the driver cannot make the call himself. In the future, such in-vehicle emergency call systems may help to minimize the consequences of accidents, especially in rural areas, by reducing the time needed by the emergency services to reach the scene of an accident. In particular, the chances of survival of seriously injured accident victims can be significantly improved through the use of telematics-based automatic emergency call systems. Guidelines drawn up by the Conference of Ministers of the Interior for these emergency call systems are recommended for application in accordance with the specific situations in the federal states, and are to provide the framework for rapid and smooth operations in the event of an emergency (see Chapter II, item 8.2.3).

To combat vehicle theft, use is made of the possibility of locating a vehicle by means of satellite. This is supplemented by so-called immobilization systems using telecommunications channels. If someone tries to break into the vehicle, a silent alarm is triggered. In addition, it is technically feasible to restrict use of the vehicle to certain areas and times, so that unauthorized use can also trigger the silent alarm. In both cases, a control centre initiates the necessary countermeasures – ranging, for instance, from informing the police to immobilizing the vehicle. For road safety reasons, however, a vehicle immobilization system may only be activated from outside the vehicle if there is no danger to the driver of the stolen vehicle or to other road users, i.e. only stationary vehicles may be immobilized, and only if they are in a safe location (e.g. motorway car parks, filling stations). Systems already on the market use remote-controlled ignition locking to prevent the vehicle from being started again.

1.5 Driver assistance systems

Driver assistance systems are all systems that support the driver in performing his driving task or improve his comfort in relation to his driving task. They can either be autonomous on-board systems (ABS, adaptive cruise control) or make use of telematics equipment (e.g. GPS in route guidance systems).

Driver assistance systems are becoming increasingly important because they provide significant support to the driver in performing his driving task. They can, for instance, assist him in critical situations by counteracting mistakes, thereby reducing the number of accidents and minimizing their consequences. Questions of acceptance play a major role in determining whether they are successful on the market and thus whether they produce the desired safety gain.

Current developments, taking into account research findings, deployment opportunities and deployment scenarios for safety-related systems that use electronics, are:

- In-vehicle technologies
  - Driver assistance systems in support of the driving task, e.g.
    - anti-lock braking system, brake assistant, adaptive cruise control to reduce the number of rear-end collisions;
    - driving stability control (e.g. electronic stability program) to prevent vehicles swerving and skidding;
    - lane departure warning systems (sensors that warn drivers of unintentional change of lane);
    - systems to prevent drivers falling asleep at the wheel / drowsy driver warning systems;
    - systems to improve visibility (adaptive headlights, junction light reflectors, rain sensors that automatically operate the windscreen wipers).
  - Convenience features to ensure that drivers are comfortable and alert (automatic transmission, air conditioning)

- Technologies that make use of telematics elements:
  - Radio Data System / Traffic Message Channel (RDS/TMC) for traffic information;
  - vehicle-to-vehicle communications;
  - vehicle-to-infrastructure communications (e.g. looking for a parking space);
  - automatic emergency call (improves response times of the emergency services and reduces traffic obstructions);
  - traffic sign recognition systems and systems that transmit speed limits and warn drivers when they exceed the limit;
  - navigation systems with voice directions;
  - head up display as an ergonomic driver information system (transmission of road traffic information and visual information in the driver's range of vision).

In the future, vehicle-to-vehicle and vehicle-to-infrastructure communications, in particular, will become increasingly important. Thus, for instance, it will be possible to automatically assess whether headlights have to be switched on or windscreen wipers activated, or whether several vehicles are braking simultaneously.

By reducing the number of accidents, driver assistance systems also help to prevent congestion.

The Federal Government is supporting the introduction of the appropriate systems. It advocates the enhancement of autonomous on-board driver assistance systems by adding elements of vehicle-to-infrastructure communications and better adaptation of the human-machine interface.

To manage road traffic and the forecast growth in traffic with a high degree of safety, care has to be taken to ensure that the driver is not overtaxed by a multiplicity of additional information. Despite the increasing influence of electronic driver assistance systems, the basic principle of road safety activities, namely appealing to the driver's sense of responsibility and not transferring decision-making responsibility to a machine, has to be upheld.

For the more distant future, driver-independent assistance systems are also being developed, which will, to a certain degree, be able to take over control of the vehicle – e.g. keeping a safe distance from the vehicle in front by automatically adjusting the speed, adapting the speed to the current flow of traffic or even automatic driving. In addition, a simple and low-cost telematics system able to identify critical traffic situations (e.g. traffic jam on a bend) occurring a number of vehicles ahead and to report the information back to the vehicle (vehicle-to-vehicle communications) is being tested. These technological developments have been supported at the national level by the INVENT research initiative (see Chapter II, item 6.4) sponsored jointly by the Federal Ministry of Education and Research and industry. At the international level, the ADASE (Advanced Driver Assistance Systems in Europe) project deserves particular mention.

The information about the environment of a vehicle made available by telematics applications allows a change in the distribution of tasks between the driver and the "intelligent vehicle". This can make driving more comfortable and enhance road safety, but it also raises questions, for instance in connection with liability if the system malfunctions, with behavioural law (driver remains responsible for his own actions) or even with international law (e.g. rules laid down by the Vienna Convention). Work has to continue on resolving these issues, especially at the international level, so as to be able to exploit any further road safety benefits that may be achieved.

1.6 Reporting and information system for vessels carrying dangerous or polluting goods

In the sphere of inland waterways, the reporting and information system for inland navigation is used for the collection and provision of transport data relating to vessels and convoys subject to reporting requirements for the purposes of averting danger. Waterway users carrying dangerous goods are subject to reporting requirements, as are all special movements and movements where certain dimensions are exceeded. The reporting requirements cover information on the vessel or convoy and its crew, voyage and cargo. In the event of an accident, the information required for accident response measures, especially that relating to hazardous cargo, is made available to the emergency services and the bodies responsible for countermeasures, without this information having to be first obtained from the ship's crew. This ensures that rapid and appropriate action can be taken in the event of accidents involving dangerous goods.

The system, with its two control centres at Oberwesel and Duisburg, covers the Rhine from Neuburgweiher to Emmerich, the lower Main up to Hanau, the Moselle and parts of the Western German canal network.

The reports about dangerous goods transport movements which are legally required by the Reporting and Information System are transmitted from the vessels, either before or as they enter the reporting area, via Nautical Information Radio, fax or computer and mobile communications to the control centres. A program developed in the Netherlands is available for this purpose. Further reports during the voyage are transmitted via Nautical Information Radio.

If vessels pass from one area of responsibility to another, the reported data is exchanged between the two control centres and with the Netherlands, France and Switzerland. The aim is to extend the exchange of data to cover Austria and inland ports.

In the sphere of maritime shipping, reporting requirements for vessels carrying dangerous goods[3] have entered into force at European level. For this purpose, a Central Reporting Point has been established at the Central Command for Maritime Emer-

[3] Transposition of EC Directive 93/75/EEC of 13 September 1993 by the Regulations of 13 September 1995 on reporting requirements for vessels carrying dangerous goods

gencies in Cuxhaven as the competent German authority. This body not only registers the reports which enable quick access to all relevant information on the cargo of vessels carrying dangerous goods, but also concentrates all the agencies of the Federal Waterways and Shipping Administration responsible for accident response measures (Waterways and Shipping Office as the shipping police authority, Central Command for Maritime Emergencies and coastguard centre) in Cuxhaven.

As part of the technical realization of the vessel reporting system, which has been in operation since 1995, the Central Reporting Point is currently setting up a Central Reporting System for the transport of dangerous and polluting goods by sea. This system is used not only by the Central Reporting Point but also by the traffic control centres of the Federal Waterways and Shipping Administration. In the future, the exchange of data will be electronic. For this purpose, the European Commission has, inter alia, decided to set up a Community vessel monitoring and information system. This system, known as SafeSeaNet, will be introduced by the Commission in 2004 and be available to all Member States. The communications systems established by the Member States for the electronic exchange of data will be linked via SafeSeaNet to make them interoperable. They thus have to exhibit the following features:

- The exchange of data must be electronic and must permit the receipt and processing of reports containing information transmitted on the dangerous or polluting goods being transported.
- The system must make it possible to transmit information 24 hours a day.
- Every Member State must be able to transmit without delay the information on the vessel and the dangerous or polluting goods on board if this information is requested by the competent authority of another Member State.

The Central Reporting Point will be connected to this system in 2005, thereby making a contribution to the prevention of maritime casualties and marine pollution.

1.7 Shipborne automatic identification system (AIS)

The International Maritime Organization (IMO), with the active involvement of Germany, has developed performance standards for a universal cooperative shipborne automatic identification system (AIS) for the fully automatic exchange of identification and navigation data and adopted a regulation, binding worldwide, requiring AISs to be fitted on all ships of 300 gross tonnage and upwards. AIS is a cooperative aid to navigation that permanently transmits all traffic-related information to all the vessels and shore stations located within the VHF range (40 to 50 km) and possessing the appropriate equipment. This significantly improves the prevention of collisions at sea, including under adverse weather conditions and in restricted visibility. In addition, the coastal states receive information at all times on vessel traffic in their waters. This provides the coastal states with a new tool for monitoring vessel traffic and optimizing the flow of traffic.

Once AIS has been introduced as mandatory for maritime shipping at the end of 2004, it will not only considerably improve vessel monitoring and information systems but also automate reports and help to significantly improve positioning and prevent collisions between vessels. In particular, it is intended to use the AIS information to compensate for the familiar physical shortcomings of radar on the open sea. It is planned to integrate the information provided by AIS into marine radars used on all ships, starting in 2008.

An AIS is also to be used in inland navigation. Studies to develop an appropriate European standard are currently being carried out.

1.8 Vessel traffic services systems

As a result of the steadily growing transport service reliability requirements, vessel traffic services (VTS) systems have, since the 1960s, been used on near-coastal navigable waterways and increasingly also in inland navigation. These navigation, communications and traffic management systems facilitate strategic traffic planning. They can help to prevent collisions and stranding. VTS systems thus make a major contribution to enhancing traffic safety. In the event of accidents, they ensure that the competent services are able to help quickly and limit the damage. In addition, they prevent delays and cut infrastructure costs.

The VTS systems currently in operation include:

- The systems in operation in the inner German Bight and the adjacent navigable waterways form the largest coherent radar-based VTS system in the world. The control centres of this system are connected with each other and with the port of Hamburg and the ports of Bremen and Bremerhaven by means of an integrated data system, via which all relevant traffic information is exchanged.

The VTS system is being permanently adapted to the growing safety and economic efficiency requirements.

It is planned to extend the exchange of information to ports in Lower Saxony and Schleswig-Holstein and to provide traffic data to other maritime services, too. Possible solutions are currently being tested.

- In the field of inland navigation, a VTS system is in operation along the Rhine Gorge. From the control centre at Oberwesel, vessels sailing in the narrow and winding channel are detected by four radar stations, the data is evaluated and traffic is controlled by light signals, in order to ensure safety despite restricted visibility and the lack of direct communication between vessels. Another example is the control of traffic passing the Magdeburg one-ship canal bridge. On the Moselle, traffic is observed in the MOVES system (Moselle Traffic Detection System) with the help of a computer network, and a large-scale traffic situation report is generated.

- The integration of vessel positions into new navigation systems using satellite navigation, such as the ECDIS system (Electronic Chart Display and Information System), has great potential for enhancing safety at sea, for instance by reducing the risk of grounding and stranding.

Essential prerequisites for the deployment of VTS systems and for safe navigation on the high seas are the precise charting of the sea area and the accurate positioning of vessels. For this purpose, the GPS satellite navigation system with an additional terrestrial differential component is used as a local system in maritime shipping.

The deployment of this system in inland navigation is at the planning stage.

1.9 Radio communications in shipping

Nautical Information Radio and the Reporting and Information System are operated as part of the international mobile VHF radiotelephone service on inland waterways. Nautical information radio is used for the transmission of information relating to the safety of individuals or to the movements or safety of vessels. Nautical Information Radio has been established on all inland waterways. Four control centres at Magdeburg, Minden, Duisburg and Oberwesel regularly transmit situation reports and are permanently available to shipping as points of contact. The Reporting and Information System is used for the collection and storage of transport data which, in the event of an accident, can be provided to the bodies responsible for countermeasures. This makes it possible to take rapid and appropriate action in the event of accidents, for the protection of ships' crews, the public and the environment (see Chapter III, item 1.6).

Terrestrial and satellite radio systems are available for ship-to-shore radio communications. In addition to their use for the exchange of information on the operations of vessels, these radio systems are also used for transmitting maritime distress alerts, handling maritime distress radio communications and informing shipping of dangers.

The international Inmarsat enterprise operates, among other things, a satellite-based maritime distress alerting system. From the Federal Republic of Germany, vessels are informed about dangers at sea via transmitters owned by the German Meteorological Service, radio stations of the Federal Waterways and Shipping Administration and in cooperation with Sweden and the Netherlands via radio stations in these countries. The transmission of maritime navigational warnings within the framework of the international NAVTEX (navigational warning via telex) service is planned to start in 2005 from the German Meteorological Service's Pinneberg transmitter.

1.10 Electronic waterway information system (ELWIS) on the Rhine

In the past, information relevant for the planning and operation of a voyage – e.g. water level forecasts or information on waterway closures – was transmitted between the waterways administration and the users of the waterway using mainly analogue or radio channels via regional VTS control centres. Since 1999, all important navigational information and information for those engaged in shipping has also been available on the Internet (www.elwis.de) for the inland waterways sector. Since 2003, this website has also included the "notices to mariners" that are relevant to vessels operating in coastal waters. On the one hand, ELWIS enables shipping operators to download comprehensive data at any time about their areas of operation that are relevant from the economic and safety points of view and to incorporate this information in their planning. On the other hand, forwarders, port operators and agents, among others, are able to include all the relevant data in their decision-making processes, thereby optimizing shipping and increasingly integrating it into intermodal transport chains.

The ELWIS-Abo module is an additional service in ELWIS that gives users the option of an information subscription, with the information being provided either automatically or on an incident-driven basis. The information is transmitted by email to the subscriber’s computer or mobile phone. This application is currently being evolved in close cooperation with the waterways administrations of neighbouring countries and inland waterway transport operators. International standardization of the formats and the information contained is designed to ensure a smooth exchange of data and the possibility of a machine translation of the contents.

1.11 Air traffic control systems

Interfaces between national air traffic control systems in Europe, their varying degrees of functionality, the resultant compatibility problems and the need to continue expanding the capacity of the European air traffic control system to keep up with the growth in air traffic make it necessary to harmonize standards, requirements, functions and procedures and to use the latest technologies.

At the European level, the necessary harmonization of national development plans and standards has so far been coordinated exclusively by EUROCONTROL within the framework of the European Air Traffic Management Programme (EATMP). The basis for this implementation programme is the strategy for the evolution of air traffic control in the 41 ECAC states (ECAC = European Civil Aviation Conference) after the year 2000 (the so-called “ATM 2000+ strategy”), which was adopted at the meeting of ECAC transport ministers in January 2000 and was comprehensively updated in 2003. This strategy regards air traffic management (ATM) as a continuous cycle in which the air traffic processes and tasks at the airports constitute integral components – a “gate-to-gate concept”. The European Community’s proposal for a regulation on the “Single European Sky” (SES) and the Community’s accession to EUROCONTROL mean that the European Commission will exert more influence.

As a direct service provider for airspace users and national air traffic control centres, EUROCONTROL operates the European Central Flow Management Unit in Brussels, which is responsible for the central control of European traffic flows and ensures optimum use of the available airspace capacity through the deployment of telematics systems.

2. Making more efficient use of the available infrastructure

In Germany, the limits of what can be done in terms of constructing new transport infrastructure and upgrading existing infrastructure have almost been reached, due, inter alia, to the high population density, aspects of landscape conservation and environmental protection and, not least, as a result of scarce financial resources. Modern information and communications technologies open up the opportunity to make more efficient use of the existing transport infrastructure with the help of intelligent technologies. This applies to all modes of transport alike.

Local authorities – especially those in conurbations – are endeavouring to relieve the traffic burden on towns and cities by means of dynamic transport telematics systems.

2.1 Parking guidance and traffic information systems

In city centres, parking space is becoming increasingly scarce. At peak times, vehicles looking for parking spaces account for 30 to 40 % of inner-city traffic. This traffic searching for a parking space can be considerably reduced by means of dynamic, collective parking guidance systems.

Parking guidance systems indicate which car parks (multi-storey and others) still have vacant spaces. This is made possible by a central computer to which the car parks are connected. Electronic signs inform drivers on the approaches to the city centres whether there is heavy traffic in the city centre and whether parking spaces are still available. In this way, the parking guidance system directs motorists to vacant parking spaces via the most favourable route.

This reduces the volume of unnecessary traffic searching for a parking space in city centres by up to 25 % and cuts the lengths of queues at car park entrances by up to 50 %. Cities such as Aachen, Dresden (mobile access to information on the availability of parking spaces by SMS text messaging), Erfurt, Frankfurt/Main, Cologne (parking information via Internet and in-vehicle unit, reservation of parking spaces), Munich (the PARK-Info system also displays information on the current on-street parking situation), Nuremberg and Stuttgart have had good experience in this field.

A survey conducted by the ADAC (German Automobile Club) revealed that dynamic parking guidance systems were in operation in 96 towns and cities (as at January 2002).

Nowadays, information from parking guidance systems is also fed into traffic information centres, which are also used by private-sector providers for their dynamic traffic information services. By means of these services, which are tailored to individual needs, travellers can obtain pre-trip information concerning, for instance, the level of traffic in the city centre, thereby enabling them to select their destination and means of transport on the basis of the traffic situation.

The use of dynamic parking guidance and traffic information systems means that traffic-related emissions can be reduced. These systems thus help to relieve environmental pressure and increase the quality of life in urban areas.

2.2 Park and ride (P+R) information and facilities

Park and ride (P+R) is an integral part of traffic management, which is aimed at optimizing transport, in particular in conurbations, in an intermodal, integrated manner.

Reliable and timely information about the traffic density in the city centre and signs indicating P+R facilities with local public transport connections to the city centre make it easier for motorists to switch to public transport. Traffic information and guidance systems which process and link real-time traffic data will gradually replace conventional signs and thus make an even greater contribution towards relieving the strain on city centres. The success of park and ride systems depends not only on real-time traffic information but also on the various types of settlement pattern, the location of the P+R facilities on the road network, their location on the local public transport network, the local public transport system, the requirements of parking space policy and urban and regional planning.

A survey conducted by the ADAC revealed that although P+R facilities are in operation in 141 towns and cities, only nine of them used telematics to control access on the basis of the traffic situation (as at January 2002).

The possibility of using public transport for a better journey to the city centre – without having to look for a parking space, which would otherwise be necessary – and in doing so also protecting the environment has resulted in a growing acceptance and an intensified use of park and ride facilities in recent years. Nevertheless, it also has to be said that, at present, only around 10 % of all commuters are potential P+R users.

2.3 Computerized operational control systems in local public transport

Guidance and control systems are designed to make local public transport operations safer and more reliable and to enable more efficient use to be made of the existing infrastructure capacity.

By using computerized operational control systems, and once all the conditions for well-organized transport operations, such as organizational and construction measures, have been created, public transport operators are able to respond to the consequences of internal or external disruption as well as to unexpected fluctuations in the number of passengers (e.g. by running additional buses, preventing bunching). In addition, these systems have laid the foundations for giving local public transport priority over private transport in a targeted and intelligent manner. At signal controlled junctions, buses and trams receive the signal to proceed upon request and, if possible, without delay.

Over 40 public transport operators already use computerized operational control systems with control centre functionality. This means that such systems are in use in nearly all major cities. Other operators have already laid the foundations for evolving such systems to perform control centre operations, for instance by introducing autonomous on-board operations. A start has also been made on equipping rural areas with these systems. Here, too, global solutions have already proved successful in meeting the special requirements of regional transport.

The integration of various computerized operational control systems is a major contribution by transport operators to enhancing customer benefit and thus to ensuring the competitiveness of local public transport. For this reason, an interface definition for ensuring connections between services operated by different companies (e.g. rail and bus) has been developed on behalf of the Federal Ministry of Transport, Building and Housing[4]. This enables individual operators to ensure connections between services at little expense. Real-time passenger information is of particular importance here. And of course, the indicators at the stops should provide information on departures of all the routes serving the stop, irrespective of the company operating them.

Apart from the recently introduced computerized operational control systems, integrated on-board information systems have for some years been used in public road transport. They control all on-board functions including ticket printers and passenger information. Communication between the control centre and the vehicles and, in some cases, the real-time passenger information at stops, is by radio. Satellite-based vehicle positioning is also being used on new systems, for example for vehicle deployment and customer information, and is thus replacing the current system of positioning in bus transport using beacons.

2.4 Computer Integrated Railroading (CIR) – new operational control systems for the railways

Telematics applications in the field of Deutsche Bahn AG's infrastructure lead to both an increase in the capacity of the rail network and an improvement in the safety and reliability of rail transport, and allow savings to be made with regard to expensive and maintenance-intensive infrastructure installations.

One example is CIR-ELKE (**C**omputer **I**ntegrated **R**ailroading/**E**rhöhung der **L**eistungsfähigkeit im **K**ernnetz – increasing capacity on the core network), which can increase the capacity of double-track mixed-operation lines by using computer and operational control technologies.

For such an increase in capacity, the following requirements have to be met:

- continuous automatic train control (LZB) with track vacancy detection sections that are adapted to train movements (i.e. moving block) has to be introduced;
- all traction units have to be fitted with continuous automatic train control equipment.

When new lines are constructed, and when the signalling technology is comprehensively renewed on existing lines, the conventional train control and protection sys-

[4] See Paper no 453 published by the Association of German Transport Operators, version 2.1, "Integrationsschnittstelle Rechnergestützter Betriebsleitsysteme"

tems will, in the near future, be superseded by the new ETCS (European Train Control System).

The establishment of seven modern operating centres on the German rail network will concentrate train monitoring and automate and shorten reporting and information channels. Not only the processes of deployment on the network, but also the systems for the dissemination of operating information will be streamlined and technologically modernized.

ERTMS (European Rail Traffic Management System)
ETCS (European Train Control System)

The greatest technological and operational problem facing the establishment of an interoperable European rail system is the multiplicity of train protection and control systems existing within Europe. The technical obstacles that exist in the sphere of control and signalling technology are to be dismantled by using technological equipment that is interoperable throughout the EU.

European railways and the railway industry, with support from the European Union, are working jointly on the development and introduction of a European Train Control System (ETCS), which is an interoperable sub-system of the ERTMS. The signalling industry has a commercial interest in assuming responsibility for the technical specifications and development (worldwide competition) and is contributing the same amount to funding.

Application of the ETCS promises to be a success not only on high-speed lines. On lines with a low and medium density of traffic, in particular, it is likely to produce significant cost savings, because it will replace the numerous older types of signal box and protective equipment at level crossings that still exist today.

On 30 March 2002, the European Commission adopted the “Technical Specifications for Interoperability” (TSI) in the high-speed rail system. Since 30 November 2002, all new construction and redevelopment work has had to comply with the material provisions of these specifications. The specifications state that, in the future, ERTMS will constitute the unified standard, with which new lines have to comply immediately. As far as the conversion of existing signalling equipment is concerned, the European Commission calls for a national implementation plan (migration strategy). The reason for this is that ERTMS, with its components ETCS and GSM-R (Global System for Mobile Communications – Railways), cannot be introduced instantly on the entire trans-European high-speed rail network and the high-speed trains that operate on this network, but can only be introduced gradually. It thus has to be installed as part of migration strategies and migration plans. The same applies to the trans-European conventional rail system pursuant to Directive 2001/16/EC of 19 March 2001, for which the corresponding TSIs will shortly be available.

Deutsche Bahn AG is planning a comprehensive deployment of telematics in the infrastructure of the rail network for monitoring and controlling rail traffic at and between stations. The mainstay is the network-wide deployment of the GSM-R mobile communications system, which is standardized throughout Europe, and radio-based operation derived from ERTMS/ETCS. Various ETCS components are currently being tested on the upgraded line between Berlin and Halle/Leipzig. However, after initial trials, and on the basis of the outcome of these trials, the development of radio-based operation for lines with a low and medium density of traffic has been discontinued by DB AG for the time being for economic reasons (especially because of the need to equip the rolling stock with the appropriate technology).

2.5 Air traffic management

In air transport, telematics is applied in the fields of air navigation services and in the management of airport and airline operations.

The safety aspect is of special importance in air transport. None of the measures aimed at increasing capacity must be allowed to compromise the high safety level. This is only possible with the help of the latest technological developments, including the use of telematics.

The disproportionately high growth in the volume of air traffic in the second half of the 1980s and the resulting problems in connection with overload conditions and delays made the need for appropriate regulatory measures apparent at an early stage. Subsequently, the airspace control centres, which previously had been situated in five different European states, were merged to form a European Central Flow Management Unit (CFMU) under the auspices of EUROCONTROL in Brussels.

The CFMU makes it possible to coordinate the planned air traffic volume (transport demand) and the air traffic management capacity, thereby preventing or alleviating foreseeable overload conditions as far as possible. Since 1996, the CFMU has dealt with all flights in the ECAC (European Civil Aviation Conference) area, applying traffic control measures where necessary. This involves rescheduling or rerouting flights in coordination with the users. Since then, delays have also been systematically analyzed. The Integrated Initial Flight Plan Processing System (IFPS) is the major source of data for the CFMU's database on transport demand and, at the same time, functions as the central provider to all air navigation services of the flight plan data required for the operation of individual flights. The quality of the CFMU's activities will be further enhanced by the input and processing of real-time traffic data in addition to the initial flight plan data. Germany is already transmitting real-time traffic data to the CFMU, and was one of the first countries to do so. The CFMU has been and will continue to be an important component of modern air traffic management, and is viewed as an example of best practice by other states.

Further improvements to the system are being continuously made on the basis of user requirements.

Other examples of the multitude of telematics applications in air transport are:

- Within the 4th EU Framework Programme for Research and Technological Development, a European consortium headed by Germany carried out a project for the development of a surface movement guidance and control system at Cologne/Bonn airport, with the aim of developing and validating functional and technical system requirements in order to increase the capacity, safety and efficiency of the movements of aircraft and ground vehicles at the airport. The results of this project, which was known as "DEFAMM" (Demonstration Facilities for Airport Movement Management), have influenced relevant ICAO (International Civil Aviation Organization) requirements.

- DFS Deutsche Flugsicherung GmbH (German Air Navigation Services), FRAPORT AG (Frankfurt Airport Operator), the Federal Ministry of Transport, Building and Housing and the federal state of Hesse have cooperated to develop various telematics systems for Frankfurt/Main airport to enhance capacity and safety. For instance, a wake turbulence warning system has been developed, which is designed to warn approaching aircraft of the wake turbulence of the aircraft ahead of them. The so-called “4D planner” makes it possible to conduct optimized overall traffic planning at an early stage and thus to enhance the capacity in the management of landings. This system generates a series of control advisories for aircraft separation, which are displayed to the air traffic controller in graphic form and enhance capacity by producing a more evenly distributed approach sequence and by providing planning assistance.

- At Munich airport, DFS, the airport operator and airlines are working on optimizing traffic management by improving the exchange of data. This involves special telematics systems (SEPL – sequence planner system) establishing a link between airport operations and the aircraft taking off and landing, which makes it possible to plan airport operations for arriving and departing aircraft much more flexibly and efficiently.

- At some smaller airfields, DFS already offers instrument approach procedures based entirely on GPS. However, not until Galileo, the satellite navigation system under civil control (see Chapter II, item 8.3), has been established will it be possible to exploit the complete spectrum of possible applications and associated cost reductions. At international airports, GPS procedures currently provide additional and complementary services. In the transitional period until Galileo is in operation, the EGNOS system will complement GPS and open up further possible applications of satellite navigation.

- It is hoped that in the future there will be significant potential for applying ADS-B (Automatic Dependent Surveillance – Broadcast), an airspace surveillance system that uses on-board data. In contrast, the position of aircraft has so far been determined by independent surveillance using ground-based air traffic control equipment. ADS-B involves the transmission by the aircraft at regular intervals of mainly position and course data, which can be received by other aircraft and air traffic control stations within the range of reception. Numerous international projects and field trials are being conducted to study the possibilities of global application with regard to safety, commercial viability and operational efficiency for aviation in a multiplicity of scenarios (ranging from the high seas to airspace with a high density of traffic and maximum ground-based air traffic control infrastructure). At the 11th ICAO Air Navigation Conference, which was held in the autumn of 2003, de facto agreement was reached that Mode S technology should be the initial step towards ADS-B implementation.

- By means of the so-called “CUTE system”, computers register which check-in desks are being operated by which airlines and communicate this information to passengers. Bar-codes are used for baggage transport.

2.6 Maritime Information Society (MARIS)

At the **G7 Ministerial Conference** on the Information Society held in Brussels on 25/26 February 1995, the participants and the European Commission discussed the conditions for the establishment of a global information society, the creation of inter-operability and compatibility of information and communications systems and the opening up of markets for information technologies, and identified these subjects as important fields for action. At their summit meeting in June 1995, the Heads of State and Government of the G7 states approved this approach and adopted eleven pilot projects for the practical implementation of these objectives in concrete fields of application. One of these projects is MARIS.

MARIS is not a research and development (R&D) programme but a framework for maritime matters and tasks which, in the form of individual projects, are to promote the establishment of a global maritime network:

- **MARTRANS** deals with the establishment of a port logistics information network to increase effectiveness within the overall transport chain.
- **SAFEMAR** is designed to further enhance safety at sea, inter alia by using modern information and communications systems more efficiently (vessel reporting systems, vessel traffic management and information services [VTMIS], electronic charts).
- **MARSOURCE** contributes to the establishment of a modern integrated information system covering fish stocks and maritime resources.
- **MARVEL** is aimed at the more intelligent manufacture of ships, with shipyards and suppliers interlinked in a global system (maritime virtual enterprise linkage).

Initial results – including those of projects in which Germany is involved – were presented at the EXPO in Lisbon in 1998. In addition, MARIS has been augmented by two individual projects defined by the requirements of maritime users:

- **MARTOUR** is designed to make available maritime tourist destinations and services on a global information network.
- **FEMAR** is aimed at improving maritime training using modern information and communications technologies.

MARIS is not limited to the G7 or EU states; the participation of, for instance, the Baltic States, the Russian Federation and the states bordering the coast of the Mediterranean is desired and is being practised. Notable sub-projects of SAFEMAR include BAFEGFIS (Baltic Ferry Guidance and Information System) and COST 326 (Electronic Chart Display and Information System), which constitute a basis and create the conditions for the introduction of electronic charts. The Federal Ministry of Transport, Building and Housing and other German institutions were involved in both projects.

The first reference solutions, and the fact that the programme is oriented towards user-driven requirements, have also led to a regionalization of MARIS activities, the result of which has been that the cities of Bilbao, Bremen, Genoa and Helsinki have agreed – in consultation with the national MARIS coordinators and the European Commission – to coordinate the programme for larger regional areas.

The MARIS projects are funded via EU and/or national project programmes, which are either ongoing or for which applications have been filed. On the one hand, this helps prevent a duplication of research or funding, and on the other hand, the MARIS framework establishes an appropriate link between R&D projects that have already been confirmed.

The multiplicity of projects and outcomes shows that the MARIS initiative, which has now been concluded, was and continues to be the right approach for progressing international maritime cooperation and supporting the establishment of a global maritime information society.

Implementation of the aforementioned individual projects has been and is being conducted in a way that reflects regional and user needs. They illustrate that, for the first time in this field, cooperation and the exchange of up-to-date development findings and reference solutions between G7 countries (including Russia) and EU Member States is a good idea and constitutes an example of “best practice”

2.7 Electronic fairway information system (ARGO)

With the objective of enhancing the economic efficiency and safety of shipping, a fairway information system is designed to inform inland waterway users, in a more comprehensive way than before, about the location of the fairway and, at selected bottlenecks restricting the amount of cargo that can be carried, about spatially differentiated water depths as a function of the water level at any given time. In the case of free-flowing navigable rivers (Rhine, Elbe, Oder, sections of the Danube), in particular, the possibilities for improving the capacity of the waterway by means of construction measures are very limited. Therefore, the provision of real-time information about the geometry of the river bed, including excessive depths, as well as the exact position of the available fairway is designed to enable ships to carry more cargo, thereby optimizing the use of the waterway’s capacity.

Increasing safety on the waterway is considered to be another important aspect. It is expected that the accident rate, which is low already, will be further reduced.

The overall system consists of the following complementary system components:

- spatially differentiated water depth information at bottlenecks restricting the amount of cargo that can be carried, expressed as a function of the water level and displayed on an electronic river chart to the ECDIS (**E**lectronic **C**hart **D**isplay and **I**nformation **S**ystem) standard of the Central Commission for Navigation on the Rhine;
- satellite positioning using DGPS;
- incorporation of the electronic chart into the radar image.

Since 2002, charts covering the free-flowing German section of the Rhine, the German section of the Danube, the Main and the Main-Danube Canal have been available from selected sales outlets appointed by the Waterways and Shipping Administration. The additional depth information covering the Rhine between Budenheim (near Mainz) and Lorch, which is currently available free of charge, is to be extended to cover other sections of the Rhine, Danube and Elbe.

Vessels using the depth information do not enjoy priority over other vessels. This additional service will not alter the nature and scope of the vessel traffic services provided so far by the Waterways and Shipping Administration. The depth information calculated at a specific point in time and displayed on the electronic chart has not become an object of the obligation to ensure vessel safety. When using this information, it must be remembered that it is merely a “snapshot”.

2.8 Water level forecast on inland waterways

On free-flowing navigable rivers (Rhine, Elbe, Oder, sections of the Danube), the possibility of using the waterway for inland navigation is mainly determined by the number of available outlets and thus by the water levels. A distinctive feature of inland navigation, namely its ability to carry large amounts of cargo, means that it is dependent to a certain extent on the depth of water available at any given time at the bottlenecks restricting the amount of cargo that can be carried.

Daily water level forecasts have been provided to inland navigation for a long time. Now, a water level forecast covering more than one day has been introduced for the Rhine, Danube and Elbe. Today, the boatmaster responsible for the amount of cargo carried can receive a forecast of the water level on those sections of the waterway that are critical in terms of the vessel’s draught two to four days ahead of his trip. This means that there is no longer any need for the previous practice of partially unloading (“lightening”) the vessel when water levels fall. On the whole, this intelligent forecast makes a major contribution to increasing the productivity and economic efficiency of inland navigation and also to enhancing safety.

This information is disseminated via the Internet (e.g. www.elwis.de), and in some cases via teletext and ship radio.

3. Making public transport more attractive through telematics

Strengthening public transport, increasing its attractiveness and giving it a larger share of the overall traffic volume with the aim of making the overall transport system more efficient and environmentally friendly is a major transport policy task. In this context, transport telematics is becoming increasing important.

Although telematics applications are already common practice in public transport, they have to be evolved and expanded if public transport is to be made more attractive. In the future, travellers will continue to be more likely to go by public transport if, among other things, they have rapid access to real-time data on the traffic situation and the operators provide customer-friendly services. The timeframe within which the telematics applications and services required for this purpose can be delivered on a large scale will mainly depend on the pace of technological development and the provision of funds.

3.1 Electronic timetable information services

Electronic timetable information systems have been in use for some years now, but they have basically been limited to one region or one integrated transport association, a specific system or an individual provider, e.g. Deutsche Bahn AG (DB AG). Some integrated transport associations are already interlinked.

A multi-modal electronic timetable information system covering almost the entire Federal Republic of Germany has been available since June 2004, when the DELFI (Germany-wide electronic timetable information) system was introduced. The Federal Ministry of Transport, Building and Housing launched this project in order to overcome people's reluctance to use public transport by pooling the information available about the services provided by the different integrated transport associations and by local, regional and long-distance public transport operators.

Thus, customers can obtain seamless, door-to-door public transport and travel information for their entire journey throughout Germany, and no longer have to consult different timetables or information points. This information includes DB AG's long-distance train services as well as local public transport services in the traveller's areas of origin and destination or timetable information from regional competitors on the transport market. The range of information services currently on the market – there are now seven different technical solutions – will not be reduced as a result of the new system. The information service providers, who act independently and in competition with one another, are interlinked by an open network that guarantees access throughout Germany. The project promotes the international competitiveness of all system providers involved and can be widened to include other European information systems without companies having to be sited at pre-defined locations.

Systems operating on the same technological basis as DELFI have already been successfully deployed in Denmark and southern Sweden.

In addition, the enhanced version (VDV 454 1.0) of the VDV 453 2.1 interface, the development of which was commissioned by the Federal Ministry of Transport, Building and Housing, makes it possible to couple computerized operational control and timetable information systems. This means that dynamic travel information can be displayed in the timetable information.

This new multi-modal timetable information service is available via all regional information systems, and further functionalities will be added in time for the 2006 FIFA World Cup in Germany. These include address searching, maps, searching by point of interest, multiple language capability and the integration of real-time reports on timetable alterations.

The realization of such a service is also a prerequisite for further improving the standard of service in public transport throughout Germany and for linking public and private transport. The results of the "Netzwerk DIRECT" project (DIRECT is a German acronym and stands for Seamless Intermodal Journey Planning with Real-Time Information), which was sponsored by the Federal Ministry of Education and Research, now also make it possible to deliver intermodal journey planning linking private and public transport. The system architecture permits the integration of existing networks and opens up the interfaces for independent content owners / content providers.

3.2 Dynamic passenger information

The current electronic timetable information systems that provide regional information or information covering an entire federal state, plus those that provide nationwide timetable information following the launch across the country, provide passengers primarily with published timetable information. Some systems are already able to reflect any deviations from the timetable that are known in advance. What is becoming more and more interesting for passengers, however, is dynamic passenger information, i.e. real-time data resulting from the actual traffic situation, including any disruption, delays, etc. In the future, timetable information systems that provide regional information or information covering an entire federal state will be able to display dynamic passenger information, i.e. the situation at any given time. The DELFI architecture was designed with this future development in mind.

Some transport operators already provide their customers with information about the actual departure times of buses, trams and trains. Stationary, electronic destination indicators at many underground, light rail and tram stops, and increasingly at bus stops, display the routes that serve the stop, their destination and the number of minutes until the next departure. In some cities, passengers can also obtain real-time information by mobile phone (text messaging or WAP).

In the future, the current operational status of the vehicles deployed will be displayed in electronic information systems. This will make it possible to provide travellers with the relevant information throughout their journey (both pre-trip and on-trip information). The WAP and UMTS transmission standards have created, or will create, new options for mobile phone-based passenger information, which will make it possible to display supplementary information such as maps.

3.3 Electronic seat reservation systems

DB AG has been using electronic seat reservation systems for a long time. As a result of technological advances, which have led to a growing potential for interlinking the different modes of transport, the foundations have been laid for the establishment of intermodal seat reservation systems. An important project in this connection is DB AG's "EPA Redesign" (electronic seat reservation system), by means of which the electronic seat reservation system is to be evolved so that, in the future, users can access the reservation systems of other modes of transport and retrieve information on the availability of seats.

Customers can now access the railways' reservation system using the Internet, mobile phones or the stationary ticket vending machines, and can reserve seats up to a few minutes before they start their journey.

3.4 Electronic fare management

Electronic fare management is the generic term for three levels of modern ticketing:

- cashless payment;
- electronic ticketing;
- automatic fare calculation.

The Association of German Transport Operators (VDV) is currently formulating a nationwide standard that will enable the interoperable use of these three levels with one medium and a uniform customer interface. This research project to develop a uniform interface and data standard also involves creating the organizational conditions, and is entitled “VDV core application”.

3.4.1 Cashless payment

Every year, German public transport operators have a cash turnover totalling billions of euros. Paying cash has many disadvantages for customers and transport operators:

- the purchase of tickets is often associated with problems regarding information about the right type of ticket and the correct fare level and with the fact that customers have to have a sufficient amount of cash in their pockets;
- the money has to be counted and transported;
- cash in ticket vending machines, or cash that is being carried by staff, increases the risk of theft and robbery/vandalism.

These are the reasons why many public transport operators have already upgraded their vending machines and sales outlets to accept cashless payment. The EC cash procedure is an ideal system for the purchase of season tickets from online-capable vending machines or staffed sales outlets. Where only small sums of money are involved, electronic purses such as the cash card or pay card would be a suitable method of payment, because they can also be used offline. The electronic purses use a contact interface.

Unfortunately, these two electronic purses have not proved to be as popular with customers as had been hoped. The pay card is still accepted by two operators, but is to be discontinued. The cash card is accepted by numerous operators and is included on many of the bank cards tied to an account, but turnover is minute.

The VDV core application will thus offer three different cashless payment methods which, although they use contact technology, can also be used for contactless applications in future phases:

- a system tied to a personal bank account, where customers are billed by their home transport operator or integrated transport association for all tickets they purchase from any operator;
- an anonymous bank account into which money has to be paid in advance, the values of which can also be used interoperably;
- a stored-value card, which is basically a multi-trip ticket that can be used throughout Germany.

3.4.2 Electronic ticketing

The next step is to use the storage medium as an electronic ticket on which data is stored on a chip, thereby making it possible to dispense with traditional paper tickets.

This technology is already in use in North Rhine-Westphalia, where some 2 million regular customers have been issued with a dual interface smart card as a season ticket. In Bremen, single electronic tickets are stored on a bank card (cash card); they are currently paid for by cash card, and in the future there will also be a direct debit option.

As part of the VDV core application, a new data standard has also been developed for electronic tickets, which will permit interoperable use.

3.4.3 Automatic fare calculation and electronic fares

The highest level of customer convenience is reached when automatic fare calculation systems transfer customers' knowledge of fares back to the system. At this third level, all the customer has to do is log on to the system in the vehicle or at the stop and log off at the end of his journey, or his ticket medium is read in the vehicle without him having to actively do anything. The VDV core application provides for the check-in / check-out method to be used for this purpose. This involves the customer passing his smart card or mobile phone over a terminal in a contactless manner. In a parallel application, the so-called be-in / be-out system accesses active customer media.

Implementation of the check-in / check-out technology is currently being planned in Berlin, Frankfurt/Main and Northern Württemberg. The be-in / be-out system will be tested in Dresden.

These systems pave the way for a customer-focused evolution towards so-called electronic fares.

This new technology will make it possible to further reduce people's reluctance to use public transport. It is likely to reduce operators' marketing costs and increase their revenue. By determining the exact number of journeys made by route, operator and transport system, the operators can further optimize the services they provide without having to carry out additional counting.

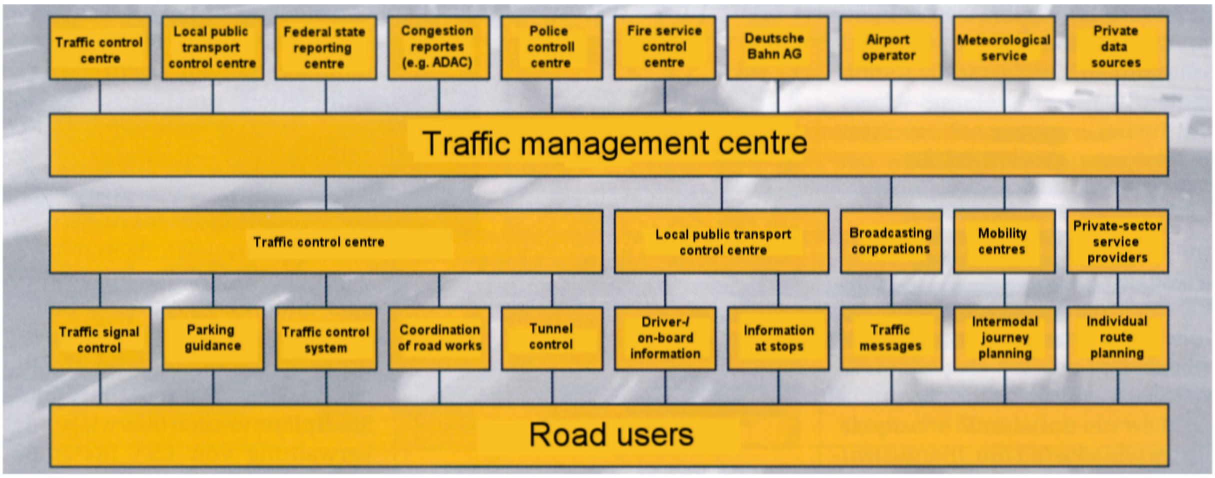
4. Real-time information enables motorists to reach their destination more quickly

Real-time data on the traffic situation prevailing at any given time and the range of transport services available are the basis of telematics services for on-trip dynamic traffic information, route planning and route guidance and for pre-trip dynamic journey planning. These services, which are designed to make transport more efficient and convenient, may be of a collective nature – thus benefiting primarily the general public – or geared to the interests of individual customers. The services can produce the greatest benefits if the measures to manage the traffic volume and meet mobility requirements are taken on the basis of cooperative, integrated traffic management systems.

4.1 Traffic management

Modern, intelligent traffic management comprises numerous traffic information and control components (e.g. dynamic traffic control systems on federal motorways and in cities, parking guidance and information systems, adaptive traffic lights, traffic signals that give priority to public transport, services providing real-time traffic information), to make traffic more efficient, safer and more ecologically sound.

The cornerstones of a traffic management system are comprehensive, high-quality and real-time data plus interconnected infrastructures of the various modes of transport. For private motor car traffic, the data is collected by, for instance, induction loops (buried in the road), infrared sensors (mounted on bridges), camera systems and congestion reporters and consolidated at traffic control centres. Other places that receive and consolidate data include local public transport control centres, federal state reporting centres, police and fire service control centres, Deutsche Bahn AG, airport operators, the meteorological service and private data sources. This data is processed at a traffic management centre and provided to road users:



Source: ADAC Good Practice Guide “Transport Telematics in Towns and Cities” (as at January 2002), translation BMVBW 2004

Comparable systems are either already in operation or in the process of being established in conurbations in some federal states, for instance Baden-Württemberg, Bavaria, Hesse, North Rhine-Westphalia, and in large cities such as Berlin, Braunschweig, Bremen, Cologne, Dresden, Frankfurt/Main, Hamburg, Potsdam, Munich and Stuttgart.

In addition, by using mobility information and advice centres, transport users can obtain information at any time on the current range of services provided by all modes of transport, thereby making their own mobility more planned and rational. Thus, significant progress has been made in the development of modern, intelligent traffic management systems, which aim primarily at integrating the various modes of transport and thus making better use of spare capacity in public transport, and at strengthening intermodal transport.

4.2 Dynamic traffic information and trip planning services

To be able to provide real-time traffic information services, private-sector service providers use real-time and reliable data on the traffic situation at any given time from a wide variety of sources. A traffic data company founded specifically to obtain real-time traffic data accesses, among other things, data that is available at the various regional and local authorities, where it is used for specific purposes such as controlling traffic lights and traffic control systems.

Public-sector traffic data is supplemented by data that private-sector service companies gather on federal motorways using their own data collection sensors. In addition, for the collection of traffic data from rural areas, expectations are focusing more and more on the so-called floating car data procedure, which involves appropriately equipped vehicles, such as HGVs and taxis, anonymously transmitting journey time data, thereby helping to create an overall picture of the road traffic situation. Trials in this field are ongoing. Other privately collected data on the traffic situation is obtained from information provided by congestion reporters (e.g. from automobile clubs and radio stations).

A crucial role in the interlinking and forwarding of data is played by the traffic information centres, which are increasingly being established in conurbations and which are used by public-sector and private-sector providers for their real-time traffic information and trip planning services.

Since 1997, private-sector services have provided dynamic traffic information based on the current traffic situation at any given time. These are real-time traffic information services which can be consulted using mobile communications systems before setting off and while on the move. This takes the form of individual, automated information which is updated regularly as the traffic situation changes and can be retrieved either for the region in which the driver is located or for a specific destination. Call centres provide real-time traffic information – geared to the individual wishes of the caller – in the traditional manner, i.e. not automated.

In addition, more and more commercial and non-commercial traffic information services are being provided on the Internet, containing not only traffic forecasts and real-time traffic information for road traffic but also real-time information for public transport. This total overview enables travellers to plan and carry out their journeys purposefully and effectively, using the means of transport best suited to the current or even potential traffic situation.

4.3 Dynamic route guidance systems

Linking in-vehicle traffic information and route guidance with the traffic situation at any given time makes it possible to provide dynamic route planning and guidance services.

The new dynamic TMC and GSM traffic information services can transmit real-time traffic information to vehicle navigation systems, where they are used to provide route guidance that is adapted to the traffic situation at any given time. Since many medium vehicles are already fitted with on-board navigation systems that can receive and evaluate real-time information transmitted via RDS/TMC or GSM, and retrofit systems are available on the market, it is likely that there will be a higher level of market penetration. The introduction of RDS/TMC has already resulted in a significant rise in the number of navigation systems sold. Germany occupies a leading position in Europe in the field of autonomous route guidance systems, and a further increase is likely. Autonomous on-board route guidance systems coupled with a TMC car radio are already in widespread use.

Further market penetration will depend on how prices develop and on the quality of the route recommendations. One aspect that is of particular importance to the public sector is that its transport policy objectives and the destination and route recommendations are in line with each other (see Chapter II, item 3).

4.4 The 2006 FIFA World Cup

From 9 June to 9 July 2006, FIFA will be staging the World Cup in Germany. This event will attract visitors from all over the world. Germany will take this opportunity to present itself as an innovative and competitive site for economic activity and to showcase technologically sophisticated services.

A large majority of the visitors, especially those from abroad, cannot be expected to have the local knowledge which will enable them to find their way around. Against this background, a comprehensive range of travel information assumes outstanding significance. Visitors should be able plan their journeys right through to their final destination before they leave home. While they are travelling here, they should be obtain to information on the traffic situation using common media. This means that it must be possible to plan routes from door to door; there must be signs giving directions to important places, especially stadiums; there must be dynamic information on the traffic situation at any given time; and the services must be provided in several languages.

The information services are by no means to be developed just for the World Cup. They are to be operated on a long-term basis, to enable more sustainable and efficient use to be made of transport infrastructure and to reduce bottlenecks.

FIFA's internet portal contains a link with the title of "Destination Germany". Starting in early 2005, this will provide, among other things, travel information (initially static) for public and private transport users to enable them to plan their journeys. This static information will eventually be replaced by dynamic information, in some cases in time for the Confederations Cup in 2005, if the cities hosting World Cup matches make dynamic data available.

The DELFI system (see Chapter III, item 3.1) will be used for public transport. Deutsche Bahn AG's advanced timetable information service will be available as an alternative.

In 1995, the Economic Forum on Transport Telematics stated that it is the task of private-sector operators to develop and market traffic information services for private transport. Traffic conditions on federal motorways are already monitored with an adequate degree of quality. Some cities that will be hosting World Cup matches already monitor traffic conditions and process this information.

The traffic information service for private transport will offer nationwide dynamic route planning, including information on disruption and parking guidance, not only to conventional car parks but also to P + R sites. For this purpose, the data from the federal trunk road network will be combined with that from the urban road networks. The interfaces required for reciprocal data transfer will be established.

The cities hosting World Cup matches are willing in principle to make their traffic data available to private-sector operators. The parties involved still have to conduct negotiations to finalize the conditions for the periods before, during and after the World Cup.

5. Potential for economic and ecological savings by using telematics in freight transport and in creating transport chains

One of the primary objectives of transport policy is to consolidate and evolve efficient and ecologically sound freight transport. To this end, it is essential that the opportunities presented by the greater use of transport telematics systems be systematically exploited. Depending on the starting point and impact on transport operations, the following fields can be distinguished:

- consignment-related systems, such as electronic data interchange (EDI) along the transport chain, consignment tracking, electronic customs clearance;
- transport-oriented systems, such as electronic freight exchange systems, freight and fleet management systems, and vehicle tracking and terminal management systems; automatic emergency reporting systems also belong to this category;
- transport-supporting systems are primarily systems for providing traffic information and traffic control, for carrying out safety checks and monitoring infrastructure; automatic fee collection systems also belong to this category;
- administrative systems, such as internal data processing.

Most of these telematics services are already everyday features in many areas of freight transport. The objective is the more efficient deployment of vehicles, optimum planning of load distribution and the possibility of permanent communications between vehicles and headquarters.

5.1 Logistics and fleet management systems

By using logistics and fleet management systems, it is possible not only to minimize empty running – which, at 30 %, is far too high – but also to reduce the number and length of movements, thereby reducing the total road mileage as well as total freight mileage in general. Freight transport and the transhipment of freight become faster and can be planned better. In addition, by exploiting the effects of pooling, it is possible to make better use of the transportation and infrastructure capacity of the various means of transport and to ensure that the railways and waterways, which are the more environmentally friendly modes of transport, have a greater share of the growth in freight traffic. By optimizing transport planning, it is possible to both reduce emissions and, from the business management point of view, save costs. According to information provided by industry, initial extrapolated results from test installations have revealed that up to 25 % fewer CO_2 emissions, almost 30 % less fuel consumption and 10-20 % lower total costs (including fuel, maintenance, overheads, etc.) are possible.

If such results are to be achieved, it is necessary not only to optimize transport movements but also to combine the individual modes of transport into an integrated overall transport system by means of technical and organizational coordination and interlinking. To this end, the services offered within the modes themselves have to be improved, and the interfaces between the modes have to be made compatible.

5.2 Telematics in transport chains

The deployment of telematics systems in transport chains facilitates the interconnection of modes of transport and simplifies their integration into logistical processes. However, the efficient fashioning of transport chains takes place in a sensitive private-sector sphere of activity. Today, many companies already use highly specialized telematics systems which are geared to operational requirements, including traffic conditions. Such in-house systems are generally not suitable for supporting comprehensive collaborative schemes. An intermodal deployment of telematics systems in transport chains on a broad basis, which would be likely to produce great benefits for the economy as a whole, is thus still encountering difficulties. Frequently, the rival companies are unwilling to agree on seamless data systems, or fail to appreciate that such systems are necessary, although it is likely that they would also produce synergistic effects from the point of view of business management. Moreover, in the field of freight transport, there is as yet no seamless application of standards (e.g. EDIFACT: Electronic Data Interchange for Administration, Commerce and Transport) for electronic data interchange between the individual modes of transport, for reasons of competition and cost, among others.

By means of electronic data interchange along the transport chain, it is possible to better integrate freight transport into logistical processes. Logistical concepts interlink the traditional fields of transport, storage and goods handling. The flows of commodities in the procurement, production and sale of goods and services are recorded at a higher level. Rationalization of the logistical processes, which is closely linked to the use of information and communications systems, means that use can be made of the significant value-added potential this sphere. This requires information to be available quickly, in the right form and at the right place. In this context, the evolution of logistics is inconceivable without appropriate information and communications systems.

Against this background, the Federal Government's transport policy directly or indirectly supports primarily telematics applications in freight transport by means of which transport and information flows are pooled in a nationwide network of freight villages, because this facilitates the changeover between modes of transport and thus the organization of transport chains.

The Federal Ministry of Transport, Building and Housing has drawn up a good practice guide, aimed specifically at small and medium-sized carriers and designed to overcome their inhibitions in using new communications media. In particular, this guide facilitates access to information and communications systems and provides general assistance on matters concerning their procurement and operation[5].

5.3 Telematics applications in combined transport (CT)

Combined transport is a special form of transport chain. Changeover between the rail, road and waterway modes is made economically efficient by the deployment of standardized loading units (containers, swap bodies). Here, too, the use of telematics systems offers a multiplicity of advantages. But again, the shippers, forwarders, CT agencies, railways and ships involved in combined transport operations all have their own data systems, which are frequently not interlinked. At CT interfaces, more than anywhere else, open data junctions are necessary to ensure that the physical transport movement is combined with an information chain. This is particularly true of consignment tracking, where advance information facilitates the consignee's planning activities as far as the delivery of the goods is concerned. However, consignment tracking has to exhibit at least the same quality as in end-to-end transport by road. This is more difficult in an intermodal transport chain than in transport by road only, because numerous players are involved. Here, telematics systems can provide appropriate solutions. Thus, for instance, the Internet-based CESAR information and booking system has been developed by combined transport operators and is now in successful operation. A complete telematics system for combined transport requires the following elements:

- a control system to optimize processes at the CT terminal;
- an automatic consignment identification system;
- open data interchange via defined interfaces.

Beyond the obvious advantages in terms of business management, the market position of combined transport will be enhanced by the deployment of telematics systems. Since this is in keeping with the transport policy objective of developing efficient and ecologically sound freight transport, the Federal Government can, as part of its financial assistance to terminals, fund the provision of the necessary hardware at the CT terminals.

5.4 Electronic freight exchange systems

Another interesting sphere for the use of telematics systems is electronic freight exchange. This involves bringing together the supply of spare transport capacity with demand via a neutral electronic exchange system. Since supply and demand on the freight transport market are normally reconciled via direct customer relations, all that is left for electronic freight exchange systems is normally short-term surplus amounts or capacities. For this reason, electronic freight exchange systems have not yet made much headway. Nevertheless, thanks to useful developments and additional functions, such systems are becoming more attractive to shippers and carriers.

5.5 Transport of dangerous goods

Telematics applications in the sphere of the carriage of dangerous goods in Germany are still at the development stage. The Federal Government is initiating feasibility studies to identify and review telematics solutions for the transport of dangerous goods.

An international approach should always be adopted when considering the transport of dangerous goods. Binding national legislation is based on international treaties and agreements. Moreover, dangerous goods are transported by all modes of transport. These transport operations are usually multimodal, especially in cross-border traffic. Thus, telematics solutions that are related to dangerous goods must always be intermodal and have Europe-wide or worldwide compatibility.

The support provided to telematics developments in the dangerous goods sphere focuses on

- creating the legal conditions for the deployment of telematics solutions and
- demonstrating the feasibility of specific telematics solutions within the framework of research projects.

[5] Visit the website at www.iml.fhg.de 342.html

At a workshop on “telematics applications and other innovations in the carriage of dangerous goods”, held as part of the “transport logistic” trade fair in Munich on 23 May 2003, the Federal Ministry of Transport, Building and Housing reviewed the status of activities so far. It was apparent that there have been several success stories, not only in the rail sector but also in multimodal transport chains. In particular, impressive proof was furnished of the feasibility of using telematics to monitor cargo in combined transport chains. This could produce not only further developments in telematics solutions but also approaches for further miniaturizing the technology used and possibly combining it with equipment already fitted in HGV and train cabs, on ships’ bridges, etc.

The tasks, which have so far focused primarily on rail transport, are now to be extended to cover other modes of transport. The statements made on 23 May 2003 take the previous tasks and results of 1999 and 2001 into account and also include ongoing and new tasks, including tasks that the private sector is recommended to perform on its own initiative:

- the deployment of telematics will enhance the quality and efficiency of freight transport, irrespective of the goods being carried;
- the deployment of telematics will result in both operational advantages for drivers and transport operators and advantages for, inter alia, the manufacturers or distributors of dangerous goods, shippers, wagon owners, etc., by allowing permanent monitoring of vehicles and cargo, including positioning;
- telematics systems are, in principle, considered to be a suitable means for further enhancing the safety of dangerous goods movements;
- the deployment of telematics can also enhance the efficiency of emergency response procedures in the event of accidents involving dangerous goods;
- the economic competitiveness of environmentally friendly modes of transport has to be improved by deploying telematics;
- the deployment of telematics requires international acceptance;
- telematics systems should be designed such that they are self-sufficient and can be used for individual transport units, so that even if only single wagons, transport units or containers are equipped, safety is enhanced immediately;

- the information required can be transmitted to the driver either indirectly, via a provider's control centre or the central control office, or directly, from the transport unit to the driver;
- the development of suitable systems that are fit for operation should be promoted by publishing supporting data;
- standardization of data transfer is necessary, with the aim being to meet international standards. The way in which safety-related data is to be processed should be addressed by the relevant bodies, e.g. ECE, IMO, UIC;
- feasibility studies should be carried out into specific telematics solutions in freight transport;
- a legal framework should be created for the deployment of telematics applications.

This agenda sets ambitious tasks, which open up opportunities for the safe transport of dangerous goods.[6]

5.6 The port as interface

Ports interlink the road, rail and maritime transport modes and thus form intermodal transport interfaces. The deployment of telematics systems in the port transport industry and at shipping and port authorities is designed to optimize transhipment operations and the planning and logistics sphere as well as to assist the ports in their interface function. Here, especially, innovative information and communications systems are absolutely essential if the changeover from one mode of transport to another, initial and terminal hauls, and transhipment are to be quick and thus economically efficient, thereby facilitating the formation of transport chains. One of the focal points of activities is therefore the creation of Europe-wide logistics systems and the provision of seamless information and communications networks for electronic data interchange along the transport chain.

In the sphere of maritime shipping, many systems are already in use. Thus, for instance, the communications systems of the ports of Bremen/Bremerhaven and Hamburg, i.e. Bremen port telematics (BHT) of the dbh database (Datenbank Bremische Häfen) and the DAKOSY data communications system in Hamburg, have created the

[6] For further developments, visit the dangerous goods page on the Federal Ministry of Transport, Building and Housing's website (www.bmvbw.de)

interfaces which are essential for the provision of rapid inter-company information along the entire transport chain from the consignor of the goods in the hinterland via the port to the consignee overseas. It goes without saying that federal government and federal state authorities, such as the customs, the federal waterways and shipping administration, the river police forces of the federal states, the fire service plus business development offices and port authorities, are incorporated.

Examples include the following products, software solutions and applications, which are provided by DAKOSY in Hamburg (see also www.dakosy.de) and by BHT in Bremen/Bremerhaven (see also www.dbh.de) , alongside many other IT services:

- SEEDOS (seaports documentation system);
- GEGIS (dangerous goods information system);
- HABIS (port railway operating and information system);
- UNIBOOK (universal booking platform);
- the ZAPP (customs export monitoring in the paperless port), EXPORT-A and ZODIAK (with link to ATLAS) customs systems and solutions;
- COMPASS (logistics and warehouse management);
- WADIS (wagon deployment and information system);
- ZOLAS (customs link to ATLAS).

Examples of good practice include the UNIKAT application (universal interface for communications between all parties involved in transport operations), which is tailored to the requirements of a rail operator and has interfaces with all the partners involved in transport operations (railways, road haulage, feeders, inland navigation, forwarders, authorities), and the ACTION project (Agents' Container Transport Improving and Organizing Network), which supports, in particular, shipowners, forwarders and brokers/agents in the management of container hinterland transport movements. In addition, the Travemünde integrated data system (TraDaV) in Lübeck is playing a leading role in the development of communications and cooperation systems in the German Baltic ports and throughout the Baltic Sea Region, for instance the telematics interface and its system solutions which the TraDaV provides to all parties involved in transport operations along the logistics chain (see www.tradav.de).

Other IT solutions, both company-specific and intermodal, exist at all German seaports. To meet requirements, they are being expanded and/or appropriate service providers and software companies are offering them on their networks and providing customer support.

Given the increased security requirements at seaports and in shipping, telematics applications will also have to meet new challenges in this field. Thus, for instance, following the introduction of much more stringent customs checks by the US authorities, customs- and cargo-related information now has to be provided for all containers before they are shipped. Here, too, the aforementioned customs systems and other specializations have integrated all the necessary control machinery, in order to meet the more stringent safety requirements on the one hand and the commercial and handling requirements on the other hand.

Other current tasks include the application and evolution of the technologies and projects that have been developed for supporting the "from road to sea" and “short sea shipping” objectives and for interlinking national or in-house solutions to form international and intermodal telematics projects. In the maritime and port industry, these include, in particular, the joint G 7/EU MARIS project and the TEDIM telematics project for the Baltic Sea.

The international TEDIM telematics/logistics project (see www.tedim.com), whose chief partners are Finland, Germany, the Russian Federation, Estonia, Latvia, Lithuania and Poland, aims to enhance efficiency, safety and reliability by the use of telematics in Baltic Sea traffic and in the Baltic rim countries. Of the individual TEDIM projects, for most of which Germany has assumed lead responsibility, the following projects have been concluded in the sphere of port communications and logistics, and have been successfully put into practice as component projects of TEDIM.

- BOPCOM (Baltic Open Ports Communication System, 1999)
  This project covers diverse applications in the fields of port transhipment, booking, hinterland connection, quality management, etc.
- GHADIS (Graphic Harbour Disposition and Information System, 2003)
  GHADIS is a tool for the visualization of database information in a fully graphical interface, combined with intelligent applications.
- NeLoC (Networking Logistics Centres in the Baltic Sea Region, 2004)

The planning of and cooperation between logistics centres plus a telematics-based platform for communications and cooperation between logistics centres in the Baltic Sea Region are the major results of this project.

In addition, the following projects, which were initiated under TEDIM, were included in the EU's INTERREG III B programme in June 2004:

- BaSIM (Baltic Sea Information Motorways)
  The project is being implemented under German leadership and addresses the standardization of ICT solutions for the spheres of transport, logistics and port security and the development of the information platforms required for new transport corridors. The project will be launched in September 2004, together with 29 partners from all the Baltic rim countries (including the Federal Ministry of Transport, Building and Housing).
- InLoC (Integrating Logistics Centre Networks in the Baltic Sea Region)
  This project focuses on further integration of the logistics centres and on interlinking them with other global networks. The Federal Republic of Germany and the Federal Ministry of Transport, Building and Housing are also playing a major role in this project.

Within the framework of integrative concepts for freight transport, inland ports, most of which are located in industrial conurbations, may become increasingly important as locations for logistics services. In recent years, they have developed, by virtue of their transport function and as multimodal freight transport interfaces, into multifunctional sites for industry, trade and distribution. Numerous public inland ports perform a function similar to that of supraregional logistic centre sites and, in addition, are integrated into regional logistics concepts, from which the regions concerned benefit economically and ecologically (see www.duisport.de).

The Federal Ministry of Transport, Building and Housing is not normally responsible for inland ports. This is primarily a matter for the federal states and local authorities. Nevertheless, the Ministry is following the development of logistics concepts at inland ports, and in individual cases it is providing active support (e.g. DUNI in Duisburg).

5.7 Shipping dues and statistics online (ASS online)

The ASS online project makes it possible for shipping operators to calculate and pay their shipping dues online using the Internet. The following functionalities are planned for all users:

- general information on the rate of shipping dues;
- registration, calculation and payment of the shipping dues for specific transport movements

This project does away with the paper-based system of levying shipping dues and the distances this involves. As a result, vessels can be dealt with more quickly at locks and shipping operators can be billed closer to the time of lock usage. The aim is for ASS online to be used at all locks in the medium term. This would also lay the foundations for improved lock management, because it would provide every lock, at an early stage, with an overview of the volume of freight and passenger traffic to be expected. It will be possible to make available the first components of ASS online to users in 2005.

IV. Transport Telematics - Where does Germany stand in Comparison with other European Countries?

In the countries of Europe, traffic management / traffic control is a statutory function. However, in many countries (e.g. Netherlands, Sweden, Italy, France), a trend towards the greater privatization of tasks that have so far primarily been the responsibility of the public authorities is apparent, and in some cases this privatization has already commenced.

1. Electronic traffic guidance systems on motorways / trunk roads

Modern traffic guidance systems are becoming increasingly important, especially in countries with a high-density motorway network with high levels of traffic (e.g. Germany).

In Europe, the emphasis in the field of electronic traffic guidance systems is on traffic control systems on trunk roads. These systems control the flow of traffic depending on the traffic situation, using variable message signs. All European countries attach great priority to enhancing road safety and improving the flow of traffic. Many European countries have realized that traffic control systems can make a major contribution towards achieving this objective. For this reason, roadside systems with variable (dynamic) displays have been installed on parts of the trunk road networks in most European countries, or are being developed and planned.

In many European countries, the information displayed on dynamic signs is classified, as in Germany, into different levels of priority (e.g. Austria, Netherlands, Norway, Switzerland, Wales). At the top of the scale are variable speed limits and danger warnings, followed by variable direction signs, sometimes with recommended diversion routes, right down to other information on the road scene.

In Germany, traffic control systems have been installed on sections of the federal motorway network that are especially prone to congestion and disruption. Various systems are used:

- **Route control:**
  This harmonizes the flow of traffic by using speed limits and danger warnings based on the traffic situation.
- **Network control:**
  This is used to divert traffic flows to alternative motorway routes.
- **Junction control:**
  This is used for ramp metering on entry slip roads.
- **Temporary hard shoulder running:**
  This is used to increase capacity at peak times, based on the traffic situation.

These installations are an indispensable component of today's transport infrastructure. Although the federal motorways, with a total length of around 11,800 km, make up only about 2 % of the length of the entire road network, they account for some 30 % of total vehicle mileage.

Although the Federal Government has made a significant financial effort in the field of dynamic traffic control – federal funding amounting to over € 500 million had been invested by the end of 2001 – the systems currently in operation (e.g. approx. 850 km with route control) do not yet cover all the problematic motorway sections. With its ongoing "Programme for Traffic Control on Federal Motorways, 2002 to 2007", the Federal Government is continuing its activities to improve traffic conditions, and has appropriated € 200 million from the budget for this purpose.

In other European countries, it is apparent that these systems are concentrated on large cities and their adjacent roads. Installation in rural areas tends to be rare, because in most cases this is not justified by the volume of traffic. One exception is the Grand Duchy of Luxembourg. Here, traffic control systems have been installed on all the country's motorways, and it is planned to extend them to cover other categories of road.

Compared with other European countries, the traffic control infrastructure in Germany can be described as very good, in terms of both quality and quantity. It is likely that new kinds of systems developed here, such as the use of variable message signs to allow hard shoulder running based on the traffic situation (which is still unique in Europe), will continue to act as examples of good practice for other European countries.

Unlike Germany, several European countries use variable text message signs as flexible display elements for traffic information. Some of these signs also display journey time information. Examples of countries that use variable text message signs are:

Finland:	A 4 (E 75) between Heinola and Lahti
France:	Paris, Boulevard Périphérique orbital motorway; various sections of motorway operated by the ASF company
Spain:	N 335 national road near Valencia, network control in the greater Barcelona area, M 40 orbital motorway around Madrid
UK:	900 variable text message signs have been installed on 1,400 km of the 10,500 km long trunk road network. In Scotland, roughly one half of the total network has been provided with such signs.
Italy:	In the future, there will be more signs displaying journey times.
Netherlands:	So far, many signs have only indicated the lengths of traffic jams. In the future, they will display journey times.

Only a few countries/regions use bilingual displays. They include Norway (tourist routes), Scotland, Wales and Belgium.

Unlike the recognized success (because it is “measurable”) of the tried-and-tested and familiar electronic variable message signs in enhancing road safety and reducing the risk of congestion, there are still numerous unanswered questions regarding the benefit of more sophisticated information displays (especially text message signs). There is as yet no uniform Europe-wide method of operation, nor has agreement been reached on establishing concise, useful messages that can also be understood by foreigners.

The development of dynamic variable text message signs is also being progressed in Germany. The objective of the ongoing research activities, which have been commissioned by the Federal Ministry of Transport, Building and Housing, is to create the technological and substantive framework for the deployment of flexible display systems for dynamic directional signposting (network control) incorporating concise additional texts that are relevant to drivers’ decision-making. Decisions on the planned extension of the range of displays that has so far been possible on federal trunk roads will be coordinated closely with the federal states.

2. Electronic traffic guidance systems in city centres

In Germany, there are around 50,000 traffic control signals. Roughly one quarter of these are adaptive traffic lights, controlled either by a central computer or at the junction itself. This is the case where it is called for by the design of the network and the density of traffic.

The situation is similar is the other countries of Europe. Here, too, such measures have been implemented, or are at the development and planning stage, for busy roads and intersections. However, it is not possible to provide more accurate qualitative or quantitative information about the state of play in other countries, because this sphere is generally a decentralized local authority responsibility and changes are taking place all the time.

3. Intelligent speed adaptation

Traffic control measures also include Intelligent Speed Adaptation (ISA), i.e. influencing the speed of vehicles by means of external technological control. However, international discussions are focusing more and more on speed alert systems, because automatic external vehicle control is not normally covered by existing legislation.

The main countries in which intensive ISA field trials are being carried out and where introduction is under consideration are the United Kingdom, Belgium (Flanders), the Netherlands, Denmark and Sweden. These trials have been very successful and reached an advanced stage in Sweden. Another noteworthy scheme is the European "Speed Alert" project which, although it uses infrastructure-based speed limits, assumes that the driver retains sole responsibility for his actions.

It remains to be seen how things develop in the future.

4. Individual systems

Throughout Europe, there is now a wide range of individual services marketed by various private-sector providers. Together with the dynamic route guidance, information and trip planning systems, they make their contribution to electronic traffic guidance.

As far as the provision of traffic messages is concerned, the services provided by the public sector (e.g. the TMC traffic message channel) are supplemented by private sector involvement, especially in the larger industrialized nations of Europe.

TMC is in operation in the following European countries:
Belgium (Flanders region), Denmark, Finland, France, Germany, Italy (north), Netherlands, Sweden, Switzerland, Spain, United Kingdom.

TMC is planned in the following European countries:
Austria, Belgium (other regions), Czech Republic, Hungary, Italy (south), Norway, Portugal.

However, individual (dynamized) chargeable traffic message services are not yet very widespread in Europe, especially in Germany, nor are they in wide-scale use. The reasons for this include the considerable costs for customers, arising from the costs of procuring the units and using mobile communications networks, and (especially in Germany) the competing information services that are provided free of charge: voice-based traffic information services, RDS/TMC and the Internet. In the future, it is likely that traffic information services provided via PTAs (personal travel assistants), mobile phones and/or the Internet will increasingly establish themselves on the market alongside in-vehicle receivers. Sales of navigation units have exhibited the following trend since the mid-1990s (Source: ADAC – figures in thousands):

	1995	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**
Germany	12	46	90	165	255	460	590
Europe excl. D	0	0	7	105	260	315	460

ADAC forecasts dating from April 2004 predict that around 1 million in-vehicle navigation units will be sold in Germany, and 1.8 million in the whole of Europe, in 2004. These are likely to supplemented by just over 1 million mobile systems that can be used flexibly and do not require installation.

According to these forecasts, over 20 % of all new cars in Germany will leave the factory with an integrated navigation system in 2004.

On the whole, Germany is playing a leading role in the introduction of electronic traffic guidance systems in the industrialized nations of Europe and in telematics applications.

Germany also has a very respectable position, compared with other European countries, in the case of telematics applications in the fields of local public transport, rail and air transport, inland navigation and maritime shipping.

However, the fact must not be overlooked that there is still a lot to be done in the field of European harmonization and standardization.

German industry has recognized the potential that exists on the market and has introduced innovative applications to tap this potential. Transport policymakers have supported industry in its efforts.

V. Transport Telematics - Investment for the Future

The approach adopted by the Federal Government, which involves a division of labour between the public and private sectors but with close cooperation between the two, has proved successful. This applies in particular to the creation of joint outline conditions, which are necessary if all sectors of transport are to be penetrated.

Despite the progress that has been achieved, telematics has still not fully exhausted the potential that exists and has not succeeded in penetrating the market to a satisfactory degree. The following prospects are emerging and will determine the areas of action for a continuation of the cooperation between the public and private sectors.

- In public transport, both customer-focused and operations-related telematics systems and services will continue to be major cornerstones in shaping modern operations. Customers are very demanding when it comes to the products offered by transport operators. To provide them with attractive services, the development and introduction of telematics-based, increasingly dynamic, i.e. real-time, customer information services, reservation systems and facilities for cashless payment will be continued and intensified. Alongside the collection of real-time data, the pooling and analysis of this data in information systems by means of suitable interfaces figures prominently as one of the major tasks.

- The continuing deployment of modern satellite, mobile communications and computer technology will open up new avenues for efficient public transport operations. Efforts will also be stepped up to expand data collection in local public transport by setting up computerized operational control centres in smaller towns and cities and at the regional level.

- Individual telematics services can benefit the user most if they are provided such that they cover as much of the country as possible. They still focus on motorways and other trunk roads. There has not yet been any significant improvement in the range of services for conurbations and rural areas. For the development of more extensive services, the federal states, local authorities and private-sector service providers have entered into a dialogue to reconcile their interests. At the same time, it is imperative that attractive and reasonably priced telematics systems be marketed.

- In passenger transport, no significant progress has been made in the development of intermodal telematics systems and services. There are currently very few intermodal services available, and there is little demand for them. One obstacle is the inability of different modal services to communicate with each other. Initial efforts have been made to develop cross-modal applications. These include, for instance, park and ride installations controlled by telematics, collective and individual services that provide information on the overall traffic situation and developments in the field of cashless payment for all sectors of transport. Significant progress will be achieved with the development of an intermodal individual traffic information system such as the personal travel assistant. What is important here is that progress be made not only in the development of the technology but also in the creation of services. This requires close cooperation between service providers and public transport operators.

- In freight transport, there are promising approaches to intermodal telematics products and services. Most progress has been made in the fields of combined transport and ports. However, small and medium-sized carriers are frequently still unwilling to agree on seamless data systems and electronic data interchange and to plan and realize transport chains in cooperation with one another, or fail to appreciate the need to do so.

- In the sphere of vehicle-related applications, the new transport telematics technologies provide a range of possibilities for improving road safety. Thus, for instance, both adaptive cruise control systems, which prevent rear-end collisions, and systems which assist the driver (visually and/or audibly) when performing turning manoeuvres or changing lanes or warn him of congestion, even on bends, by means of vehicle-to-vehicle communications, have been developed. Other telematics applications currently being developed by industry for motor vehicles include driver-independent aids, which automatically control the vehicle's speed and distance from the vehicle in front, and even allow several HGVs to be coupled to form a convoy. These technological possibilities, which raise numerous legal questions, have to be clarified at an early stage from a regulatory and legal standpoint in a dialogue with industry, in order to optimize benefits and prevent undesirable developments.

- Galileo, the European civil satellite navigation system, is designed to make Europe independent of systems under national control and open up potential uses in safety-critical and statutory applications. Another objective is to make European industry more competitive in future-oriented fields. These include all spheres in which accurate positioning and time information are required, such as financial services, fleet management, freight tracking, geodesy and agriculture, plus applications with a great basic requirement for continuity, integrity and precision of the systems, e.g. fully automatic precision approach in the aviation sector, train control and monitoring systems in rail transport, the worldwide tracking of containers or collision avoidance systems in aircraft. Most Galileo applications are in the transport sector. The Federal Ministry of Transport, Building and Housing will thus continue to participate in this project within the framework of the activities of the European Commission.

The strategy pursued by the Federal Ministry of Transport, Building and Housing of doing without rigid targets and regulations in transport telematics wherever possible and confining itself to providing support by creating an appropriate framework has proved successful and will continue to guide our actions in the future.