ATLANTIC

A Thematic **L**ong-term **A**pproach to **N**etworking
for the **T**elematics and **I**TS **C**ommunity

Traffic and Traveller Information Services in Europe

Country Digests

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TRAFFIC AND TRAVELLER INFORMATION SERVICES IN EUROPE
TTI COUNTRY DIGESTS

The digests that follow summarise the current state of traffic and traveller information (TTI) service development and provision in 24 European countries*. They are based on a series of more detailed national profiles that have been prepared by expert contributors based in each of these countries. They are designed to present decision makers with a convenient reference tool that will give them a useful insight into the status of TTI in each individual country, as well as contributing to a comprehensive overview of the current state of play across Europe. This unprecedented information-gathering exercise has been carried out as an integral element of the ATLANTIC project, in the context of the EC's Recommendation (2001/551//EC) of July 2001. In this, the EC issued an invitation to all Member States to initiate moves towards the creation of legal and commercial frameworks for private-sector involvement in the implementation of telematics-based traffic and travel information (TTI) services. (The recommendation specifically encouraged the emergence of public-private partnerships).

Key elements in the recommendation include recognition of the need for sharing data between public- and private-sector actors, and of the commercial value of privately-provided services. While acknowledging the continuing role of public authorities in financing major investments, it emphasises the importance of ensuring that the private sector has scope for bringing into the market successful initiatives that are not dependent on public funding.

At the European level, it is important that individual governments are prepared routinely and regularly to exchange their ideas on, and experience in, the development of TTI services. In this way, the population of the EU as a whole will stand to benefit from the success of the most innovative national initiatives.

The EC in Recommendation (2001/551/EC) has invited Member States to produce, during July 2003, initial reports on the progress they have made, and are planning to make, towards meeting the objectives of the recommendation. This set of digests therefore represents a perspective on the current situation across Europe, country-by-country, in advance of the production of these national reports; and, will help to establish a benchmark for monitoring future developments.

ATLANTIC (**A** **T**hematic **L**ong-term **A**pproach to **N**etworking for the **T**elematics and **I**TS **C**ommunity) is a global ITS project supported by the EC, the US Department of Transportation (USDOT) and Transport Canada. Its three main components are:

- The operation of an Internet-based ITS Forum.
- High-level meetings between transatlantic partners.
- Development of good practice and policy for ITS-based traffic and traveller information, in support of the eEurope Action Plan.

*All 15 EU Member States, plus Norway and Switzerland (non-Members) and seven candidates: Bulgaria (accession 2007), Czech Republic (2004), Hungary (2004), Lithuania (2004), Poland (2004), Slovakia (2004), Slovenia (2004).

The full country reports can be downloaded from **www.atlan-tic.net**

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Netherlands: Ed Troost
Norway: Børge Bang
Poland: Szymon Puczyński, Wojciech Suchorzewski
Portugal: Susana Neves, Lies Goller
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Every effort has been made to ensure that the information contained in this report is accurate and up to date but the ATLANTIC consortium partners cannot accept liability for any error or omission. Users are advised to make their own independent checks on the current position for each TTI service reported here.

Contact details for **ATLANTIC:**

Dr. John Miles
Managing Consultant
Ankerbold International Ltd.
Tel: +44 118 975 1566
Email: jcm@ankerbold.co.uk

Steve Morello
ISIS Consultants
Tel: +33 4 78 71 89 55
Email: s.morello@isis.tm.fr

Ian Catling
Ian Catling Consultancy
Tel: +44 1737 552225
Email ic@catling.com

Prof Theodor Crainic
Centre de recherche sur les transports
Université de Montréal
Tel: +1 514 343-7143
Email: theo@crt.umontreal.ca

Prof Kan Chen
2420 Skyfarm Drive
Hillsborough CA, USA 94010
Tel:+1 650 375 8890
Email: kan@kanchen.com

Prof Chelsea White
Georgia Institute of Technology
School of Industrial & Systems Engineering
Atlanta GA, USA 30332-0205
Tel: +1404 894 2307
Email: cwhite@isye.gatech.edu

Isabelle Dussutour
POLIS
Tel. +32 2 282 84 67
Email: polis@polis-online.org

Marc Wolfram
Rupprecht Consult GmbH
Tel: +49 221 60 60 55 16
Email: m.wolfram@rupprecht-consult.de

Dr. Baher Abdulhai, Director
ITS Centre and Testbed
University of Toronto
Tel: +1 416 946-5036
Email: baher@ecf.utoronto.ca

Dr William Johnson
Transport Research, Education & Development Services
58-280 McClellan Road
Ottawa, ON K2H 8P8 Canada
Tel: +1 613 797 1489
Email: johnswf@attglobal.net

AUSTRIA

1. Institutional framework for TTI development

Legal and public policy context

The Österreichisches Bundesministerium für Verkehr, Innovation und Technologie (BMVIT, Austrian Federal Ministry of Transport, Technology and Innovation) has the role of encouraging innovative travel and traffic systems and applications nationally. The nine federal provinces carry out the role regionally. There has historically been no legal requirement or framework for transport operators in Austria to exchange data, and no actual exchange of publicly- and privately-owned data, or between private operators. This is expected to change with the development of the Austrian Transport Telematics System (TTSA) as a technical and regulatory framework for the period to 2010. The TTSA will set up clear procedures for TTI development, emphasising integrated transport chains, system compatibility, and modal split.

The BMVIT's Autobahn- und Schnellstraßen Finanzierungs AG (ASFINAG, State Motorway Development and Funding Agency) finances motorway construction and collects data from operating motorways. The rail situation will change with the upcoming of the rail infrastructure and creation of a competitive environment as a prerequisite for more efficient and less cost-intensive services. In public transport (PT), public- and private-sector operators and associations of operators acquire and use traffic information for their own purposes.

Role of the private sector

Examples of private-sector activities include traffic information via mobile phones from radio broadcaster ORF (OE3) and leading mobile network operator Mobilkom Austria. For a daily fee, subscribers receive general traffic information or customised route guidance via SMS. Some PT operators use the same system to give passengers real-time information on e.g. delays. In 2000, Mobilkom Austria began offering rail ticket booking and purchase, a service now used by some 6500 passengers per month and extended to e.g. cinema and concert tickets.

2. TTI service implementation and research

State-of-the-art of TTI service implementation

The ORF OE3 application is seen as leading-edge, and is based on real-time traffic information derived from drivers. The Euro-regional project CORVETTE (Co-ordination and Validation of the Deployment of Advanced Transport Telematics Systems in the Alpine Area), which covers Austria, is promoting an RDS-TMC service that is seen as having good market prospects. One of the first PT TTI applications to be widely recognised by its target group is Vienna PT operator Wiener Linien's, which gives accurate arrival-time information, on-platform and (often) at station entrances.

TTI research activities

A 2000 benchmark study by Trust Consult for the BMVIT found that Austria had yet to realise much in terms of TTI projects, applications and services as compared with other EU Member States. It recommended implementation of a comprehensive Austrian telematics plan, which led to the TTSA project. This derives from the European ITS architecture project KAREN. Coordinated by the BMVIT, it aims to create a comprehensive, future-proof telematics framework for all modes.

Another BMVIT initiative, the 1999-2003 TAKE ÖV (Telematik Anwendungen für den Kunden Entwicklen im Öffentlichen Verkehr – Developing Telematics Applications for PT users) programme aims to encourage ITS development and implementation in PT. The BMVIT is also establishing a new support programme, I2S (Intelligente Verkehrssysteme und Services – Intelligent Traffic Systems and Services). This aims to bring Austrian companies' levels of participation in R&TD for ITS up to general European levels.

3. Key issues for TTI implementation

Drivers and trends

Institutional (public and private)

Discussions with experts involved in developing I2S, and the first findings from the TTSA project, rank the importance of the key organisations driving TTI implementation as:

1. The BMVIT.
2. Telecommunications supply companies (private sector).
3. Telecommunications operators (private and public sectors).
4. Universities and research centres (public sector).
5. Austrian broadcaster ORF (public sector).
6. The EU.
7. IT companies.

Technological (data acquisition and service delivery)

The same sources rank the key TTI-related technologies for future development as:

1. Real-time information in public and private transport.
2. Floating car data (FCD) in urban areas and on major highways, coupled with a road-pricing infrastructure.
3. Dissemination of TTI by a range of media (e.g. GSM, GPS, Tetra, WWW, RDS-TMC, VMS, DAB, public displays, on-board units, mobile phones).
4. Content provision.
5. Adaptive traffic systems.
6. Navigation systems.

Key obstacles to overcome

The same sources rank these as:

1. The political framework.
2. Public-sector decision makers' tendency to favour new road/rail construction.
3. Legal obstacles (e.g. liability).
4. End-users' perceptions and readiness to use services.
5. Political perceptions of the urgency of the need for TTI solutions.
6. Lack of appropriate business models for private-sector TTI dissemination
7. End-users' price consciousness
8. Operators' consciousness of the need for accuracy in TTI, and of end-users' needs.

Major potentials to use

The same sources rank these as:

1. Intermodal PT timetables, supplemented with real-time data.
2. Real-time mode-independent TTI offering public-/private-transport options.
3. Real-time TTI via all available means of dissemination.
4. Private and PT navigation systems with adaptive capability reflecting the actual traffic situation.
5. Adaptive traffic control via intelligent signals and VMS based on real-time data.
6. Integration of travel information with enhanced regional data.

4. Key actors in TTI development

BMVIT: Evelinde Grassegger, Responsible for Telematics: Evelinde.grassegger@bmvit.gv.at
Trust Consult: Dr Michael Prohaska, Expert on PT telematics: michael.prohaska@trustconsult.com
ORF (OE3): Thomas Ruthner, Responsible for Traffic Information Broadcasting: thomas.ruthner@oe3.at

BELGIUM

1. Institutional framework for TTI development

Legal and public policy context

Since the 1988 regionalisation of Belgium, transport has become the responsibility of three regions: Brussels (the capital), Flanders and Wallonia. There is thus no overall national legal framework plan for TTI development, though the three regional governments have agreed on a cooperative approach and regard TTI provision as their public responsibility. Funding of TTI (and ITS in general) is mainly public. With its dense motorway network, Belgium is giving priority to ITS solutions in improving traffic conditions, road safety and network capacity, in preference to extending the network with environmentally-unfriendly infrastructural works. The emphasis is on improving traffic information centres (TICs) and traffic control centres (TCCs) in a context of European interoperability. A key early decision was to exchange information through DATEX standards originally developed for cross-border use. Particular attention is being placed on:

- Extension of traffic monitoring.
- Improvement of weather monitoring.
- International traffic data exchange (DATEX).
- Assisted motorway emergency operations.
- Dissemination of traffic and mobility information.

The information chain for road-based TTI deployment works on the general basis that data acquisition and fusion are handled by the infrastructure owners (e.g. regional transport ministries for inter-urban roads); information supply and transmission, marketing and support by both the owner and third-party service providers, e.g. public and commercial broadcasters. (The national police, under the Ministry of the Interior, operates the National Traffic Information Centre (NTIC), which is fed with information from traffic monitoring equipment maintained and installed by regional ministries and passes this on to broadcasters).

The emphasis on third-party service provision has increased dramatically in recent years, and this trend is expected to continue. One current example of official public-private cooperation is the broadcasting of privately-generated data from the Touring Mobilis service of the Belgian Touring Club (www.touring.be/trafic/default.asp).

In the rail sector, data acquisition and data fusion, information supply and transmission, and marketing are all handled by national rail infrastructure owner and operator SNCB/NMBS. Pre-trip information is available via call centres and the Internet, providing a full journey-planner service (www.b-rail.be). In-trip information is available via at-station information points/ticket offices and on-train announcements. Responsibility for local public transport (PT) has been devolved to regions. Travel information (only rarely dynamic) is generally managed by individual operators.

Role of the private sector

The private sector has so far played only a minor role in TTI deployment. Brussels PT concern STIB/MIVB, a private company 100% owned by the Brussels Region, has begun implementing real-time at-stop next-bus arrival information, and aims to cover all-important stops within five years. A private company uses location information available at the STIB/MIVB control centre to calculate estimated arrival times. Real-time information on location of vehicles and waiting times at all stops is available at www.stib.irisnet.be Telecommunications providers have begun developing partnerships with PT operators to allow them to deliver customised information to their clients using SMS and/or WAP. A similar service gives flight information at http://flightinfo.advalvas.be/av2/

2. TTI service implementation and research

State-of-the-art TTI of service implementation

General road traffic information is broadcast to the public free of charge, and there are no plans to make this data available to the private sector. Automatic data collection derives from:

- Loops: some 400-measurement points at 10km-15km on major roads (mostly motorways). The system was installed in the 1960s and 1970s for statistical purposes and records average speeds, traffic densities and numbers in vehicle categories at two-minute intervals.
- Cameras: some 20 camera-based video detection systems installed on motorways around Antwerp and Ghent. The infrastructure is maintained by regional road authorities and the data sent to the police NTIC for sending on to broadcasters.
- Emergency phones, installed at 2km intervals on virtually all motorways (though their importance as a source of information on accidents and breakdowns has diminished with most emergency calls now being made via GSM.
- A network of 47 roadside weather detection stations, mostly in Wallonia.
- Several thousand GSM-users reporting regularly to Touring Mobilis.
- Police and Belgian Touring Club air surveillance of traffic on busy days.

Data distribution for pre-trip and in-trip dynamic information is via live broadcasts, RDS-TMC and the Internet, with DAB planned. Services are nationally coordinated to provide, at minimum, complete motorways coverage.

Most PT operators disseminate available information (essentially on timetables and fares) via (in order of importance) the Internet; call centres and mobile phones (SMS and WAP). STIB/MIVB has long deployed a full real-time continuous fleet monitoring and management system, based on dead reckoning and beacons, and a real-time at-stop next-bus/tram announcement system is being implemented. There is also an Internet-based multimodal PT information and journey-planning service that coordinates with other regions and national rail (www.stib.irisnet.be). Wallonia and Flanders each have umbrella organisations of regional PT providers (respectively TEC and De Lijn), with pre-trip and in-trip information available on regional websites. Real-time fleet management capability is currently limited, but there are plans for implementation in the near future.

TTI research activities

Belgium has no national ITS research programme, but has been involved on a number of EU-funded projects, the most important of which are:

- CAPITALS and CAPITALS PLUS (Brussels Region; provision of real-time travel information on major urban roads).
- The CENTRICO Euro-regional project (Flanders Region; cross-border data exchange between regional TICs using DATEX).
- TRIDENT (Flanders Region; integration of existing TTI solutions to minimise duplication of development and disruption to user organisations, with the emphasis on integrating urban road traffic and PT information).
- EDEN (Directory of European traffic centres).

3. Key issues for TTI implementation

Drivers and trends

Institutional (public and private)

Development of a common architecture.
Development of communication protocols (DATEX).
EU emphasis on the need to develop trip time estimates, and ensure that the Trans-European Road Network (TERN) is instrumented to provide relevant input data.
The CENTRICO Euro-regional project, the main driver for all these development, in which all regional transport ministries are taking part.

Technological (data acquisition and service delivery)

Common implementation of DATEX nodes for exchanging traffic data.
Definition of standards for publication of data for service providers.
Creation of cross-industry portals providing personalised services
Availability of GSM.
Release of new-generation wireless communications.

Key obstacles to overcome

Legal issues of data ownership, roles and responsibilities; and liability.
Need to liberalise the market so that information is available to service providers on the basis of 'fair compensation' as opposed to via exclusive supplier relationships. Need for correct data management, so that only valid and current information is presented. Gaps in integrated intermodal information provision (exacerbated by lack of a EU protocol). Need to present information in a user-friendly way.

Major potentials to use

Given widespread availability of basic national road information, there are considerable opportunities in the development of personalised services, in particular ones that provide:

- Seamless integration between as information sources.
- Effective communication in user-friendly ways.

4. Key actors in TTI development

Ministère de l'Equipement et des Transports (Wallonia): Yvon Loyaerts, Head of the Department of Transport Infrastructure: yloyaerts@met.be
Ministerie van Vlaamse Gemeenschap (Flanders): Reginald Keygnaert, Head of the Department of Transport Infrastructure: reginald.keygnaert@lin.vlaanderen.be
De Lijn: Hugo van Wezemael, General Manager: tel: +32 15 44 07 01.

Websites

www.belgie.gov.be
www.belgium.fgov.be
www.vlaanderen.be
www.wallonie.be
www.bruxelles.irisnet.be
www.delijn.be

BULGARIA

1. Institutional framework for TTI development

Legal and public policy context

TTI is not currently a priority in Bulgarian transport policy, largely for financial reasons. For the last 12 years, transport has suffered from chronic under funding, with priority given to e.g. infrastructure maintenance, completion of postponed projects and subsidising public transport (PT). The situation is unlikely to change in the near future. Practical steps towards ITS deployment have included a data transfer network within Bulgarian State Railways (BDZ). This was consciously over-developed as the basis of a future integrated multimodal travel information system, while travel planning centres were established in Sofia, the capital, and other large cities. With the reorganisation of transport in the early 1990s, attempts to create centrally managed TTI systems were abandoned. This stemmed partly from economic difficulties, and partly from a misunderstanding of the role of a modern transport system in a market economy. There now seems, however, to be a new awareness that central and local government have to lead in long-term policy making for ITS development. This is reflected in the Bulgarian National Transport Strategy, which envisages "the creation of information-management systems for rail and road networks".

Overall, the legislative framework can be characterised as neutral to TTI development. There are no significant incentives, nor restrictions - in fact, problems could arise due to lack of regulation. Practical obstacles could also emerge from successive administrative changes. For example, road administration has recently been separated from the Ministry of Transport and integrated with the Ministry of Regional Development and Construction, resulting in some lack of coordination between the former and the Executive Road Agency (ERA). (There are also problems of coordination with the Traffic Police, and with municipal authorities that are responsible for urban sections of the network). BDZ has joined an international consortium planning a large-scale travel information system. There is central and local government support for TTI development in PT. Sofia's municipally owned Public Transport Company (PTC) has installed modern tram and bus monitoring, with scope for development to provide passenger information. Economic pressures are, however, affecting further initiatives, with priority given to data collection and processing for traffic management and improved road safety. There is some scope for including provision of travel information in PT networks that are due for upgrading.

Role of the private sector

Road transport has been completely privatised since the early 1990s. Some operators use modern ITS systems, but for operational management - not to provide travel information. Overall, the private sector is developing TTI systems across all modes, using specialised software and radio links with onboard devices. ICT has been one of the few economic growth sectors over the last 10 years, and offers considerable scope for TTI development.

2. TTI service implementation and research

State-of-the-art of TI service implementation

The following limited and modest examples virtually exhaust Bulgarian experience. One of the oldest and most successful TTI systems provides radio information for road transport. Local ERA offices collect information on road and weather conditions (especially at crucial points, e.g. mountain passes), diversions, temporary speed limits, capacity restrictions and the situation at border crossings. This information is transferred to the Traffic Police Central Office, which adds data on congestion and major accidents and sends the results to Bulgarian National Radio and private stations. On the major road network, there is no comprehensive system for automatic traffic density monitoring. Some 150 sensors are located at key points (plus around 30 in Sofia), but the ERA uses the data for road load assessment, not for generating real-time TTI services. At some major intersections, message panels give alerts on conditions ahead; these are particularly useful in winter when the weather can change rapidly, especially in mountainous areas. There are similar panels at tunnel entrances, combined with video camera

surveillance. Several private companies offer electronic maps of the national road network, which are used by the Traffic Police and the road administration for e.g. precise distance calculation.

In the PT sector, the Centre for Telematics Services transmits regular travel information. A member company of the Bulgarian Telecommunications Association Ltd, its main role is the operation of the national videotext system INFOTEL, which has over 10 000 customers connected via phone or PSDN BULPAK. Examples of its relatively underdeveloped content include timetables and fares for privately-operated inter-city bus lines, BDZ timetable changes, and flight information. The major bus companies post timetables and prices on the Internet. Other services (e.g. via www.bus.bg.com) include booking, travel information (especially for trips abroad) and travel agent contacts. Most operators offer adequate service information by phone.

An EU PHARE-supported project initiated by the Ministry of Transport is aimed at developing a local subsystem of the international 112 emergency phone call system.

TTI research activities

A laboratory at the Technical University of Sofia has been active in developing modern PT position-monitoring systems, including those operated by the Sofia PTC (one GPS-based); and real-time at-stop next-tram arrival announcement panels.
An ERA research unit has been involved in the development of traffic monitoring and control systems (though funding has recently been significantly reduced).

3. Key issues for TTI implementation

Drivers and trends

Institutional (public and private)

On-going integration of Bulgaria's legislative system into the EU's is a prerequisite for accelerated adoption of EU standards, including transport-related ones.
The Bulgarian transport system is an important part of the European network. Significant freight and passenger flows crossing the country are stimulating demand for TTI.
So is growth in tourism, a key element in government transport policy.
Commitment by state institutions to currently planned TTI-related projects is a positive sign of government readiness to support TTI development and implementation.

Technological (data acquisition and service delivery)

The recent telecommunications boom creation of related infrastructure, could stimulate TTI development. The availability of electronic maps and GPS technology shows that some of the prerequisites for TTI e.g. auto navigation, already exist.

Key obstacles to overcome

Lack of adequate financing, which can only be overcome by attracting foreign investment and taking advantage of EU-funded projects. Low levels of public-/private-sector cooperation, with the state needing to play a leading role. Need for clear regulations on data ownership and access rights, to facilitate data exchange.

Major potentials to use

Bulgaria's population enjoys high educational standards, and a large number of private companies have engaged in ICT despite economically critical conditions.
Access to EU-funded programmes has opened doors to more effective cooperation with EU-based partners and participation in international consortia involved in TTI-related activities.

4. Key actors in TTI development

Ministry of Transport: Dimitar Zoev, Head of Transport Policy: tel: +359 2 932 4397.
Centre for Telematics Services, Bulgarian Telecommunications Company Ltd: Dr Dejan Donkov: Donkovd.ctu@btc.bg

Traffic Police Central Office: Dr Dimitar Radomirliev, Departmental Head: tel: +359 2 982 4792/3486.
Technical University of Sofia: Associate Professor Tzetzo Lukarski, Head of the Microprocessor-Based Control Systems for Transport Automation Section: tel: 359 2 965 3523/3299.

CZECH REPUBLIC

1. Institutional framework for TTI development

Legal and public policy context

The Czech National Transport Policy (1998) and daughter documents only partially endorse ITS as an integral part of the transport system – and then mainly in the areas of sustainable development, road safety and public transport (PT) rather than in road user information. This probably correctly reflects a feeling that ITS is something for tomorrow rather than today. The policy does not deal with business models for supporting investment in, and operation of, TTI; though this may change in response to the EU's Transport Policy White Paper.

The 2001-5 national research project ITS in the Current Conditions of the Czech Republic is the effective base of an ITS strategy and architecture and addresses TTI implementation issues (possibly via PPPs). It covers cost/benefit issues and business models. Of the two national ITS organisations, SDT and ITS Czech Republic, SDT, with 50+ members, is an effective advocate and advises the Ministry of Transport. However, a general lack of knowledge of TTI systems and enabling requirements in national and local government is proving a serious barrier to development, with the technical and legal skills needed being much more prevalent in the better-paid private sector. (This indicates a need for PPPs - and for expert independent support in setting them up). A new law on personal data protection may prove a problem in e.g. maintaining personal travel preference profiles. The recent emergence of autonomous regions will lead to more localised, if less homogenous approaches to TTI, though this should not affect the national PT timetable (see below).

The Roads and Motorway Directorate (RSD) is working on a plan for ITS development on the main road network, including strategically placed VMS warning of exceptional weather and other conditions. The main legal barriers to wider TTI provision are the fact that no roadside equipment can belong to or be managed by a private provider; and the lack of any specific legal/regulatory framework for public tendering for, and management of, PPPs. (This will change). Another barrier is the lack of any legal requirement for the state to collect much relevant TTI data (with the exception of PT schedules); while traffic management is entirely the domain of the police, with the boundary between road traffic management and information unclear. The RSD acknowledges the problem and is working on solutions; currently, given legal uncertainties, it is reluctant to 'give away' data to private actors. Authorities at all levels have yet to make road-based TTI funding a priority.

PT is currently the main beneficiary of practical policy support at state level. One example is the public funding of a national Internet timetable database (legally regulated but privately-managed) for all national and regional services, and many large-city ones. The larger local PT operators are generally owned by municipalities, who decide on TTI funding. There is, however, little room in operators' tightly managed budgets, outside Prague. Regional operators are privately owned but heavily cost-regulated, again leaving little room for investment. Funding and coordination of TTI in regional PT may fall to the new regions.

Role of the private sector

This is currently mainly restricted to systems development and technology maintenance (exceptions include vehicle recovery groups, described below). There are strong locally based developers (though the basic technology is generally imported), most of whom are ready to provide TTI services, given the right market entry conditions. Important systems developers include Siemens affiliate ELTODO, which is developing mainly road-based systems in Prague; and Cross Zlin, which supplies much ITS equipment outside Prague.

2. TTI service implementation and research

State-of-the-art of TTI service implementation

TTI services cannot generally compare with those in the EU. There are no traffic/travel information centres (TICs), and little remote data collection or real-time monitoring. Traffic information from disparate sources is broadcast for the main national and urban routes. Loop-based traffic detection operates on the motorway and trunk road network, though data is not used for real-time information provision. All new motorways are equipped with loop detectors at 6km intervals. The planned doubling of the network over the next 10-20 years will provide a base for information applications, though retrofitting existing infrastructure is low-priority. Elsewhere, little data currently comes from automatic detection systems, though work is under way on harnessing traffic signal loop detector data in cities including Prague.

The recent completion of the D5 motorway to Germany included the installation of a VMS system to warn drivers of weather conditions, speed restrictions and border queues.

The RSD is completing a digital map of all motorways and first/second-class roads, as the basis of future geographical applications. It has also developed and trialled an Internet database of lane closures. Its local weather forecast database is currently for internal use only.

Vehicle recovery groups UAMK and ABA provide online road information (www.aba.cz, www.uamk.cz) on roadworks, weather, traffic and incidents. ABA also offers a WAP service.

Carmaker Skoda has begun developing the first Czech in-car navigator with Tele Atlas, with plans for expansion into a transport portal including traffic information. This completely private initiative should be fully available in 2006, with earlier partial availability.

In the urban sector, Prague is committed to TTI for managing the limited capacity of its historic street patterns. Its TIC will pool intermodal data and deal with technical cooperation and compatibility issues as well as relations with private-sector providers. The city has already trialled VMS in its Prague 5 ATRACIT project; fully developed, this will give information on weather, tunnel closures, congestion, accidents and parking. Other cities do not yet consider road-based TTI an investment priority.

For rail users, mobile phone operator RadioMobil offers a paid-for timetable service. There are, however, no current multimodal or booking services.

In the PT sector, bus timetables can usually be obtained by phone. The national CIS timetable database (www.idos.cz) - legally regulated and publicly-privately managed - is publicly available for all national and regional and many local services. Many cities have their PT timetables Internet-searchable. Prague and Zlin have real-time at-stop arrival information. Several cities provide the visually impaired with information via receivers in their sticks.

TTI research activities

The ITS in the Current Conditions of the CR research project is producing an outline strategy, architecture and cost-benefit evaluation framework for ITS development and managing five pilot projects. The main partners are the Czech Technical University (CVUT) and the Transport Research Institute (CDV). The 2001-3 RDS-TMC in the Czech Republic national research project (main partner the CVUT) has explored ways to implementation. A parallel project has looked at waterway use.

3. Key issues for TTI implementation

Drivers and trends

Institutional (public and private)

The growing ITS community is doing much to promote ITS (including information) solutions, standards and an integrated approach to systems development.
Transport policy emphasis on sustainable development will continue to be important, but needs clear commitment to real-time information systems.

Growing realisation of the benefits of quality information systems (enhanced by exposure to EU projects and worldwide 'mainstreaming') will continue to be a powerful driver.

Technological (data acquisition and service delivery)
Installation of loop detection on all new motorways is a major step forward. Prague and Zlin are important models for further development of real-time PT information.

Key obstacles to overcome

Low levels of public-sector awareness and acceptance.
Competing for finance with road construction and maintenance demands.
Financing PT information systems within tightly regulated budget structures.
Lack of an institutional 'bridge' to help develop intermodal TTI.
Lack of clarity in data ownership and commercial access to publicly owned data.
Little tradition of cost/benefit comparisons of investment options, making technology-based projects harder to sell against more conventional solutions.
Lack of definition of responsibilities for TTI as against traffic management systems.
Lack of definition of types, volume and quality of data the state needs to collect and process.

Major potentials to use

There is considerable scope for private-sector co-operation in developing whole road systems.
The RSD's ITS strategy will be important for developing basic infrastructures and databases for road information systems and enabling private-sector participation. The legislative precedent of the national PT timetable database may help define information chain responsibilities for all modes, and specifically for state funding of real-time services. Development of floating car data (FCD) systems may prove key for the collection of high-quality real-time TTI on the secondary road and even motorway network. Development of 3G-based vehicle location could provide cheap travel-time information. With affordable, quality communication frequently a major problem, public authorities should make maximum use of powers to grant infrastructure access to communications networks.

4. Key actors in TTI development

Ministry of Transport: Evzen Prediger: tel: +420 5143 1325.
RSD: Roman Nekula, Technical Director: <roman.nekula@brno.rsd.cz>
CDV: Ivan Fencl, Head of Telematics Department: fencl@cdv.cz
CVUT, Transport Faculty: Dr Miroslav Svítek, ITS Researcher: svitek@fd.cvut.cz
ELTODO: Dr Pavel Pribyl, Technical Director: Pribylp@eltodo.cz
CROSS Zlin: Thomas Jurik, Managing Director: jurik@cross.cz

DENMARK

1. Institutional framework for TTI development

Legal and public policy context

There is no enabling framework for TTI deployment at national, regional or local level, and no national policy concerned specifically with traffic information. The government's 1993 'Traffic 2005' action plan has not been formally followed up. There is very limited political drive to implement a national traffic information masterplan. Regulation is based on public ownership of roads and infrastructures; and public transport (PT) and privacy legislation

Road owners own traffic data collection equipment and the resulting data, which is exchanged between publicly-owned traffic control centres (TCCs) and traffic information centres (TICs). There is currently no organised system for exchanging data with the private sector. Relevant public authorities maintain their own databases. Information is mode-specific and disseminated by Internet and phone.

Key actors involved in TTI are:

- Trafikministeriet (Ministry of Traffic, MoT; responsible for strategy and regulation).
- Vejdirektoratet (Danish Road Directorate, DRD; responsible for national roads).
- Counties (responsible for county roads).
- Municipalities (responsible for urban roads).
- Danish State Railways (DSB; responsible for national rail and ferries).
- HUR (Copenhagen Public Transport Company; responsible for buses in the capital).
- Bus og Tog Samarbejdet (Bus/Train Cooperation; responsible for national TTI coordination).

Role of the private sector

Limited private-sector involvement reflects the absence of a political framework. No major PPP has been formally established for TTI, and the private sector currently has no established base or incentive for involvement in traffic information dissemination.

2. TTI service implementation and research

State-of-the-art of TTI service implementation

The DRD's Globus system offers a 24-hour traffic information service for Denmark and neighbouring countries, using data from the police, rescue services, road authorities, travellers and the Danish Meteorological Institute. It operates pre-trip via the Internet and text TV, and on-trip via RDS-TMC, VMS and phone. Planned extensions include an e-mail service. TRAFIKINFO is a cooperative effort between HUR, the DSB, the police, the cities of Copenhagen and Frederiksberg and others, providing intermodal transport information (www.trafikinfo.dk). Plans include a customised interactive service.
The National Travel Planner is a cooperative effort by major national and local PT operators (www.rejseplanen.dk).

TRIM (Traffic Information on Motorways in the Copenhagen Area) covers some 100km of motorway around the capital (including the Øresund link with Sweden) and is updated minute-by-minute, using loop detectors (www.vd.dk links to the DRD traffic map). Travel time estimation is planned.
The DRD and CM have been working in joint venture to implement travel time estimation on a major arterial road, Frederiksundsvej.
Seven cities including Copenhagen and Aalborg have implemented parking information systems, covering public and private facilities. Aalborg has implemented a local website (www.aalborg-trafikinfo.dk) providing dynamic information on parking availability, road works, bus locations and bus movements.
QUO Vadis in Aalborg is a VMS-based route guidance system advising drivers on queue times on the Limfjord crossings, by calculating vehicle speeds using local sensors. It is typical of the current level of VMS deployment.

TTI research activities

Research is concentrated at the Technical University of Denmark (DTU) and the University of Aalborg, and largely sponsored by the MoT and the Danish Transport Council. The main FORTRIN research programme focuses on analysis and assessment of road pricing systems; its AKTA project is part of the EU-funded PRoGR€SS project (www.akta-kbh.dk).
The DRD carries out TTI R&TD on its own initiative and through EU-funded projects (primarily under the VIKING Euro-regional project). Some involve county and municipal authorities. DSB, Bus og Tog Samarbejdet and Copenhagen County have taken part in the EU SPIRIT project on European intermodal reservation, information and ticketing.

3. Key issues for TTI implementation

Drivers and trends

Institutional (public and private)

With no agreed national vision for TTI implementation, there is a need for political drive.
There is a trend towards decreased investment in TTI by the public sector, which cannot at present identify lucrative business areas on its own account.
Key institutional actors are:
The MoT.
The Department of Justice.
The DRD.
County traffic offices.

Technological (data acquisition and service delivery)

Nationwide deployment of TRIM.
Its expansion to include travel-time estimation, probably based on licence-plate recognition.
Expansion of the National Travel Planner to include regional urban bus services and ferries, and upgrading to include real-time information.

Key obstacles to overcome

Need for the MoT to play a proactive role at strategic level.
Need to create greater political awareness.
Need for allocation of appropriate funding to research and implementation projects.
Need for a focus on targeted education.

Major potentials to use

Environmental policies.
Local political parties.
Conferences.
Media.

4. Key actors in TTI development

Ministry of Traffic: Thorkild Eriksen, Head of Traffic Planning Office: trm@trm.dk
DRD: Henning Christiansen, Director General: Vd@vd.dk
Bus og Tog Samarbejdet: Niels Mortensen, Section Head: nm@arf.dk
DTU Centre for Traffic and Transport (CTT): Professor Oli Madsen, Head of Centre: info@ctt.dtu.dk
Municipality of Copenhagen, Highways and Parking Department: Ole Bach, Director: vejpark@btf.kk.dk
Municipality of Aalborg: Kurt Markworth, Principal Engineer: Trafik.veje@aalborg.dk

Websites

www.trafikministeriet.dk
www.transportraadet.dk
www.vd.dk
www.dsb.dk
www.vejpark.kk.dk
www.ht.dk
www.trafikdage.dk

FINLAND

1. Institutional framework for TTI development

Legal and public policy context

The Ministry of Transport and Communications (MTC) has overall responsibility for four public-sector bodies: the Finnish Road Administration (Finnra), the Finnish Rail Administration, the Finnish Maritime Administration and the Finnish Civil Aviation Administration (CAA). These are involved in creating a framework for the introduction of private TTI, with appropriate regulation, and broadly favour open distribution of data.
TTI is a key element in future planning by the MTC, which is involved in telematics development through R&TD programmes concentrating on ITS architecture and basic frameworks. It has also earmarked funds for developing the Digiroad national road and street database (see below) and realising electronic traveller information for public transport (PT).
Finland's lengthy road network, low population density and weather conditions have all influenced telematics development. With limited market potential, the public sector has had the major involvement. There are, however, indications that road condition information could be of private-sector interest as a base for developing TTI, owing to its high quality and national coverage. A number of issues – e.g. on regulation – have yet to be resolved.
Finnra is responsible for maintaining the public road network, and for related telematics R&TD development. It is the only organisation collecting real-time traffic data and aims, in time, to achieve a single database that could be accessed by private service providers.
Policy would be to provide information free to service providers, for use in their own offers. (However the Finnish Meteorological Institute (FMI) sells weather data commercially, and the issue has yet to be fully resolved). No private-sector actor has yet shown interest in installing traffic monitoring equipment, though Finnra would be likely to find this acceptable.
The Helsinki Metropolitan Area Council (YTV) provides PT in the capital region and has been developing services and systems for improved PT information.

Role of the private sector

Finnish Road Enterprise (FRE), a state-owned-company operating on a commercial basis, is developing a number of telematics applications (see below).
Mobile communications operators have important roles to play in realising TTI services.
Of the few revenue-sharing services that have emerged, two with distinct commercial possibilities are the YTV's and FRE's.

2. TTI service implementation and research

State-of-the-art of TTI service implementation

FRE has recently introduced provision of road condition information, pre-trip and in-trip, via mobile phone (SMS). It is based on Finnra's real-time monitoring of road conditions, weather forecasts and winter maintenance operations. (Finnra's data is provided free; the fee, charged on phones bill, is for FRE's input and mobile phone charges). Finnra also operates a website giving real-time road weather condition information for Helsinki and Tampere, which broadcasters and other media use this in programmes (www.tiehallinto.fi/alk/english/index.html). Finnra's Uusimaa Road District is implementing a travel-time information system on Helsinki's Ring Road I.

Railway stations outside Helsinki are being equipped with new information displays, to be based on real-time information as data systems become available. The YTV gives door-to-door travel information using all PT modes via mobile phone, 'communicators' and palm computers (http://pathfinder3.meridian.fi/ytv/eng/). This free service can be personalised.

The CAA provides real-time air-travel information for Helsinki Airport via teletext and Internet (www.ilmailulaitos.com/ilmailulaitos). National carrier Finnair also provides information via Internet (www.finnair.com) and mobile communications (e.g. the Nokia Communicator, WAP, SMS). No TTI

services are planned for marine transport, where telematics development is focussed on electronic cargo documentation, tracking and tracing, also positioning.

TTI research activities

The MTC's Finnish Research and Development Programme on ITS Infrastructures and Services (FITS) runs from 2001-2004. It covers both public and private sectors and all modes, concentrating on seamless cooperation between operators and user need-oriented activities (www.vtt.fi/rte/projects/fits/indexe.htm).
Finnra's Digiroad database, being developed for the MTC, will contain data needed to facilitate pre-trip route planning, in-trip navigation, and route guidance for emergency services, and PT use. It will also serve traffic management, driver information and road maintenance needs to a limited extent. Finnra is also developing a mobile phone-based positioning system aimed at providing real-time traffic flow data for travel-time estimation on major roads.

An electronic PT traveller information system has reached system definition phase, and is intended to be available within a few years.

3. Key issues for TTI implementation

Drivers and trends

Institutional (public and private)

The major organisational drivers are the MTC, Finnra and the YTV. Road-sector telematics exploitation has focussed largely on collection of road weather information, primarily for scheduling winter road maintenance. The MTC has been putting significant effort into realising a basic TTI infrastructure.
The YTV probably represents the most interesting commercial market area for TTI services. Its PT service can be regarded as a current example of best practice.

Technological (data acquisition and service delivery)

Key areas are mobile communications – via phones, communicators, palm computers; developments in traffic monitoring; and road weather information systems (RWIS) as means of data acquisition.
Developments in mobile communications – specifically in data transmission capability - will bring cheaper and more effective offers and encourage greater public use.
Development of traffic monitoring is crucial for the emergence of reliable, comprehensive, real-time TTI systems. Effective and low-cost information gathering is critical.
Road weather information systems will be a key component of future systems.

Key obstacles to overcome

Limited funding for implementing an extensive traffic monitoring system.
Lack of low-cost detection tools of adequate quality.
Lack of regulation covering data exchange

Major potentials to use

Road condition data on the trunk road network.
Traffic data in the Helsinki area – especially on congestion and incidents.
PT timetable information in the Helsinki area, the most densely-populated in Finland..

4. Key actors in TTI development

Ministry of Transport and Communications: Matti Roine, Head of Transport Telematics: matti.roine@mintc.fi
Finnish Road Administration: Jan Juslén, Project Manager for Digiroad: jan.juslen@tiehallinto.fi
Finnish Road Enterprise: Petri Ellmén, Project Manager for Product Development and Customer Relations: petri.ellmen@tieliikelaitos.fi
Helsinki Metropolitan Area Council: Kimmo Sinisalo, Responsible for PT Information Planning: kimmo.sinisalo@ytv.fi

FRANCE

1. Institutional framework for TTI development

Legal and public policy context

The government is responsible for policy and provision of national traffic information. Public data has by law has to be free (or, if charged for, only at the cost price of provision in required format). There are no standard contracts for supplying public data to service providers. Some public authorities prefer to manage all information themselves as part of traffic management, as with SIER, the interdepartmental road operation service in the Ile-de-France (Greater Paris). So much information is provided free that there is often little incentive for private providers, though some PPPs have emerged. No privately-operated traffic monitoring equipment has yet been installed on public roads, though national standards exist.

Regional governments fund regional services, though operation (including TTI provision) lies with state-owned, but commercially-oriented, national rail operator SNCF and bus operators. (Services in the Ile-de-France are coordinated by the STIF umbrella organisation).

Local authorities fund local PT services and manage local road infrastructure, for which they can develop TTI (often with private-sector involvement). TTI in PT is the responsibility of regional or local authorities or operators, and is weak in rural areas. There is no national multimodal TTI service, though major cities e.g. Paris and Marseilles have local initiatives.

Most French interurban motorways are toll roads, owned and operated by private or semi-public concessionaires. The rest of the network is the responsibility of the state, with roads owned and operated by local authorities or highway directorates (departments of the Ministère de l'Equipement, des Transports, du Logement, de Tourisme at de la Mer, METLTM), outright or in public or public/private consortia.

Road operators are responsible for providing traffic information. Data collected is generally public and made available to traffic control centres (TCCs); and to regional (CRICR) and national (CNIR) traffic information centres (TICs) jointly operated by the MPWT and the police. These centres supply information to service providers. e.g. broadcasters, and exchange data with centres in neighbouring countries, e.g. via DATEX links with Spain.

Motorway concessionaires provide TTI as a customer service and consider themselves in the vanguard of information rovision. Services include real-time in-trip information by dedicated motorway radio and VMS, and pre-trip information via eg websites for journey planning. These services do not necessarily contribute to overall traffic management, as their aim is to attract paying users and not encourage diversions. In peak traffic or emergencies, however, there is good co-operation between motorway concessionaires and public authorities, thanks to special plans which transfer decision making to the regional prefect. Transport operators often provide TTI as a customer service or marketing tool, sometimes as commercial ventures (eg by airlines and SNCF), sometimes with public subsidies (e.g. for local buses). Private bus and coach operators provide road-based PT information within a highly-regulated environment of single-operator licences from local authorities. There is no national door-to-door PT planner and interfaces are rare. STIF is an exception.

Role of the private sector

Although TTI is fairly public sector-oriented, private-sector infrastructure and transport operators play significant roles. Mobile phone operators and Internet service providers offer value-added services (e.g. Mappy's Internet-based trip-planning service). Commercial PT operators and toll-motorway companies (some private and semi-public) provide services. Websites with booking facilities include those of SNCF, most airlines and ferry companies, and toll-motorway operators (the last allowing online electronic tag purchase). Online booking is also available for most major operators by phone (also by Minitel for rail).

The transport industry is undergoing a major transformation, with decision-making lying increasingly with system integrators and developers. The private sector is expected to grow substantially, particularly in IT,

telecommunications and the supply of passenger (and some freight) services, where the trend is towards a market dominated by a small number of large players.

2. TTI service implementation and research

State-of-the-art of TTI service implementation

The Ministry provides a range of public road travel information services and coordinates Bison Fûté ('the cunning bison'), which aims to reduce traffic peaks by advising on best times to travel, using the Internet, broadcasts and VMS. Key road travel information services include:

- TICs and TCCs providing automatic faxed service bulletins to broadcasters. (Autoroute FM 107.7 covers most of the toll motorway network).
- RDS-TMC on motorways; and, more recently, nationally from Mediamobile. (Real-time traffic information can be provided for integration into navigation systems).
- Extensive VMS installations on motorways.
- National/regional phone services (motorway companies also provide a common automated service and some have their own lines).
- Traffic information services from mobile phone operators.
- The Internet: (e.g. www.bison-fute.equipement.gouv.fr) motorway companies' sites (e.g. www.autoroutes.fr, www.asf.fr) and some private services (e.g. www.visionaute.com).

Some websites offer trip calculation, WAP servers and/or personalised SMS/email messages.
Some major city websites provide traffic or PT information (sometimes with trip calculation). Especially noteworthy is the Ile-de-France Sirius system, giving real-time traffic information via 175 VMS, Minitel and the Internet (Sytadin website), with in-car systems fed by service providers Visionaute, Influx and Carminat. Sytadin is the first European server of its kind, and receives 75 000 hits per month. Sirius also helps improve traffic flows and road safety by automatic congestion detection. Similar systems are installed or planned in other cities.

TTI research activities

The main vehicle for state-sponsored research is the PREDIT inter-ministerial programme. PREDIT 3, which started in 2002, has three broad TTI-related themes:

- Mobility and territory.
- Intelligent vehicles (including vehicle/infrastructure communications).
- Safety and new technologies.

Toll motorway operators also carry out substantial research, some pooled through the Association of French Toll Motorway Operators (ASFA). In TTI, this covers standardisation, alternative route guidance and information platforms.
Current research priorities include:

- New services using GPS/GNSS positioning and communication technologies.
- Improving urban/interurban TTI interfaces.
- Use of PPPs for providing information services.
- Traffic information exchange.

Two recent demonstration projects are:

- AIDA (vehicle/roadside communications using DSRC to deliver value-added information), involving a motorway operator and three French car manufacturers.
- HANNIBAL (covering the Franco-Italian trans-Alpine road network). This tested DATEX-based electronic traffic information exchange both in France and cross-border.

3. Key issues for TTI implementation

Drivers and trends

Institutional (public and private)

Need to define which TTI services should be free and which sold.
Improved customer services, e.g. via TTI, being seen as vital by infrastructure owners.
Need for information for visitors, including TTI accessible from other countries.
Need to organise research at regional, national and international levels.

Technological (data acquisition and service delivery)
Lack of low-cost systems for minimal data collection on lighter-trafficked road sections.
Increased access to/use of mobile phones and the Internet.

Key obstacles to overcome
Lack of a 'champion' to promote joint TTI services linking neighbouring operators.
Lack of a structure for provision of genuinely multimodal information.
Limited convergence between different service providers.
Differing data sets for different operators (especially in PT).
Insufficient integration of in-trip road information as between motorways and other roads
Insufficient pan-European integration of TTI services.
Little incentive to develop TTI services for rural transport, due to low demand.
Lack of continuity of service (especially for long-distance journeys).

Major potentials to use
Toll revenues enabling motorway operators to invest in new information systems.
Rapidly growing Internet access taking over from 1980s Minitel technology.
High mobile phone ownership allowing use of pre-trip enquiry services on-trip.
High mobile phone ownership allowing journey time prediction by tracking signals.

4. Key actors in TTI development

METLTM – DSCR: Roger Pagny, Head of European Projects: roger.pagny@equipement.gouv.fr
CERTU (Centre d'Etudes sur les Réseaux, les Transports, l'Urbanisme et les Constructions Publiques, Study Centre for Networks, Transport, Planning and Public Works): Jacques Nouvier, Responsible for Traffic management and Telematics: jacques.nouvier@equipement.gouv.fr for
City of Paris: Bernard James, Leader of the ITS France Urban Multimodal Information Working Group in ITS France: bernard.james@mairie-paris.fr
ATEC (Association pour le Développement des Techniques de Transport, d'Environnement et de Circulation, Association for the Development of Transport, Environmental and Traffic Technology): atec@wanadoo.fr
ITS France: Stéphane Péan, Director of Development: tel: +33 1 45 24 09 09.
ASFA (Association des Sociétés Françaises d'Autoroutes, Association of French Motorway Operators): Jacques Boussuge: jacques.bossuge@autoroutes.fr
Isis SA (Traffic Engineering and ITS Consultants): Martial Chevreuil, Technical and Scientific Director: m.chevreuil@isis.tm.fr

Websites
www.securite-routiere.equipement.gouv.fr
www.predit.prd.fr
www.atec-tec.net
www.itsfrance.net
www.autoroutes.fr

GERMANY

1. Institutional framework for TTI development

Legal and public policy context

Germany's federal structure divides transport responsibilities between four levels: the Bundesregierung (national government), Länder (federal states), Kreise (counties) and municipal authorities. The Bundesregierung lays down national policy, and is directly responsible for the construction, finance, maintenance and control of the federal autobahn and trunk road networks. In practice, it delegates most day-to-day operations (including traffic management) to the 16 Länder, the key authorities concerned with inter-urban road transport. These collect motorways and trunk road traffic data at regional traffic information centres (TICs, linked to the German National TIC), where it is combined with information on scheduled roadworks and (from the police) on incidents.

Within Länder, the Kreise are responsible for the construction and maintenance of interurban road networks, and for bus services. Municipalities enjoy considerable autonomy and are responsible for the construction and maintenance of their own networks, traffic planning and management, and road data collection. Large cities combine the roles of Kreise and municipality and three - Berlin, Bremen and Hamburg – enjoy the status of Länder.

In the rail sector, former national operator Deutsche Bahn (DB) was privatised in 1994 and split into infrastructure provider DB Netz and some 200 operators. DB Netz collects and processes rail operational data for use by operators; but data is only exchanged with PT providers within a Verkehrsverbund (see below).

Local PT is provided by companies that are mostly under the direct or indirect control of local authorities. In major conurbations, operators have formed Verkehrsverbünde (service associations) that coordinate collection of traffic and incident information. Airport operators exchange traffic and incident information with the privately-owned airlines; and with DB Netz, for coordinating 'rail&fly' services connecting with Frankfurt Airport.

The German national strategy for ITS aims to:

- Promote economic development and the success of German industry.
- Encourage sustainable transport, integration and inter-modality, greater PT use.
- Encourage better use of existing infrastructure.

It gives the public sector a key role in providing basic infrastructure and services for network management and control, and traveller information; and sees the private sector as key to the provision of value-added and personalised services within a liberalised regulatory framework.
In 1995, the Bundesministerium für Verkehr, Bau- und Wohnungswesen (BmVBW, Ministry of Transport and Construction) set up the Federal Economic Forum on Telematics to promote ITS implementation in an integrated transport context. The Forum, consisting of public- and private-sector organisations, has developed a legal framework, codes of practice and agreements for ITS development and deployment. It played a key role in a series of seven 'regulatory cornerstones' for TTI development - starting with a December 1995 Memorandum of Understanding on an Agreement on the Rapid Introduction of Telematics Services in Germany - which were published by the BmVBW in a single document in 2000. It is also a catalyst for new services, and active in standards development.

Other BmVBW initiatives include a study of ITS impacts on transport volumes and innovative employment; and the Mobilitätsoffensive (mobility initiative). This makes strategic recommendations on infrastructure development, planning, intermodal transport, logistics, public subsidies, market liberalisation, and stimulation of 'technology thrust'.

Several Länder have developed regional and urban traffic control centres (TCCs) and TICs: exclusively public-sector (e.g. Bayerninfo and Mobinet); or with private participation (e.g. Stadtinfo Köln and VMZ Berlin). Locally, the large cities are key actors in ITS deployment.

Role of the private sector

Two private-sector organisations were involved early in traffic data provision. DDG, a joint venture between mobile phone operators T-Mobil and Vodafone, has installed data collection equipment on motorways and federal trunk roads, under a model contract with the BmVBW, and expects to make increasing use of floating car data (FCD). German motoring association ADAC collects information on incidents from members' reports, its patrol vehicles and helicopters. UMTS deployment is expected to widen the field.

2. TTI service implementation and research

State-of-the-art of TTI service implementation

Pre-trip information is available on the Internet, and in-trip information via VMS, radio, RDS-TMC, DAB and teletext. Information covers road and weather conditions, traffic and incidents, and route planning. PT information is available pre-trip through the Internet. Some urban areas provide real-time information at bus stops. Private operators provide more up-to-the-minute in-trip information, based on DDG traffic data, than is available from public-sector traffic information centres. Mobile phone operators also provide navigation and personalised information services via GSM. Regional inter-modal traffic and travel information centres have been set up in some areas, notably Bavaria, and others are being developed. Bavaria's Bayern-Info provides road, public transport and cycling information including forecasts and route planning services. Several major cities have deployed ITS-based traffic management and information services, all based on co-operation between the public-/private-sector cooperation.

TTI research activities

National transport and telematics research responsibilities are divided between the BmVBW and the Bundesministerium für Bildung und Forschung BmBF, Ministry for Education and Research), which provides most of the funding. Coordination is the role of large, thematically-focused research institutions (projektträger), eg TÜV Rheinland for transport. The 2000 Mobility and Traffic research programme has grouped a number of TTI-related projects round the concept of the Intelligent Transport Network. Four major initiatives are:

- INVENT (2001-05), dealing with driver assistance systems and Traffic Management 2010, which aims to achieve more efficient use of infrastructure and greater PT attractiveness.
- Mobility in Conurbations, launched in 1997 to demonstrate cooperative approaches to integrated urban traffic management through large private-public projects in Berlin, Cologne, Dresden, Munich, Rhein-Main and Stuttgart. Some have fed the DIRECT project, which aims to connect local and regional information services in a cooperative network covering public and private transport, using the results of the EU DELFI and EU-SPIRIT projects.
- Mobility-Information Services, demonstrating new approaches to TTI development.
- Better Understanding Mobility - including the Tele-Travel-System (TTS), project, which aims to improve transport data quality and availability.

3. Key issues for TTI implementation

Drivers and trends

Institutional (public and private)

The Federal Government introducing distance-based heavy vehicle charging, to be installed and operated by a private consortium. Automotives equipping vehicles with open telematics platforms for multiple applications. Mobile telecommunications operators looking for ways to recoup huge investments in UMTS licenses. National research and demonstration projects creating know-how, enhancing cooperation between actors and facilitating 'good practice' transfer.

Technological (data acquisition and service delivery)

FCD collection becoming an important complementary data source (especially urban).
GSM deployment and broad availability of mobile devices enhancing service demand and opening up new possibilities for contents (e.g. LBS) and applications (e.g. tracking).

Key obstacles to overcome

The demand paradox: high user expectations of service content (competing with other media) contrast with very low willingness to pay (competing with free public-service provision).
Business models: private providers need to develop user-oriented service content and billing models that can be successfully marketed.
User awareness: politically-desirable TTI services (e.g. inter-modal public/private transport) are not in demand, as modal choices are fairly rigid.
Reliability: high standards are needed to ensure TTI services do not provide outdated or 'wrong' information, so depressing demand.
Data availability: Important gaps exist at intersections between urban and interurban networks, and in restricted access to rail and PT data.

Major potentials to use

Distinct local actor networks could be linked nationally via an independent (though state-subsidised) common forum.
The existing Economic Forum has lost some of its initial impetus but could still have a role in establishing links between industry sectors, especially telecommunications, automotives and SMEs.
PPPs can bridge gaps between limited resources and high political interest in TTI provision (public sector), and between low demand and the need for a business case (private sector).
B2B business cases based on TTI service packages could be sold to automotives, hotel chains, resorts, leisure complexes and shopping centres.

4. Key actors in TTI development

BmVBW: Wolfgang Hahn, Head of Transport Policy Division: wolfgang.hahn@bmvbw.bund.de
BmVBW: Rainer Wünsch, Head of Transport Telematics Division: reiner.wünsch@bmvbw.bund.de
TÜV-Rheinland: Peter Rüenaufer, Director: ruee@de.tuv.com
DDG Gesellschaft für Verkehrsdaten mbHinfo@ddg.de
Land Berlin: Ural Kalender, Responsible for Urban/Regional TMC/TIC and TTI Services: ural.kalender@senstadt.verwalt.-berlin.de
City of Cologne: Peter Hasberg, Head of Traffic Management: peter.hasberg@stadt-koeln.de
Mobinet (Munich): Wilhelm Wolters, Project Coordinator for Urban/Regional TMC/TIC and TTI Services: kriele@projektbüro.mobinet.de
Siemens AG: Heinz Sodeikat, Head of Communication and Standardisation Division; Member of the Federal Economic Forum on Telematics: heinz.sodeikat@siemens.com

GREECE

1. Institutional framework for TTI development

Legal and public policy context

The market for TTI services is lagging behind expectations. Out of a number of mid-1990s initiatives – primarily local demonstrators or pilot implementations of EU-sponsored projects - very few survived and fewer still have developed. One reason is the failure to identify the right agency for implementation. The public sector has yet to initiate a well-defined and coherent policy on information provision. The first need is for a process of inter-agency information sharing. A good indication of the current state of affairs is the fact that the most publicised TTI service is the dynamic Athens Real-Time Traffic Map (www.transport.ntua.gr/map - see below). This has been developed by an independent research organisation, the Department of Transportation Planning and Engineering of the National Technical University of Athens (NTUA).

Role of the private sector

The expectation is that private operators will set up partnerships with public authorities to support traffic operations centres and contribute to the collection, distribution and fusion of traffic data. These will most probably develop as major transportation projects are given out to private build-operate-transfer (BOT) concessions (see e.g. www.attiki-odos.gr). The private sector does not yet seem to see a promising, self-sustained market for such services. Those available are part of broader offers. COSMOTE (www.cosmote.gr), one of three Greek mobile phone operators, has launched an SMS service to track flights at the new Athens International Airport. Sending the message 'AEPO OA270 04/03/03' to a service center (1651) enabled the user to track incoming Olympic Airways flight 270 from London Heathrow on 4 March 2003. COSMOTE has also developed a voice portal, giving the same information to callers to 1656, and provides short-sea shipping timetable information.

2. TTI service implementation and research

State-of-the-art of TTI service implementation

For the Athens Real Time Traffic Map, raw sensor-derived data capturing traffic volumes and occupancies reaches the NTUA's Control Strategy Selection Tool (CSST) every 90 seconds. The processed data generates graphics image format (GIF) images covering the city centre. The final result is accessible to any Internet user at www.transport.ntua.gr/map. (A cell phone version is available at: www.transport.ntua.gr/map/en/mobile.html. The site offers related services, including concurrent displays of messages displayed by VMS operated by the municipality of Athens, (www.cityofathens.gr). Their content can also be accessed at its WAP site (www.cityofathens.gr/index.wml).

Providing travel time information is seen as important for achieving network efficiency. Route origin points are defined at key approaches, with speeds and travel times estimated using an algorithm fed by available flow and occupancy data from UTC controllers. Estimated times are represented graphically; clicking on a traffic light symbol representing a selected gateway tells travelers how far they can go in 15 minutes.

In 2000, the Ministry of the Environment, Physical Planning and Public Works (M-EPPPW) launched a new initiative with a consortium of industrial partners, complementing the dynamic map beyond the city centre (www.pdk.minenv.gr/map.html). The site is designed to develop from congestion displays to a full incident map as part of an 'integrated system for environmental traffic control'. A key innovation is the concurrent display of travel time estimates, posted on specially-erected VMS panels, as dynamic text overlaid on pictograms. NTUA dynamic traffic mapping handles information processing and dissemination.

New traffic messaging alerts network users to congestion by e-mails sent as SMS messages to mobile phones. Time-based messages are sent out twice daily; event-based ones whenever an incident is

detected. Users must register for the service, which is free (though they may incur phone company charges. http://frida.transport.civil.ntua.gr/map/el/terms_sms_gr.html
For public transport (PT) information, the Urban Transportation Organisation of Athens has launched a new site (www.oasa.gr) offering static bus information. (This is, however, designed more as a contribution to e-government than as a specific TTI service). For port information, a VMS system at Piraeus matches harbour gates to island destinations. A similar system in Thessaloniki displays parking availability and other relevant information.

TTI research activities

The EU-sponsored QUARTET PLUS research initiative introduced the TTI concept to Greece. It aimed to combine the roles and resources of various public organisations in a synergetic, cooperative effort promoting the 'integrated road transport environment' (IRTE). A key element was the 'mobility regulator' concept, designed to deter excessive private car use by traffic gating, supplemented by pre-trip and in-trip information to:

- Redirect vehicular traffic as applicable, with re-routeing advice.
- Optimise local PT operation, by bus pre-emption.
- Disseminate TTI using electronic techniques including the Internet.

The long-term aim was to minimise traffic impact on urban environments. It has led to development of an IRTE-based urban travel information and traffic control system.
The Eye in the Sky project involves a consortium of German and Greek partners headed by the Berlin (Germany)-based Gedas group. Co-financed by the EU, it integrates airships, fitted with navigation and GPS technology and special cameras, with information from floating car data (FCD) sensors for more effective traffic management.

3. Key issues for TTI implementation

Drivers and trends

Institutional (public and private)

New services will emerge primarily from mobile phone companies offering transport-related information at national/regional and, ultimately, local/neighbourhood levels.
Service providers may compete to increase content and scope of information provision from medium- to short-term.
Total mobility packages will emerge in time for the 2004 Athens Olympics.

Technological (data acquisition and service delivery)

The Internet will play a major role in raw and processed data transfer, and finished products.
WAP services will probably not catch up, but SMS services (pull- or push-driven) are already very popular will expand.
Web-based services/operations will emerge by 2003.
Location-based services will emerge by 2004.

Key obstacles to overcome

Relative small market size.
Need for the public sector to motivate itself before it can stimulate the wide-ranging private-sector initiatives needed to build up momentum.
Very small number of data sources that are collecting and storing traffic- and travel-related data in any systematic or permanent way.

Major potentials to use

3G mobile telephony will be the major TTI enabler for a host of new applications, all expected to be available on next-generation handsets.
Location-based services will expand rapidly.

4. Key actors in TTI development

Ministry of the Environment, Physical Planning and Public Works, DMEO Division: Kostas Skiadopoulos, Head of Traffic Control and ITS Applications Division: Kskiadopoulos@hotmail.com
Urban Transport Organisation of Athens: Dr Stratos Papadimitriou, Managing Director: Stratos@ath.forthnet.gr
Municipality of Athens IT Company: Constantinos Lambrinopoulos, Director: Clab@cityofathens.gr

HUNGARY

1. Institutional framework for TTI development

Legal and public policy context

Hungary's draft national transport policy sees ITS as an important tool for ensuring better use of the existing infrastructure, e.g. by providing accessible and universal TTI services for both road operators and users. Under the e*Transport* banner, the country aims to attain sustainable mobility with high service standards by creating economic and environmentally-friendly transport systems, with particular emphasis on:

- A comprehensive service including both dynamic and static travel data and map information transmitted by a range of media.
- Enhanced intermodality.
- Greater use of urban public transport (PT).

The main actors are the Ministries of the Economy and Transport (MET), and of Informatics and Communications (MIC), both established in 2002 after a major governmental reorganisation. The MIC's main task is to create a framework for widespread IT use through the continuously monitored and updated Hungarian Information Society Strategy (HISS).

The Hungarian motorway network is operated by the State Motorway Management Company (M0, M1, M3, M7) and AKA Rt (the M5 concession). The new Motorway and Trunk Road Development Plan to 2015 reflects the fact that four Pan-European transport corridors intersect at Budapest. Heavy international transit traffic loads on the national network are exacerbated by missing links in the national motorway system

Non-motorway interurban roads, and national roads crossing urban areas, are managed by 19 county road administrations, while local authorities operate urban roads.

The National Roads Technical and Information Service (ÁKMI) operates the national road databank. It coordinates the operation and maintenance of the 30 000km national road network and provides traffic and safety information, using data from county administrations on e.g. temporary road restrictions and roadworks. ÁKMI is also active in research.

In Budapest, the capital, an Urban Traffic Control Centre (UTCC) operates 860 signal control junctions, 60 per cent centrally controlled and CCTV for traffic control, with special cameras on bus lanes. The city is developing an Integrated Transport Information System, starting with electronic alerts on highway and utility maintenance and repair works via a map-based web interface. Regional motorway traffic control centres are being connected to it.
PT services are operated by local authority-owned companies in major cities and by regional bus companies in smaller ones.

2. TTI service implementation and research

State-of-the-art of TTI service implementation

The early 1990s MARABU (MAnagement of Road traffic Around BUdapest) system continuously monitors the M0 Budapest ring road to optimise capacity and the road's distributor function, and enhance road safety. The comparable MAESTRO, implemented in 1999 on the M3, also gives traffic information on connecting roads. It complements loop-based traffic data collection with video camera monitoring.
Launched in 2000, the ÚTMET road and weather information system supports winter road maintenance work, with some 200 meteorological data collection stations across the network.
The planned ÚTFORG traffic data collection system, with 50 traffic data collection stations, will generate traffic and speed data (by vehicle category) from critical sections of the network, 24 hours a day, and enable early detection of congestion. Its real-time data will feed the MET's ÚTINFORM service, which provides information on road traffic conditions across the national network. (Data is collected from county road administrations via ÁKMI).

The key technical conditions exist for individual TTI systems and some are functioning – but primarily experimentally and not on any comprehensive or integrated basis.
GPS is operating in a number of systems, offering fleet management and (experimentally, so far) navigation applications. GSM provides data transference capability and numbers of mobile phones are increasing rapidly, expanding scope for new services.
The NavCity/RoadGuide on-board navigation system uses GPS combined with a map database stored in an on-board computer. Further development involving eg dynamic data is under consideration. The mobile phone-based PannonWap Navigator is an automatic positioning-based object-searching service providing route guidance and travel-time estimates in the Budapest region and major towns.
Spedinform is a pre-trip information system for small freight transport companies, which achieve significant time and fuel savings by using it.

Rail users can use Hungarian State Railways (MÁV Rt)'s ELVIRA electronic timetable and MÁVINFORM schedule change alert system. Information is also available via radio, Internet, videotext and phone. Regional bus operators provide mostly static information on timetables and fares via phone and the Internet. (A WAP interface is being tested). Multimodal trip planning with e.g. rail is not yet available.
Budapest Public Transport Operator BKV Rt has operated automatic vehicle monitoring on main bus routes since 1996. The system is, however, not linked to the UTCC and does not provide real-time information. BKV's FŐVINFORM acts as a regional equivalent to UTINFORM and includes PT information.
The Info-Touch pre-trip information service operates via touch-screen terminals at Budapest PT interchanges and tourist detinations. Information can be displayed on a map, in text or graphically, with route guidance for both PT and car journeys.
For waterborne transport, GPS-based inland ship navigation maps are available in electronic format for the river Danube and Lake Balaton.

TTI research activities
ITS Strategy for the National Road Network (MET project 2003). Priorities: elimination of bottlenecks; motorway traffic information and control systems; distance-based road pricing; traffic information centres, ITS tools for better road management; system architecture.
ITS System Architecture for the National Road Network (MET project 2003). Progress: development of system architecture concept for regional traffic control and information centres for Budapest (hardware procurement completed for connection to regional information systems) and Debrecen (installation by end-2003).

3. Key issues for TTI implementation

Drivers and trends
Institutional (public and private)
The MIC's role in promoting the Information Society is of overriding importance.
There is high private-sector interest in fleet management, navigation and information systems.
EU regional and cohesion funds are available to Hungary as a new Member State.
The institutional background for ITS in road transport is available.
Demand for ITS deployment is coming from both operators and users.

Technological (data acquisition and service delivery)
GSM, GPS and the Internet are available and in use.
Several TS applications are operational, with further development planned.
Common, comprehensive databases are being established.

Key obstacles to overcome
General shortage of funding.
Lack of political support for complementing EU R&TD funding.
Lack of the institutional conditions for deployment in regional and urban transport.
Lack of a regulatory background for use of information.
Lack of interoperable and open systems.
Lack of user-related infrastructure.
Lack of standardisation efforts, in e.g. data collection and digital mapping.

Major potentials to use

Establishment and consistent execution of a comprehensive ITS strategy.
Comprehensive government strategy for achieving the Information Society.
Establishment of a system architecture for integration of future systems.
Active participation in the EU's Sixth Framework R&TD Programme.
Active government support for researchers and entrepreneurs.
Acceleration of the standardisation process.
Support for pilots of systems that have not yet been deployed.
Possibilities for using EU funds.
Rapid expansion of existing systems.
Effective public/private partnerships.

4. Key actors in TTI development

Ministry of Informatics and Communications: Dr Csaba Csapodi, Director General: csaba.csapodi@ihm.gov.hu
Ministry of Economy and Transport, Transport Policy Department: Dr Ferenc Szentkláray, Director General: szentklaray@gkm.hu
Ministry of Economy and Transport, Road Transport Department: András Székely, Director General: szekely@gkm.hu
Institute for Transport Sciences Ltd: László Ruppert, Director General: ruppert@kti.hu
MATAV (Hungarian Telecoms Company): Zoltán Tankó, Chief Officer, Business Services: tanko.zoltan@ln.matav.hu
Antenna Hungaria Co: Zsuzsa Patonai Joób, System Developer: joobz@ahrt.zene.hu
State Motorway Management Company: Tamás Leinemann, ITS Controller: leinemann.tamas@autopalya.hu
National Roads Technical and Information Service (ÁKMI): Péter Hernádi, ITS Controller: hernadi@mail.kozut.hu
MÁV Informatika Ltd (Hungarian Rail Research Consultancy): Lajos Szűcs: szucsl@mavinformatika.hu

Websites

www.ihm.hu (MIC)
www.gkm.hu (MET)

IRELAND

1. Institutional framework for TTI development

Legal and public policy context

Proposals for ITS, and TTI services in particular, are in their infancy in the Republic of Ireland. The public sector is providing the momentum for introducing TTI initiatives, eg real-time passenger information systems, and private-sector involvement has so far been limited.

The major bodies currently responsible for transport in Ireland are:

The Department of the Environment and Local Government (responsible for policy, legislation and funding for roads and traffic management).

The Department of Public Enterprise (responsibilities for public transport (PT)).

The National Roads Authority (NRA, planning, coordination and funding roles for roads, with project implementation via local authorities).

Local authorities (local responsibilities for roads and traffic).

Corás Iompair Éireann (CIE) and its three operating subsidiaries, Dublin Bus, Iarnród Éireann (Irish Rail) and Bus Éireann (responsible for most PT services). (A few private bus operators provide very limited services. The Railway Procurement Agency is responsible for developing light rail and metro proposals).

The Dublin Transportation Office (responsible for coordinating and monitoring implementation of the Dublin Land Use and Transportation Strategy; and monitoring implementation agencies to ensure that works are consistent with the Strategy).

The Garda Siochána (Police, responsible for enforcing traffic law, with some functions shared with some local authorities).

The basis for infrastructural development is the National Development Plan (NDP) 2000-2006 (www.ndp.ie), which outlines Government's objectives for improving key areas including transport. While this contains no specific reference to TTI services, it includes the aims of improving reliability, reducing journey times, improving road infrastructure and contributing to sustainable transport policies. Sources for capital funding include the European Union Cohesion Fund and European Regional Development Fund.

Central to NDP implementation is the provision of €22.4 billion over the period 2000-2006 for public infrastructure developments including roads and PT projects. The current remit for TTI development is limited, given infrastructural deficiencies, which need to be rectified prior to its widespread introduction.

Role of the private sector

Private-sector input into strategic and policy development in transport is limited. While private funding had not featured in transport for some ten years, the situation has changed with the adoption of the public-private partnership (PPP) approach for certain projects, to accelerate the pace of development. There are no current PPP projects for TTI provision.

The PPP approach has been adopted on a case-by-case basis. The NDP sets a minimum target of €2.35 billion of PPP funding, with €1.65 billion for roads and PT projects. The key area of private-sector involvement in TTI services is expected to be in the provision of traffic/ passenger information on the Internet or via mobile phone.

2. TTI service implementation and research

State-of-the-art of TTI service implementation

INSTANT (Information and Management System for Multimodal Transport in the Republic of Ireland and Northern Ireland) is a European-funded project based on a multimodal traffic management and information system for cross-border traffic between Dublin and Belfast (the capital of Northern Ireland). Its three principal components are:

- A pre-trip planning tool.
- Creation and dissemination of real-time traveller information.

- Traffic control and management.

The study is also examining issues of technical feasibility, system costs, impact assessment, system finance, and implementation.
The Euro-regional STREETWISE project (2002-2006) aims to provide seamless and effective travel information on the Trans-European Transport Network (TEN-T) between the Republic of Ireland, Northern Ireland, Scotland, Wales and England. It acts as a bridge in a planned pan-European network.
The NRA's M50 Motorway Management System involves implementing ITS technology on the orbital motorway west of Dublin. The project is being developed to include automated incident detection system and variable message signs (VMS) for driver information.
In PT, Dublin Bus' Q-Time real-time passenger information system gives estimated waiting times for the next bus, and is updated every 30 seconds. Iarnród Éireann has introduced a similar system on the Dublin Area Rapid Transit (DART) electrified suburban rail service which carries over 80 000 passengers a day.
A number of authorities have developed local traffic management systems including CCTV, VMS signage (primarily for urban parking, eg in Dublin and Cork, but also for route selection, eg by the NRA), and automatic traffic counting information (eg by the NRA) that is posted on the Internet for informational purposes.

TTI research activities

Transport research is not significant. The primary source is the Transport Study and Research Group (TSRG) of the Department of Civil, Structural and Environmental Engineering of Trinity College Dublin, which has taken part in a number of EU-funded projects.
The Traffic Research Unit (TRU) of the Department of Civil and Environmental Engineering in University College Cork has expertise in transport modelling and planning, urban traffic management and the use of ITS.

3. Key issues for TTI implementation

Drivers and trends

Institutional (public and private)

The current focus is on developing sustainable transport systems. This will result in new TTI projects, with private-sector involvement encouraged under the Government's PPP policy.

Technological (data acquisition and service delivery)

The Republic's three mobile phone system providers are all keen to develop data systems using GSM, SMS and WAP based on 2.5G and 3G technology.
There are moves to develop remote monitoring for PT vehicles using GPS.

Key obstacles to overcome

The main obstacle is the lack of a comprehensive transport infrastructure. Others include inconsistencies in proposals from different authorities; lack of funding; lack of resources for project design, management and implementation; and lack of private-sector involvement.

Major potentials to use

Traffic is increasing rapidly in major cities. TTI services will be needed to effect changes in travel patterns, e.g. through encouraging increased PT use and avoidance of congested road conditions, and providing information on parking availability.

4. Key actors in TTI development

National Roads Authority: John Fitzsimons, Senior Project Manager, Transportation Section: jfitzsim@nra.ie
Dublin Transportation Office: John Henry, Director: postmaster@dto.ie
Dublin City Council: Owen Keegan, Director of Traffic: Owen.keegan@dublincity.ie

Dublin Bus: Derry O'Leary, Strategic Planning Manager: Derry.oleary@dublinbus.ie
Irish Rail: Michael Murphy, Manager, Suburban Rail: tel: +353 1 703 3504
Railway Procurement Agency: Donal Mangan: info@luas.ie
Trinity College Dublin, Dr Margaret O'Mahony, Director of the Transport Study and Research Group (TSRG): mmmahony@tcd.ie
University College Cork: Dr D O'Cinneide, Director of the Traffic Research Unit (TRU): d.ocinneide@ucc.ie

Websites

www.nra.ie
www.tcd.ie
www.ucc.ie
www.irishrail.ie
www.dublinbus.ie

ITALY

1. Institutional framework for TTI development

Legal and public policy context

The Ministero delle Infrastrutture e dei Trasporti (Ministry of Infrastructure and Transport, MIT) is responsible for all non-toll highways and national roads through the Italian National Road Directorate (ANAS). It has been developing a legal and business framework for private-sector participation in TTI; published road hierarchies based on DATEX and RDS-TMC applications; and established a legal framework for handling data in emergencies. It is now identifying the best ways of promoting TTI, notably by formally distinguishing private- and public-sector responsibilities, and ensuring that commercial developments give added value.

The MIT works with police ministries that are directly involved in traffic control (to ensure prompt handling of emergencies) to coordinate collection of traffic information. This is distributed through eg national broadcaster RAI's the Centro Controllo Informazione e Sicurezza Traffico (CCISS, National Traffic Information Centre) and other broadcasters.

Below national government, administration operates at three levels: 20 regions; 87 provinces; and some 8000 communes (municipalities) and local transport authorities. The most relevant levels for TTI are national and municipal. The latter co-operates with the national level in collecting and delivering traffic information on the urban network. Key actors are:

- Local transport authorities, responsible for transport planning and monitoring. They generally have a range of information available for dissemination, eg on traffic conditions, road works and closures, events, access control and parking.
- Local transport operators.

The information chain for TTI deployment works generally on the basis that data acquisition and fusion are handled by the infrastructure owner; information supply and transmission, marketing and support by the owner and third-party service providers. Emphasis on third-party service provision is rising. Interurban road infrastructure owners include ANAS, motorway operator Autostrade, and regional authorities; third-party service providers include RAI, Quattroruote, Mizar Mediaservice, and Italian Automobile Club ACI. Urban roads are the responsibility of municipal authorities.

National rail infrastructure owner RFI runs a central rail traffic control center (TCC), which gives information to rail operators for public dissemination jointly with service providers. Regional and local public transport (PT) information is generally managed by operators. Only rarely is dynamic PT information made available to end-users or intermodal.

In May 1996, the Ministry of Public Works (now part of the MIT) published its Telematica e Sistemi di Comunicazione Avanzata Applicati ai Sistemi Stradali – Primo Piano Nazionale (1996-2002) (First National Plan for Telematics and Advanced Communication Systems Applied to Road Networks). This emphasised improvement in TCCs and traffic information centres (TICs) in a context of European interoperability. A key early decision was to exchange information through DATEX standards originally developed for cross-border use.

The Second National Plan, published end-1998 and extending to 2004, introduced wider ITS aspects and focused on improving road services through driver information and support, with information a key factor in improving road safety.

Under the 2001 Piano Generale dei Trasporti e della Logistica (PGTL, National General Plan for Transport and Logistics), TTI is a priority for delivering integrated and intermodal transport. The PGTL's call for the establishment of a reference legal and technical framework led to a 2001 public tender for the development of a National ITS Architecture.

Role of the private sector

26 private companies operating some 6000km of toll roads, grouped in the AISCAT industry organisation, collect data on service levels and traffic conditions and provide information individually or in collaboration.

Service providers are transport-based (eg Mizar Mediaservice, with Infomobility, and the ACI; or cross-industry. The latter, including telecoms companies, tend to integrate travel and general information to provide one-stop shopping pre- and in-trip

2. TTI service implementation and research

State-of-the-art TTI service implementation

Private highway operators run local traffic centres for support and assistance, some of which exchange information with adjacent operators (generally via DATEX). An example of integration is Autostrade's Rome-based central TCC, which distributes information via broadcasters, teletext, fixed and mobile phones, GPS and the Internet; and to the CCISS for onward distribution to service providers.
RDS-TMC, developed by RAI, has been used experimentally in Northern Italy. FIAT has recently produced Stilo model cars fitted with RDS-TMC receivers.
The Rome and Turin (5T) TCCs feed TICs (the latter giving PT and personalised services).
Rail information is available:

- Pre-trip (static) from call centres (often created ad-hoc to handle strikes/emergencies) and the portal run by Trenitalia, the primary national railway operator; and
- In-trip via station message panels and announcements (managed by RFI); and information points/ticket offices and on-train announcements (Trenitalia).

At regional and local PT level, static information services are plentiful. Operators are increasingly interested in ITS, e.g. for TTI, and national ITS body TTS Italia expects dramatic improvements by 2005. Good examples of dynamic PT information providers include ATAC (Rome) and 5T (Turin). Both have contributed to intermodal travel information development.
Airports and airlines provide real-time information via call centres, teletext and the Internet, including portals run by SEA (for Milan) and Aeroporti di Roma (for Rome). SEA's free personalised e-mail service updates on pre-selected flights.

TTI research activities

The National ITS Architecture programme is linked to pilot projects exploring the architecture needs of specific ITS applications.
The Rome component of the EU's TRIDENT project has focused on the integration of PT and urban road traffic information.
Italy is involved in the SERTI and CORVETTE Euro-Regional projects, which focus on the development of traffic information and trip time services in northern regions.

3. Key issues for TTI implementation

Drivers and trends

Institutional (public and private)

Development of the National ITS Architecture.
Use of DATEX to exchange domestic traffic information between operators.
EU emphasis on development of trip-time estimates, and consequent need to ensure instrumentation on the Trans-European Road Network (TERN).

Technological (data acquisition and service delivery)

Increased DATEX implementation.
Definition and refinement of data publication standards, facilitating development of information services by third-party service providers.
Implementation of cross-industry portals providing personalised services.
Widespread availability of GSM to provide real-time traffic and mobility information.
Release of new-generation wireless communications presenting important new opportunities.

Key obstacles to overcome

Legal issues of data ownership, roles and responsibilities; and liability (now being addressed).
Need to liberalise the market so that information is available to service providers on the basis of 'fair compensation' as opposed to via exclusive supplier relationships.
Need for correct data management, so that only valid and current information is presented.

Gaps in integrated intermodal information provision (exacerbated by lack of an EU protocol).
Need to present information in a user-friendly way.

Major potentials to us

Given widespread availability of basic national road information, considerable opportunities in development of personalised services, in particular ones that provide:

- Seamless integration between as information sources.
- Effective communication in user-friendly ways.

4. Key actors in TTI development

MIT: Carla Messina, Responsible for EU Projects: tel: +39-06-4412 3279.

RAI: Amedeo Massimo Minisini, Responsible for CCISS: am.minisini@rai.it
RFI: Nicola Manderino, Responsible for Process and Systems Innovations: n.manderino@rfi.it
AISCAT: Massimo Schintu: tel: +39-06-4827163
TTS Italia: Olga Landolfi, General Secretary: tts.italia@inwind.it
Autostrade: Giuliano Trenta, Responsible for EU projects/DATEX: gtrenta@autostrade.it
Società Trasporti Automobilistici (STA): Maurizio Tomassini: m.tomassini@sta.roma.it
ATAC: Stefania Di Serio: sdiserio@atac.roma.it
5T (Turin): Rosella Panero: panero.r@atm.torino.it
Mizar Mediaservice: Alfredo Bolelli, Managing Director: alfredo.bolelli@verona.miz.it

Websites

www.atac.roma.it
www.autostrade.it
www,radio.rai.it/isoradio
www.5t-torino.it

LITHUANIA

1. Institutional framework for TTI development

Legal and public policy context

Lithuania's transport system has been developed in accordance with her National Transport and Transit Development Strategy (NTTDS), which focuses on safeguarding sustainable mobility for the travelling public. Its main long-term strategic goals are:

- Modernisation of transport infrastructure by integrating major trunk roads into the trans-European networks.
- Expansion of multimodal transport.
- Speedier integration of Lithuanian carriers into European transport service networks.
- Increased transit volumes.
- Creation in major cities of logistic centres, integrated into European networks.
- Development of a safe, environmentally-friendly transport system, on whose services users are well informed.
- Meeting the needs of domestic and foreign transport users.

Lithuania is crossed by two major European transport corridors and has a well-developed and maintained highway network. This is due to be upgraded and reorganised, with priority given to international corridors and new multimodal logistics centres. TTI technologies will play a key role, with services needing to expand significantly. While there are no clear strategies for integrated TTI development, consideration is being given to a portal that would provide e.g. traveller assistance, tourist and weather information, and traffic alerts.

Currently, however, TTI development is a matter more of intent than of significant implementation. Historically, responsibility has been divided between:

- The Lithuanian Road Administration (LRA, www.lra.lt) of the Ministry of Transport and Communications (www.transp.lt), which is responsible for road construction and maintenance and
- The State Tourism Department (www.tourism.lt).

The Information Systems Department (ISD) of the Lithuanian Transport and Road Research Institute (TRRI) is responsible for developing and maintaining traffic data collection (including the results of a traffic-intensity monitoring system) and dissemination. It has produced for the LRA an IT strategy, including the development of the Lithuanian Automobile Road Databank (LARD) and Automobile Road Supervision Information System (ARSIS) – both bases for TTI development. TTI for road users is not currently a priority for local authorities.

Role of the private sector

The private-sector role is limited to specific areas – eg advertising and informational signs, financed under agreements with local authorities. Most commercial carriers belong to the Lithuanian National Road Carriers' Association (LINAVA), which provides driver information – some free (www.linava.lt). Operators receive information from the Traffic Police and the Lithuanian Automobile Union (www.las.lt). Some have installed GPS systems for real-time cargo tracking and itinerary monitoring, with dispatcher-driver contact. But these are expensive and relatively uncommon.

A new website (www.maps.lt), created by HNIT-BALTIC Geoinfoservisas, provides free interactive maps for locality or address searches for the whole country and Vilnius, the capital (www.vilnius.lt).

Air and sea passengers receive information from relevant operators.

2. TTI service implementation and research

State-of-the-art of TTI service implementation

Lithuanian TTI services are still under development and not comparable with those of EU Member States. Broadcasters provide regular traffic and weather information, as does the LRA's LAKIS road information system (www.lra.lt/index_en.html). Digital road maps are readily available. The main Vilnius-Kaunas highway has a small number of electronic signs giving real-time information on speed limits and road-surface conditions. The Baltic Roads (www.balticroads.net/lt) website links to sites covering the entire Baltic road network.

The city of Kaunas has introduced route guidance and parking payment by mobile phone.
Public transport (PT) operators, including privately-owned long-distance coach companies, are responsible for providing information on their services, mostly via phone and at rail and bus stations and stops. Some, eg Vilniaus Autobusų Parkas, in the capital, have websites. The city also operates its own website (www.vilniustransport.lt) via a municipal enterprise, Communication Services (CS), which is considering providing real-time PT information, using GPS-based AVL.
JSV (Lithuanian Railways)'s website (www.litrail.lt) allows trip planning via interactive maps.
Both Vilnius (www.vilnius-airport.lt) and Kaunas (www.kaunasair.lt) International Airports have websites, as does national air carrier Lithuanian Airlines (www.lal.lt).The port of Klaipeda (www.spk.lt) provides extensive tourist and business information.

TTI research activities
Electronic data exchange at the Port of Klaipeda.
Telecoms development for JSV.
Participation in the EU-funded VIVALDI demonstration project, under the CIVITAS initiative (EC DG TREN).
Development of a national tourist information system, including Internet capability.
Development of a coherent tourism signposting system.

3. Key issues for TTI implementation

Drivers and trends
Institutional (public and private)
Importance of integrating the Lithuanian highway network into the European road transport system, which will encourage faster TTI implementation.
Importance of implementing TTI services nationally and in major cities to support economic and industrial development, eg by speeding up commerce and relieving urban congestion.
Importance of building on the development of the LARD and ARSIS.

Technological (data acquisition and service delivery)
Systems which integrate data acquisition and service delivery are under consideration, as is the TTI portal described above.
Need for updating of current traffic-intensity data collection system.
Need for automation of current urban PT data collection system.

Key obstacles to overcome
Lack of a common national strategy for TTI system development.
Lack of institutional links between public and private actors for intermodal TTI development.
Differing opinions on the importance of TTI in national development and EU integration.
Inadequate PT funding, inhibiting allocation of finance for information systems.
Need to clarify issues of data collection, ownership and dissemination for public use.
Need for clarity of data access as the basis for PPPs.
Need for international experience and awareness of modern technology in TTI implementation.

Major potentials to use
A TTI strategy as part of the NTTDS would be highly beneficial and help clarify private- and public-sector roles in development.
LAKIS could be extended to produce more valuable road-traffic data.
A special committee could monitor implementation and coordinate international and national project activity as between relevant actors.

4. Key actors in TTI development

Ministry of Transport and Communications, Department of Information Technology and Telecommunications: transp@transp.lt
Lithuanian State Tourism Department: Rimantas Skirmantas, Head of the Information and Marketing Division: rski@tourism.lt
LRA: Vytautas Timukas, Head of IT Division: lra@lra.lt
LINAVA: Gintautas Romaslauskas: tel: +370 2 786 572
Transport and Road Research Institute: J Patašius, Head of IT Division: j.patasius@tkti.lt
VGTU Transport Research Institute: Professor A Baublys, Director, Transport Programme: genmil@ti.vtu.lt

LUXEMBOURG

1. Institutional framework for TTI development

Legal and public policy context

All travel- and traffic-related matters are the responsibility of the Ministère des Travaux Publics (MTP, Ministry of Public Works) - and, specifically, its Administration des Ponts et Chaussées (APC, Administration of Bridges and Roads) - which also have major responsibility for funding and introducing ITS-related services. The motorway system consists of a network connecting with routes in Belgium, France and Germany. Priority is being given to improving its capacity and safety, using ITS solutions, rather than extending it.

Particular attention is being given to the improvement of traffic information centres (TICs) and traffic control centres (TCCs) to ensure interoperability, especially cross-border, and the ability to communicate with foreign equivalents. There is particular emphasis on:

- Extension of traffic monitoring.
- Improvement of weather monitoring.
- International traffic data exchange (DATEX).
- Assisted motorway emergencies operation.
- Dissemination of traffic and mobility information.

An early achievement was the decision to base exchange of traffic information on the DATEX standard.

The information chain works on the basis of data acquisition and fusion being handled by the APC, as infrastructure owner, which also maintains a website (www.cita.lu). The Ministère de l'Intérieur (Ministry of the Interior), organised in six regional 'circonscriptions', operates the National Traffic Information Centre (NTIC) in collaboration with the APC, and passes the information on to third-party broadcasters, who transmit it. The information is free.

In the rail sector, national rail operator CFL (www.cfl.lu) has an automatic link with the German Deutsche Bahn timetable and journey planner, which takes care of the entire information chain. Pre-trip information is available from call centres. In-station information is provided through station panels and announcements. In-trip information is provided at stations through information points/ticketing offices and in-train announcements.

Urban and inter-urban public transportation (PT) information is generally the responsibility of the individual operator. Only rarely is dynamic information available to end-users.

Role of the private sector

All traffic information broadcasting is the responsibility of private national broadcasters.

Telecoms providers are currently working on partnerships with PT operators, to allow delivery of customised information using WAP and/or SMS.

Private-sector initiatives in information or added-value service provision include a website for people travelling from Belgium, France and Germany to work in Luxembourg, which provides journey times by SMS to registered users. Some telecoms operators have plans to provide traffic information via the Internet, WAP and SMS.

2. TTI service implementation and research

State-of-the-art of TTI service implementation

Automatic road data collection for the APC website and free broadcasts is based on:

- Loops, (mostly motorway-located).
- Cameras, installed since 1998 and maintained by the APC.
- Emergency telephones installed at 2km intervals along virtually the whole motorway system. (Their importance as a source of information on accidents and breakdowns has reduced greatly as most emergency calls are now made through GSM).
- A network of 15 roadside weather detection stations, which are also used for forecasting, eg thermal mapping).
- Live radio broadcasts and Internet- based services with maps showing real-time traffic situation and travel times, for pre-trip and in-trip dynamic information.

DAB services are being considered.
CFL provides at-stop timetable information for its network of regional and interurban connecting bus links. Pre-trip and in-trip timetable is also available, e.g. via a call centre.
Local PT operators are fully aware of rising interest in telematics systems, especially for improved system management and traveller information. Most provide essentially static (timetable and fares) via (in order of importance):

- The Internet.
- Call centres.
- Mobile phone (SMS and WAP).

Luxembourg city's bus network provides static at-stop timetable information. Pre-trip and in-trip information is also available (www.autobus.lu).

TTI research activities

Luxembourg has no national ITS research programme, but is involved in the CENTRICO Euro-regional project. A major specific concern is safety in tunnels, which are being equipped with the latest equipments (e.g. for automatic incident and smoke detection).

3. Key issues for TTI implementation

Drivers and trends

Institutional (public and private)

Development of a common architecture.
Development of communication protocols, DATEX.
EU emphasis on the need to develop trip time estimation, and ensure that the Trans-European Road Network (TERN) is instrumented to provide the relevant input data.

Technological (data acquisition and service delivery)

Common implementation of DATEX nodes for exchange of traffic data.
Definition of standards for publication of data for service providers.
Creation of cross-industry portals providing personalised services.
Availability of GSM.
Release of new-generation wireless communications.

Key obstacles to overcome

Legal questions of data ownership, responsibility and liability.
Lack of systematic definitions of the roles and responsibilities of different actors.
Liberalisation of the market, so that information is made available to service providers on the basis of fair compensation, not exclusive supplier relationships.
Need to manage information so that only valid and current information is presented to users. Lack of intermodal information.
Lack of a EU protocol for intermodal information.
Need to present information in a user-friendly way, for effective communication of messages.

Major potentials to use

Scope, given wide availability of basic road traffic information, for focusing on personalised services, with the emphasis on:

- Providing seamless integration between information sources.

- Development of information services that communicate effectively and in user-friendly ways, reflecting the method used (eg WAP, SMS, Palm, on-board computer).

4. Key actors in TTI development

Ministère des Travaux Publics, Administration des Ponts et Chaussées: Georges Simon, Head of IT and Management Division: georges.simon@pch.etat.lu

NETHERLANDS

1. Institutional framework for TTI development

Legal and public policy context

The National Traffic and Transport Plan (NVVP), published by the Ministerie van Verkeer en Waterstaat (MVW, Ministry of Transport and Water Management) in October 2000, accepts the need for mobility as self-evident. Key guidelines are:

- While the Government retains responsibility for the urban/spatial planning, it will increasingly create frameworks for other actors to develop solutions and services.
- Users will pay for their choices (as with information services and the proposed distance-based road user changing (RUC) scheme).
- Optimal use of road, rail and water infrastructure is vital, using eg controlled access, incident management and in-vehicle real-time information.
- Reducing road accidents is a policy priority, with intelligent speed adjustment (ISA) as an example of advancing technology.
- Overall policy aims to ensure timely and effective deployment of innovations; eg by promoting key technologies which the market cannot develop under its own steam.

The MVW, as national road network manager, sees basic traffic data collection as part of its role and has installed a highly-automated, publicly-owned and operated system along the motorway network. Provinces and municipalities collect data on their own roads, ad-hoc and without automation – making structural data exchange a problem. Police report local events to the National Traffic Information Centre (NTIC)

Role of the private sector

This is limited to distribution of TTI as a value-added service. The MVW does not play an active role, but offers incentives – as with the launch of the national RDS-TMC service (see below). Examples of private-sector services include TravelStar (see below) and some initiatives using data from GSM networks.

2. TTI service implementation and research

State-of-the-art of TTI service implementation

RDS/TMC began in 1998 as a digital radio traffic information service, initially publicly- financed because its commercial value was unclear. A consortium of private companies has subsequently started a privately-funded service called TMC4U. With substantial numbers of navigation systems with TMC functionality on the market, the availability of TMC traffic information has become a strategic issue for suppliers. To keep receiver prices affordable, the Netherlands Road Administration has helped the market introduction of reasonable-priced TMC equipment through the national RIC (Realisation In-Car) initiative. One result is TravelStar, a TMC receiver connected to a colour-screen PDA showing TMC messages on a map display of the road network. The multifunctional PDA can also be used for other purposes. Response has been enthusiastic, and the device is now on the market.

During the last 10-15 years, the MVW has funded a large number of traffic management systems on the congested Netherlands motorway network, to improve traffic flows and increase road safety. The entire network is equipped with a ttraffic monitoring system that measures traffic flows and vehicle types and provides essential traffic information. About 50 per cent of the network is equipped with a system that automatically detects changes in flows and alerts drivers to maximum safe speeds. Operators can also use the system to close lanes and warn drivers of upcoming of road works, and a specific fog warning system has been developed on the basis of it.

Strategically-located dynamic route information panels (DRIPs) provide traffic information (queue lengths) for alternative-route sections of the network; and, at some points, travel times to the next major junction. Some 100 DRIPs have been installed, and experience has been good; in the Amsterdam region,

congestion dropped by some 30%. Their return of investment rate is therefore very high. Of drivers surveyed, more (62%) appreciated DRIPs information than regular radio traffic information (52%). The travel-time component is being expanded and will in the near future be integrated in more panels. Ramp metering has been implemented in a number of locations, though there have been jurisdictional and technical problems. All traffic management and information systems are funded, operated and maintained by the MVW.
For PT, the national OVR service provides door-to-door trip information covering all modes. Completely automated, it can be accessed by phone or the Internet (www.ovr.nl), and gives optimal and alternative routes including walking time.
Dutch rail operator NS provides an Internet-based trip-planning service.

TTI research activities
A current project aims to add navigation functionality to TravelStar.
Several initiatives are focusing on travel-time estimation services, and an initial system became available for trialing in 2001.
Netherlands company CMG has developed travel-time estimation software based on locations of GSM users and claims to have overcome privacy issues.

3. Key issues for TTI implementation

Drivers and trends
Institutional (public and private)
As traveller needs are by definition individual, new technologies can provide interactive communications, leading to individualised services that people can be expected to pay for.
No single product or service can accommodate every individual, so proper market segmentation is vital.
TTI services do not stand on their own; total mobility packages may well emerge.
Most TTI services are still mode-oriented. Future integrated services will be needed to address opportunities for multimodal door-to-door transport.

Technological (data acquisition and service delivery)
TTI services using Internet technology have evolved enormously in recent years and will continue to do so, especially if the mobile Internet becomes widely available.

Key obstacles to overcome
New and complex services often require high initial investments with corresponding risks, which can vary for each link in the information chain. Problems in securing the necessary commitment can mean services being delayed or even abandoned.
Private-sector expertise is needed, but the process of building up effective public/private partnerships is slow and difficult.
The introduction of new technology needs large markets. The Netherlands offers a small one, with little or no influence on the marketing policies of the electronic or automotive industries.

Major potentials to use
If GSM location data could be used for traffic information services, once the privacy issue has been tackled, it could trigger new commercially-attractive services because of lower infrastructural costs.

4. Key actors in TTI development

MVW: G van Toorenburg, Responsible for Policy Development on Traffic Information: Ge.toorenburg@dgp.minvenw.nl; J Klijnhout, Senior Advisor on Transport Telematics: j.j.klijnhout@avv.rws.minvenw.nl
ANWB (Netherlands Automobile Club): Ward Koopmans: w.koopmans@anwb.nl
ARS Traffic & Transport Technology: Jan Linssen, Director, Software and Service Development for TTI Services: linssen@ars.nl

CMG: Cees de Wijs, Deputy Director: Cees.dewijs@cmg.nl

Websites

www.minvenw.nl
www.tic-nl.org
www.verkeersinformationdienst.nl
www.tmc4u.nl
www.travelstar.nl
www.ns.nl
www.anwb.nl

NORWAY

1. Institutional framework for TTI development

Legal and public policy context

Traffic congestion, though less serious than elsewhere in Europe, is of growing concern in urban areas. The value of investments made over the last 10 years in the road network of the capital, Oslo, has been virtually nullified by traffic growth. New road construction in urban areas is becoming unfeasible, on grounds of cost and land shortage, and the use of ITS in general, and (though at an early stage) TTI in particular, is emerging as an alternative. ITS activity is based on a number of strategic plans developed by Government ministries and the Research Council of Norway (RCN), among them:

- The National Plan for Transportation 2002 - 2011 (Ministry of Transport and Communications, MTC).
- eNorway – ICT action plan 2000 (Ministry of Trade and Industry).
- National Strategy on ITS (preliminary version), 2000 (MTC).
- A national R&D Strategy for ITS, 1997 (RCN).
- Better, Safer and More Efficient Transport - by ICT, 2002 (MTC).

A great deal of work remains to be done, particularly on a regulatory framework for TTI and the development of guidelines and requirements for TTI services and operators.

Within the public authority sector, the MTC has overall responsibility for transport and infrastructure development for all modes, but devolves executive management to four sectoral agencies:

- Vegdirektoratet (the Norwegian Public Roads Administration, NPRA).
- Jernbaneverket (the Norwegian National Rail Administration, NNRA).
- Luftfartsverket (the Norwegian Air Traffic and Airport Administration, NATAA).
- Kystverket (the Norwegian National Coastal Administration, NNCA).

All disseminate TTI through national channels eg broadcasting, phone and the Internet.
Five regional traffic information centres (TICs) disseminate TTI dissemination mainly via two special phone numbers: 175 for road traffic information; 177 for public transport (PT).
At local municipal level, public authorities collect or disseminate little TTI data except insofar as some own bus companies. Most of these operators offer TTI via the Internet or phone, and give timetable and major delay information. Some also provide internet-based trip planning. In some regions, PT operators have banded together to provide cooperative travel information groups; a good example is Trafikanten (see below).
Some municipalities provide parking information and guidance, eg via VMS.
Data collection is mainly handled by infrastructure owners, the rest of the information chain by these and service providers. TTI in PT is mostly handled by the operators.
Data ownership, and public authorities' roles as data providers, are subjects under discussion.

Role of the private sector

There are no private infrastructure owners, eg motorway operators. The few service providers are either telecoms companies (Telenor Mobil offers TTI on a commercial basis) or commercial radio stations. Several of these offer frequent traffic information in their programmes, especially during peak hours. P4, the only national commercial radio station, has developed its own traffic centre, where calls from drivers reporting on events and traffic conditions are the main data source apart from its traffic helicopter.
Several private bus companies offer TTI, available via phone or the Internet and including timetable and major delay alerts. They also take part in cooperative travel information groups.

2. TTI service implementation and research

State-of-the-art of TTI service implementation

Traffic Info Gardermoen, the first Norwegian TTI service to present real-time travel-time information on the Internet, was set up to cover the main road between Oslo and Gardermoen Airport. Commissioned by the MTC, it formed an integral part of the traffic management plan developed for the 1998 opening of the

airport, and was also part of the Dynamic Data for Road Transport R&TD project, which was part-financed by the RCN.
Implementation of RDS-TMC, which is operational in most other European countries, will complete the network and give Norwegian additional benefits when travelling abroad. It is expected to increase the potential of RDS-TMC as an important channel for dissemination of traffic information and messages.
Recent new channels give access to dynamic TTI messages via SMS (commercial); and the Internet and WAP (free). Data is collected from phone calls from drivers, and from the police and the NPRA, and only to a very limited extent from detectors and sensors.
Norwegian State Railways (NSB) offers electronic timetables via SMS, and gives information on alterations and delays (also available via teletext).
Local PT TTI services are mostly provided by individual operators for their own routes, typically in the form of timetable access via the Internet.
Among the few multimodal services, Trafikanten (www.trafikanten.no; wap.trafikanten.no - also available by dialling 177) provides route planners and timetables for all PT routes in the Oslo region. It is funded by Oslo og Akershus Trafikkservice AS, a private company owned by regional PT companies, and the local partner of the national Ruteopplysningen 177 association of PT and related companies (www.ruteopplysningen.no).
NATAA gives flight information for main airports; delay information can be accessed via teletext.

TTI research activities

ARKTRANS, whose main phase started in 2002, aims to establish a framework architecture for the implementation and operation of information systems for intermodal transport www.informatics.sintef.no/projects/arktrans/arktransweb. In the absence of a national ITS architecture, it is of relevance to a number of other projects, including:
IBIS (Integrated Payment and Information Systems), the Norwegian component of the EU ProGR€SS project, based in the city of Trondheim. Its main aim is to show how integration of multi-modal information and urban road pricing can be used for demand management.
ICT in Road Traffic, which has developed the dynamic message channels described above. It has gained much useful experience on cooperation and data flow between the various partners in the information chain for TTI provision, and has also focused on safety aspects.
DynamIT, which began in 2002 and is led by SINTEF Civil and Environmental Engineering. Financed by the NPRA and RCN, its main goal is to develop value-added TTI services by following up ICT in Road Traffic and Traffic Info Gardermoen, with the emphasis on:

- Data processing, analyses and short-time prediction.
- Development and evaluation of various models for PPPs.
- Testing different detector technologies and algorithms.
- Investigating the use of AVI technology for travel-time estimation and prediction, taking advantage of the new, standardised AutoPASS tags that have been in use since end-2001 for toll collection.

3. Key issues for TTI implementation

Drivers and trends

Institutional (public and private)

Most currently-available information describes events, eg congestion, accidents or road closures, but without quantifying anticipated delays. DynamIT is relevant.
PPP has been accepted as a necessary means for developing efficient TTI, and the organisation of an appropriate framework is a sub-task in DynamIT.
Most currently-available services are unimodal. Intermodal services will make for easier travel planning. IBIS is relevant.
Several NPRA projects aim to integrate distinct types of dynamic data, eg on road and weather conditions and pollution. The NPRA has carried out a feasibility study of 'A common system for dynamic data'.

Technological (data acquisition and service delivery)

More dynamic and in-trip information is needed to increase the value of TTI. Achieving this will necessitate development of solutions involving mobile devices, eg WAP, SMS, PDA and in-vehicle navigation systems.
Making services more personalised will increase their value.
Most larger cities have toll rings, based on electronic toll-tags. The NPRA wants to make use of these for collecting travel-time information.

Bravida Geomatikk is involved in several projects developing map-based solutions for TTI.

Key obstacles to overcome

Absence of a national ITS architecture.
Lack of defined roles for the public sector as owner and supplier of traffic information data, which inhibits private actors in developing new TTI services.
Organisational and financial questions on operation and maintenance of on-line TTI services, and lack of clear definition of the roles of the various actors in the value chain. (Some successful TTI services have closed down, partly because of lack of maintenance funding).
Protection of privacy. Norway has strict legislation.

Major potentials to use

Establishment of dynamic TTI covering major urban roads has considerable potential for increasing network efficiency and, possibly, reducing the need for new road construction.

Up to 80% market penetration of toll tags in some cities implies considerable potential for travel-time information collection.

4. Key actors in TTI development

National Public Roads Administration: Ivar Christiansen, Transport Informatics Division: ivar.christiansen@vegvesen.no
NTNU: Arvid Aakre, Department of Transportation Engineering: arvid.aakre@bygg.ntnu.no
SINTEF: Torbjørn Haugen, Department of Roads and Transport: torbjorn.haugen@sintef.no; Marit Natvig, ARKTRANS Project Manager: marit.natvig@sintef.no
Trafikanten: Jarl Eliassen: trafikanten@trafikanten.no
Telenor Mobil: Bjørn Asmundvåg: bjorn.asmundvaag@telenor.com
Bravida Geomatikk: Steinar Høseggen: steinar.hoseggen@bravida.no

Websites

www.vegvesen.no
www.jernbaneverket.no
www.luftfartsverket.no
www.kystverket.no
www.nsb.no
www.p4.no/trafikk

POLAND

1. Institutional framework for TTI development

Legal and public policy context

The government is committed to ITS and, specifically, TTI development. Reorganisation has created a new Ministry of Infrastructure, responsible for all areas of transport and telecoms; and a new General Directorate of National Roads and Motorways (GDDKiA). An action plan, Infrastructure - Key to Development, adopted in 2002), contains important references to TTI. It followed an e-Poland document, adopted in 2001 and based on the EU's e-Europe strategy, which outlined plans for developing a Polish information society over the period to 2006. It recommended the creation of a Central Transport Database; the establishment of a National Telematics Architecture by 2003; and specific TTI development plans (including wider use of the Internet, GSM and RDS).

Despite these policy advances, however, ITS and, specifically, TTI are not yet generally seen as transport priorities. The main focus is on legal and institutional preparation for EU accession, and the maintenance and development of basic transport infrastructure. At the same time, it is clear that accelerating IT development may in time bring about significant TTI development and resulting changes in travel behaviour – especially in sectors that are central government responsibilities, eg the national road network. Other roads are managed by regional and local authorities, for which TTI is not a current investment priority.

Public transport (PT) is not a responsibility of the State, which has deregulated and withdrawn totally from its previous role as owner, funder and manager of urban transport, leaving municipal authorities to take over. Some have set up PT authorities, with services provided by municipally-owned or (increasingly) private operators and TTI centrally controlled. Elsewhere, operators are responsible. Despite growing awareness that advanced TTI is among the key quality criteria for PT, it is not currently a priority for financial reasons.

Role of the private sector

Scope is restricted by:

- Limited willingness by the public sector and of transport operators to invest in TTI.
- Legal barriers.
- Lack of a regulatory framework for commercial use of publicly-collected data.

Private companies are not permitted by law to install their own equipment on public roads. Privatised transport companies are still young and not giving priority to TTI.

Opportunities may lie in PPPs, which have already been used for motorway development.

2. TTI service implementation and research

State-of-the-art TTI service implementation

In 2000, the Polish government set up a programme to create a central database for all major transport modes, starting with roads, which is expected to provide a good basis for TTI. An early initiative is the www.gddp.gov.pl website, set up by the former General Directorate of Public Roads (GDDP), now part of the GDDKiA. Its main TTI component gives information on conditions on national roads, following implementation of the ZIMA (Winter) and Utrudnienia (Roadworks) projects, using local data gathered by phone or the Internet and giving advice on eg rerouteing. The GDDKiA has also installed some 100 VMS giving real-time information on eg vehicle speeds and road works.

The national Motorway Development Programme envisages construction of 2600km of motorways by private concessionaires, to be responsible for installing advanced traffic management and telematics solutions - an early example being the A-4 between Kraków and Katowice. (There have, however, been doubts over the concession system).

There are no TTI services on non-national roads, apart from conventional radio broadcasts. Some stations receive systematic traffic information from taxi drivers.

No Polish cities yet possess comprehensive advanced traffic management systems incorporating TTI functions. One of the most advanced systems has been installed in the centre of Poznań with funding

through the European EUREKA programme; it uses dynamic centralised flow optimisation, providing good basic data for TTI implementation.
Other cities have initiated advanced complex traffic management systems. The first phase of CEZAR - in Warsaw, the capital is expected to be operational from 2004.
An ambitious private-sector initiative (www.korkonet.pl) uses strategically-located digital cameras to give real-time traffic information for Warsaw. Financed by advertising, it has followed up with an SMS service, accessible via all three major GSM operators.

National rail operator PKP's website (www.pkp.pl) represents one of the earliest advanced TTI applications. Based on a solution developed by German rail operator Deutsche Bahn, it allows international as well as domestic trip planning and a WAP facility (wap.pkp.pl).
Warsaw's approach to urban PT is typical. Its Public Transport Authority is the main provider of information, with pre-trip information available from a call centre or the www.ztm.gov.pl
Website, which offers route options between stated origin and destination points. For in-trip information, a WAP service gives timetable information on timetables, while buses and trams have started to give on-board real-time information. All Polish transport authorities provide information via the Internet. Real-time at-stop information is mainly available on tram routes.
Intermodal door-to-door transport information is available via Warsaw's www.ztm.gov.pl website. Historically low levels of cooperation between transport modes at operational level are improving, and evidence of integration offers prospects of better information.
Freight operators are increasingly adopting advanced logistics services for optimal route planning. A number of larger companies are building their own databases.
LOT - Polish Airlines - provides standard information, booking and ticketing services on its website (www.lot.com.pl)

TTI research activities
Several universities and research institutes are involved in telematics, including TTI.
Most effort is being concentrated on traffic management.
Participation in EUB projects has been limited.

3. Key issues for TTI implementation

Drivers and trends
Institutional (public and private)
Growing motorisation and congestion are highlighting the need to improve the efficiency of the transport system, giving advanced TTI a higher profile.
At Government level, there is evidence of a positive climate for ITS deployment, including TTI, thanks largely to EU policy pressure.
Pressure for high-quality PT in response to increasing congestion will encourage development of advanced information services to satisfy information needs.
The private sector offers a wide spectrum of technological and software solutions. (The creation of Korkonet demonstrates its proactivity and capability).

Technological (data acquisition and service delivery)
The Motorway Development Programme will accelerate TTI deployment.
The installation of central traffic management systems eg Warsaw's CEZAR will have considerable impact on other cities.

Urban PT operators' development of automatic vehicle location (AVL) will accelerate TTI deployment, eg of real-time at-stop information.

Key obstacles to overcome
Priority being given to capital-intensive infrastructure projects.
Lack of an institutional 'bridge' between transport sub-sectors, which the state should create. Insufficient cooperation between relevant organisations. (The Chamber of Urban Public Transport (IGKM) offers a positive example).
Limited knowledge of ITS/TTI potential, which needs to be tackled through education.

Legal restrictions on data collection and use, and lack of clarity on data ownership and access to publicly-owned data.
Lack of architectural and strategic frameworks for ITS implementation.

Major potentials to use

Rapid developments in telecoms.
Computerisation of society and growing numbers of Internet users.
Government's declared intention to build a Polish information society.
Private-sector capabilities.

4. Key actors in TTI development

GDDKiA: Stefan Sarna, Head of Motorway Infrastructure Division: asarna@abiea.pol.pl
ITS Technology: Tomasz Krysiak, President: itstechnology@wp.pl
Polish Telematics Association: Piotr Jaglak, President: itstechnology@wp.pl
Silesia University of Technology, Institute of Transport: Professor Jan Piecha: piecha@polsl.katowice.pl
PKP: Adam Bremer, Website Administrator: a.bremer@pkp.com.pl
IGKM: Stanislaw Karasek, Vice-President: igkm@igkm.com.pl
E-monitoring Sp z o o: Krzysztof Szalwa, Responsible for Korkonet website: korkonet@korkonet.pl

PORTUGAL

1. Institutional framework for TTI development

Legal and public policy context

The institutional process for decision-making is fragmented across several ministries and agencies, to the detriment of the technology development. TTI deployment is conditioned by lack of funding and research.
There is no legal framework for encouraging private-sector participation in telematics-based TTI. Road traffic data collection is carried out by:

- CIRPOR, the Traffic Control and Information Centre of the Portuguese Road Institute (IEP), an agency of the Ministry of Transport's Directorate General for Land Transport (DGTT).
- Toll road concessionaires.
- Municipal authorities. (Major cities have their own traffic centres, but these are not linked to CIRPOR).

The IEP has to approve installation of all roadside equipment.
The plan is for CIRPOR eventually to become the sole data processing centre, taking relevant information from municipal authorities and concessionaires. It already has a permanent police presence, to ensure effective handling of incidents.
National rail infrastructure manager REFER runs rail-sector traffic control centres (TCCs).
In urban public transport (PT), operators collect and own data on e.g. schedules, arrival times and service interruptions and make this available via various TTI services. Initiatives are usually individual to operators; exceptions are AMMOS and SIGITI (see below).
National airports manager ANA makes flight data available through a range of TTI services.

Role of the private sector

The main transport operators are mostly publicly-owned, leaving relatively minor scope for the private sector. Actors include broadcasters and the Portuguese Automobile Club (ACP).

2. TTI service implementation and research

State-of-the-art of TTI service implementation

CIRPOR collects road traffic data from roadside cameras and traffic sensors. Resulting information, on incidents congestion, route alternatives and weather conditions, is relayed to roadside VMS via fibre-optic links. Traffic images are also sent to the two main TV channels, SIC Notícias and RTP. In addition CIRPOR, the Police and individual travellers (via free phone numbers) feed information on main urban road conditions to radio stations.
CIRPOR's main current initiative consists of a single traffic information phone number, an Internet site, and a feed to mobile telecoms operators, from whom traffic information can be accessed via WAP, SMS or PCs, with images incorporated.
The ACP's members' service can be accessed by (mobile) phone (voice or SMS data).
Of Portugal's two multimodal TTI projects, AMMOS (www.ammos.pt) covers bus, rail and metro services in the Lisbon area, offering journey planning and travel times, and airport flights. Plans include multimedia kiosks at stations, interchanges and shopping centres. SIGITI (Geographic Interactive Information System for Interurban Transport) has been commissioned by the DGTT as a website designed to serve as the sole Portuguese multimodal transport and tourism information site. It will integrate AMMOS and cover the mainland with digital maps and an intelligent journey calculator.

Rail traffic data is collected by REFER's TCCs and used by Portugal's two rail operators, the publicly-owned national CP and Fertagus, a private company operating the Tagus River Bridge service. Fertagus' more up-to-date technologies provide:

- DPI on TV screens inside stations and on platforms.
- Announcements giving train arrival time, platform and destination.
- In-train DPI indicators giving next station, supported by announcements.

CP offers similar services, but not universally.

The main PT operators have websites, some allowing individual searches. In many cases, information can also be accessed via the WAP services of the three Portuguese mobile telecoms operators. Most operators also maintain free phone numbers. A few operators have automatic vehicle location (AVL) systems to inform waiting passengers. Information on main rail services is available via ATMs, which also allow ticket purchase.
The Lisbon Metro's TTI service consists of on-platform indicators with next-train destination and relevant passenger information. Trains have internal DPI indicators and announcements giving the next station and interchange options.
ANA distributes real-time flight information via its website and phone.

TTI research activities

A Lisbon Metro study has investigated the integration of all public information to speed up passenger flows and response to disruptions. Oporto PT operator STCP has commissioned a study on 'Passenger Information on the STCP Network'. Aimed at currently occasional users, it envisages awareness programmes, pre-trip planning and dynamic in-trip information services, all derived from a regularly updated common database.

3. Key issues for TTI implementation

Drivers and trends

Institutional (public and private)

TTI initiatives are largely locally driven by operators, especially in PT. Recent multi-modal website projects, however, indicate the emergence of a collaborative approach, providing better passenger service by using advanced technologies.
CIRPOR is expected to centralise all road-based traffic and traveller information collection and distribution, investing its own funds to ensure uniform and integrated delivery of information (including alternative route guidance) for sale to broadcasters and made freely available to local authorities. CIRPOR will also allow privileged information access to transport operators, including those in the PT sector with whom no links currently exist.

Technological (data acquisition and service delivery)

The future direction for data delivery seems to be via the Internet and mobile phones.

Key obstacles to overcome

Lack of a single agency responsible for co-ordinating PT operators.
Lack of strong support for the research sector.
Little inter-linkage between traffic databases, except in the multi-modal website projects.
Privacy issues.
Lack of an enabling framework and limited funding, due to health and education taking priority over transport in the current Portuguese economic context.

Major potentials to use

Dense ATM network, offering potential future channel for traffic and travel data dispatch.
High (80%) mobile phone access.
Oporto's new light rail system offering potential showcase for new TTI technologies.
ACP initiatives can influence national context for TTI development.
Acceptance of the Internet, despite relatively low PC availability.

4. Key actors in TTI development

DGTT: Carlota Sales Henriques: Chenriques@dgtt.pt
IEP: António Manuel Rodrigues, Director of the Telematics Department): iep@iestradas.pt
CP: José Gaspar, Director of Information Systems: Jrgaspar@mail.cp.pt
Fertagus: Ana Cristina Dourada, Administrator: Fertagus@fertagus.pt

Metropolitano de Lisboa (Lisbon Metro): Guilhermino Rodrigues, Administrator: metro.relpub@mail.telepac.pt/
Carris (Lisbon bus operator): Maria Adelina Rocha, Administrator: linha.aberta@carris.pt
STCP (Oporto bus operator): Marques da Cruz: Clientes@stcp.pt
ACP: Gil Estevez, Head of IT Services: Gilestevez@acp.pt
ANA: Isabel Rebelo, Information Systems Directorate: Isabel.rebelo@ana-aeroportos.pt

Websites

www.dgtt.pt
www.gismedia.pt
www.refer.pt
www.cp.pt
www.fertagus.pt
www.metrolisboa.pt
www.carris.pt
www.stcp.pt
www.acp.pt
www.ana-aeroportos.pt

1. Institutional framework for TTI development

Legal and public policy context

A country in transition, Romania is making huge efforts to transform a highly-centralised economy into a free-market one. Most economic sectors have experienced difficulty in adapting, though road and air transport, communications and IT have shown significant growth. Road transport investment has focussed on rehabilitation and new construction. National transport policy derives from the 1996-1998 Transport Master Plan, which defines market requirements and development trends to 2015. It focuses on classic infrastructure, with ITS implementation as a secondary stage. The absence of a national ITS implementation strategy has kept investment in ITS applications at a low level.

Major cities have transport master plans which, again, do not include ITS as an integral element. There are, however, recommendations on ITS, mainly for traffic management.

Change can be expected, given that:

- National priority for EU integration involves measures for transport interoperability.
- The information society is a key governmental objective.
- Key professional actors are active in promoting ITS.
- Returns from some existing ITS applications are significant.

ITS implementation levels vary according to mode:

- Air and maritime transport has to meet international requirements. Basic ITS applications include vessel traffic management and information systems (VTMIS) in operation nationally and at the port of Constantza.
- ITS applications are used in rail and inland waterway and transport to support traffic monitoring and infrastructure management.
- Road-based ITS implementation is at a low level. The institutional framework has recently changed, with national, regional and local road administration responsibilities being modified and activities transferred to the private sector. Individual ITS applications reflect actors' immediate interests (eg fleet and infrastructure management). Preparation of a national ITS implementation strategy is imminent, with TTI as a priority.
- Surface public transport (PT) authorities are preparing traffic management and traveller information projects. Metro services benefit from automated traffic control that also provides TTI services.

In the absence of a national ITS implementation strategy, there has been no clear perception of traffic and traveller information (TTI) issues. Operators use traffic management-derived information internally, for better management, and disseminate it only if required to do so by regulation or in the framework of a mutual agreement. Most refuse to make it public; although PT operators have a direct interest in providing real-time travel information.

- A number of service providers are beginning to offer TTI services on a commercial basis. Some GSM providers offer value added services; for example, DIALOG's 'Info Util'.
  INFOTRAFIC SA's value-added services include:
- www.transnet.ro, for e-commerce in road freight.
- www.transportal.ro, for general road transport information.

In preparation is a value-added service for road transport planning, giving information on eg route, speed and weight restrictions, and roadworks.

Current Romanian legislation provides only a general basis for TTI service development. Implementation of efficient services needs specific agreements between interested parties, in the context of EC Directives on interoperable transport.

Role of the private sector

METRO SA has designed and installed, for metro operator METROREX SA, automatic traffic control, with TTI capability that provides real-time schedule information via the Internet, in-station and in-vehicle.

Broadcasters issue traffic information to increase ratings. (Many FM radio stations carry traffic information gained from road authorities and traffic police under mutual agreements).

TRANSINFO SA, a specialist in e-commerce for transport field, has started providing national road-based TTI services.

2. TTI service implementation and research

State-of-the-art TTI service implementation

TTI services are at an early stage and do not represent a well-defined domain. Existing applications are independent of each other, in the absence of a national plan or clear objectives, and typically meet immediate needs. There are no central or local traffic information centres.

The road weather information system implemented on the 160km-long DN1 Bucharest-Brasov national road is a large-scale pilot. Its main functions are:

- Automatic acquisition of road weather parameters.
- Local data collection and processing.
- Short-term (two-hour) and medium-term (24-hour) road weather forecasting.
- Issue of weather warnings.
- Driver information via VMS with text and graphic panels.
- Data transfer to service areas and information kiosks.
- Road weather data recording and dissemination.

Processed road weather data is used to make roads safer to use, especially in winter. The system infrastructure can also be used to send traffic messages.

FM broadcasters provide periodic traffic and weather information, often local. Data comes by fax or phone from local authorities and road administrations; none is automatically generated.

The Bucharest Metro's automatic traffic control system provides traveller information: in-station on graphic panels; in-vehicle via voice-synthesised messages; and via a website.

TTI research activities

Urban Traffic Management System (2001-2004). Partners: Information Systems Institute (SIAT), Politehnica University of Bucharest, and RASSCO Traffic. The project is developing logical and system architectures; designing and implementing an experimental model (including a TTI module); and carrying out cost-benefit evaluation.

Mobile communication platform - GSM Railway (2001-2003). Partners: Railway Research Centre (AFER); ITS Romania; Transport Research Institute (INCERTRANS). The project covers 60km of main railway line and includes TTI and private traveller communication.

3. Key issues for TTI implementation

Drivers and trends

Institutional (public and private)

The national ITS implementation strategy will provide a firm foundation for TTI development. It will define a national architecture, priorities, available technologies, institutional and PPP frameworks, cost-benefit evaluation criteria, and key public- and private-sector actors.

TTI implementation must be preceded by the implementation of traffic management and fleet management systems, to create needed traffic and vehicle location databases.

Interconnecting various proprietary databases requires a legal and institutional framework.

TTI services could develop at more than one level:

Independent (local): covering a single mode/area (e.g. urban PT; regional road transport); supplied as a product of traffic management or by specialist companies.

National and/or inter-modal; with TTI data collected in dedicated databases and sent to users via standardised channels using internationally-recognised standards.

Technological

Traffic management systems are basic data sources. Image-processing sensors are preferable as traffic detectors and fulfil other functions e.g. speed measurement and enforcement, traffic monitoring and incident management.

Information delivery means include:

- Text and/or graphic VMS along roads and at stations.
- Web pages for pre-trip and general information.

- RDS-TMC etc.

Key obstacles to overcome

Knowledge and experience of TTI technologies and benefits are limited.
User information is not a clearly-defined activity for road administrations.
PPPs are at an early stage.
TTI needs to be correctly prioritised and funded in a national ITS implementation strategy.
Decision makers, transport professionals and civil administrators are wary over the content, costs and benefits of TTI services.
There is no legal/technical framework for connecting proprietary public-/private databases.

Major potentials to use

Existing national priorities of transport and information society development.
European transport interoperability requirements.
Technology transfer from the EU.
Existing professional expertise in electronics, communications and IT.

4. Key actors in TTI development

Politehnica University of Bucharest: Professor Corneliu-Mihail Alexandrescu, Transport Telematics Team Leader: cma@eltrans.pub.ro
National Roads Administration: Petre Dumitru, ITS Development Division: +40 1 223 2606.
METROUL SA: Constantin Dumitrescu, Automation Manager: dumitres@mail.moronet.ro
Ministry of public works, Transport and Housing: Mihai Dionisie, Deputy Director of Strategy and Information Directorate: tel: +40 9 514 4207.
Romanian National Hauliers' Association: Valentin Mirescu, Vice President: office@untrr.ro
ITS Romania: Dorin Dumitrescu, Director-General Director: ddumitrescu@totalnet.ro

SLOVAKIA

1. Institutional framework for TTI development

Legal and public policy context

Strategic documents published by the Ministry of Transport, Posts and Telecommunications (MTPT), mainly dating from 1999, do not specifically define a role for ITS in transport policy, or directly address the issue of TTI services (though changes are expected from 2003). In the mid-1990s, there was a move towards ITS deployment, and the private sector participated in a major motorway implementation; but this ended in 1998 with a government decision to scale down motorway construction. From 2002, the MTPT began giving grants for transport R&TD projects, some of which have been in the ITS sphere. Overall, however, there is a lack of the common strategy and business models needed to support financing of TTI development. There is currently no drive for coordinated TTI development at state level, or that of the new regions (created in 2001) or municipal authorities.

Under the Roads Act, ownership of traffic data and data collection lies with the state or municipal authorities. There is no requirement for them to cooperate with the private sector, and no provision for private-sector data collection. One way forward would be to create a new legal and institutional environment that would:

- Define a clear role for TTI in state transport policy.
- Establish an information chain, with requirements for data acquisition and processing, data fusion, information supply and transmission, marketing and PPP involvement.
- Define those TTI applications that are priorities in the public interest.
- Encourage development of an ITS architecture.

On motorways (mainly new ones), traffic information is collected via loops. The system provides complete information on numbers, types and weights at 15-minute intervals for each lane. Systems on other roads have ceased to work efficiently.

Road traffic information is currently available on a free phone number via the mobile phone network, and broadcast by private radio stations. General traffic news is transmitted (mainly in winter) to all radio stations, but without systematic input from road/traffic operators. If there is an officially-recorded problem, the relevant authority contacts radio stations to have information broadcast. This is done twice daily, under legislation that lays down the responsibilities of the Slovak Road Administration (www.vlada.gov.sk).

. There has historically been no cooperation between traffic/transport and emergency service operators, but legislation to introduce the universal European emergency call number 112 will improve matters.

There is currently no framework for RDS-TMC implementation.

In public transport (PT), passive TTI applications include timetables available in printed form, and via phone and the Internet pages. Privatisation is progressively providing opportunities for more advanced systems. In Bratislava, the capital, and Kosice, PT integration is stimulating production of coordinated timetables.

Role of the private sector

The private sector, although well-developed and prepared, has not so far played any major role in TTI development, largely due to the lack of legal frameworks. Road infrastructure owners and managers have historically been state-owned, and it has not so far proved possible to create a structure for private-sector involvement. As the market opens up, however, it will highlight the need for the state to define legal and standards frameworks for private-sector participation in traffic/transport information chains.

Integration of information service content is a clear candidate for future PPP structures.

The previously publicly-owned rail system has been split into two state-owned commercial companies, opening the way for privatisation of rail services.

2. TTI service implementation and research

State-of-the-art of TTI service implementation

Advanced traffic control and information systems are under development. Early operational applications involve deployment of the Motorway Information and ContRrOl System (MICROS) on sections of the

national motorway network near Bratislava and Trencin, together with a central control room for the Slovak Road Administration.
MICROS has an open architecture, designed to accommodate future additional control systems and TTI applications. It is, for example, providing the basis of a planned, privately-financed Tourist Information System, with kiosks at service areas and mobile phone access.
Several cities have introduced automated fare collection in their PT, with architectures designed to prepare the way for TTI applications.

TTI research activities

In 2002, the MTPT officially launched an ITS research programme, with the involvement of ITS Slovakia, universities and the national Transport Research Institute. Research is oriented towards the EU's e-Europe project, and key elements include:

- ITS architecture, in the context of the European FRAME architecture.
- An international initiative on EFC (supported by the French Government.

3. Key issues for TTI implementation

Drivers and trends

Institutional (public and private)

The current ITS research programme aimed at developing a common architecture.
The activities of ITS Slovakia.
Adoption of the e-Europe programme.
Adoption of the European Transport Policy White Paper.
Recognition of the need, to achieve real progress, for:

- A legal framework for traffic and emergency information services.
- An institutional role for PPP.
- A minimum of two pilot projects demonstrating the potential of TTI services.

Technological (data acquisition and service delivery)

Existing road management systems, and automated fare collection (AFC) in PT, provide strong bases for TTI service development. There remains, however, the need to develop the following technical drivers:

- A common definition of data acquisition requirements at state, regional and municipal levels.
- A statutory database of statistical and on-line data, as the basis of traffic control systems and TTI services.
- Investigation of the scope for traffic data acquisition, processing and dissemination as licensed commercial activities for the private sector.

Key obstacles to overcome

Lack of awareness and interest at Government level.
Lack of sufficiently deep-level discussions between private-sector and governmental actors.
Lack of legal and institutional frameworks, especially for RDS-TMC services and for enabling PPP projects.
Lack of official interest in the development of a common ITS architecture, in which the private sector needs to be involved.

Major potentials to use

Opportunities in the development of motorway management systems, and privatisation of urban PT, which will provide a solid base of TTI data for future private-sector involvement. The applications with the most development potential are therefore:

- Road-based TTI applications, using dynamic RDS-TMC.
- Integrated online PT information.

4. Key actors in TTI development

MTPT: Dusan Faktor, State Secretary: tel: +421 2 52 44 23 01
ITS Slovakia: Tibor Schlosser, President: schlosser@dopravoprojekt; skschlosser@dotis.sk

University of Zilina, Electrotechnical Faculty: Professor Pavol Tomasov, Responsible for Rail Control and Information System: tomas@fpedas.utc.sk
EM TEST: Ladislav Heglas, Director: heglas@emtest.sk
VISICOM sro: Heliodor Macko, Director Responsible for Software Development: Heliodor.Macko@visicom.sk

SLOVENIA

1. Institutional framework for TTI development

Legal and public policy context

Responsibility for transport is divided between the Ministry of Transport (MoT); the Traffic Police Department of the Ministry of the Interior (PU MNZ); and municipal authorities. The MoT is the central authority for transport policy and implementation, operating through directorates for roads (DSRC), rail, and maritime and air transport. It is also responsible for coordinating operations between road authorities and the Traffic Police.

Mobility-oriented TTI services (for which no specific regulation currently exists) form part of a broad ITS implementation strategy. The MoT sees ITS as a tool for achieving transport policy goals that cannot be attained solely by new road building, and identifies two key areas:

- Road management and TTI, involving development of a national traffic control centre (TCC), a priority in the 2004-8 ITS Action Programme and Deployment Strategy; a single intermodal TTI system; and PPPs for providing information to end users.
- Deployment of a free-flow EFC system for road pricing, which will be distance- and vehicle category-based, and possibly cover all roads and incorporate eg parking payment and access to sensitive urban areas.

The planned eventual integration of these constitutes an ambitious challenge for the future deployment of integrated ITS in Europe. (In 2003, Slovenia joined the CORVETTE Euro-regional project).

ITS is also emphasised in the 2002 e-Slovenia Action Plan and in the 2002-4 e-Government Action Plan, which envisages a clear division between roles for the public and private sectors. While basic infrastructures, and control and information services, are seen as the former's responsibility, the latter's is to provide new value-added and personalised services.

Currently, traffic data collected by infrastructure operators and traffic police is made available to a range of media (radio, Internet, mobile phones and WAP) via the Slovene Motorway Company (DARS), a 100 per cent state-owned private company, and the Automobile Club of Slovenia (AMZS). There is currently no central national TTI centre.

The publicly-owned Slovenian Railways (SŽ) makes operational and incident data available to end-user providers. Public transport (PT) information services are available from local companies co-financed by, or under the full control of, local authorities, but there is a marked need for standardised intermodal information.

Major cities, eg Ljubljana (the capital), Maribor and the port of Koper, are actively interested in deploying ITS in areas including TTI. There is consensus on the importance of open standards and system architectures, with the political context favouring PPPs.

Role of the private sector

Due to the existing public authority structure, the private sector has not yet played as active a role as in some EU Member States; while low traffic volumes are a disincentive to major investment. (The greatest interest is coming from telecoms operators). Dutch transport consultancy AVV-NL is advising on new models for public-/private-sector cooperation.

Companies currently involved include the AMZS information channel (service provider), Traffic Design (system integrator), Iskra Sistemi (communications equipment manufacturer), DDC (road engineering) and Mobitel (the country's largest mobile network operator).

2. TTI service implementation and research

State-of-the-art of TTI service implementation

A publicly-owned automatic data collection system currently covers the country's motorway network, major national roads and urban intersections. Data is collected via loops and (more recently) cameras. An on-line network of weather information now covers the motorway network and is being extended. Resulting information on traffic conditions, incidents, roadworks and special events, with route recommendations, is

freely available via (a few) VMS, radio, a free phone line and the Internet. There are no informational outputs from the
Ljubljana and Maribor TCCs, and no real private TTI services.
A real-time rail information service is currently under development.
PT operators provide mostly static pre-trip information on timetables and fares (via the Internet), and in-trip information at stops.
Airport companies provide pre-trip (via the Internet) and in-trip (via phone) air travel information. Airlines and travel agencies provide trip-planning information via the Internet and phone. For waterborne transport, there is the central ELWIS on-line system.

TTI research activities

Responsibility is divided between the MoT and the DRSC. Horizontal tasks (eg project management and evaluation) are handled by research centres, at Ljubljana and Maribor universities, and in private companies e.g. OmegaConsult and DDC, with significant contributions from European research institutes including the NEI, NEA and DorschConsult.

3. Key issues for TTI implementation

Drivers and trends

Institutional (public and private)

The Government plans to introduce distance-related road pricing for all vehicles by 2008. It aims to identify the best payment method for providing core data core for other ITS systems.
Mobitel sees TTI as a potentially important market, subject to appropriate legislation and partnership arrangements.

Technological (data acquisition and service delivery)

National research and demonstration projects are creating know-how and enhancing cooperation between local and international actors, so facilitating 'good practice' transfer.
GSM deployment and the recent start of the EU Galileo programme are opening up new possibilities for location-based services and tracking applications.

Key obstacles to overcome

Users are already paying to use the infrastructure and therefore expect free TTI services.
To develop user-oriented services that can be successfully marketed, the private sector expects public investment in the basic information infrastructure.
Politically desirable (eg intermodal) TTI services are not in demand when the main transport choice is the private car.
High standards of reliability are needed to ensure that TTI services are up to date.
End users expect fully personalised and location-based information
Data availability is low at the urban level and for rail and maritime transport.
There is no single information portal for all modes of transport.

Major potentials to use

The different local actor networks need to be integrated at national level.
PPPs need to find a better balance between public and private interests. Gaps between limited resources and high political interest in TTI (in the public sector), and low demand and the need for a business case (in the private sector) need to be bridged.

4. Key actors in TTI development

Ministry of Transport: Dean Herenda, Head of ITS and Road Pricing: Dean.herenda@gov.si
Ministry of the Information Society (e-government): Joze Gyorkosz, State Secretary: Jozef.gyorkosz@gov.si
Roads Directorate (DSRC): Vili Žavrlan, Director: Vili.zavrlan@gov.si
The Slovene Motorway Company (DARS): Pedja Ašanin Gole, Director: Pedja.asanin-gole@dars.si

AMZS: Bogdan Brus, Head of TTI Services: Bogdan.brus@amzs.si
OmegaConsult: Cveto Gregorc, Head of Research: Cveto.gregorc@omegaconsult.si
University of Ljubljana, PTI Traffic Institute: Marijan Žura, Research Director: mzura@fgg.uni-lj.si
DDC: Bojan Podgornik, Project Coordinator: Bojan.podgornik@dd-ceste.si

SPAIN

1. Institutional framework for TTI development

Legal and public policy context

Public administrations have key roles in all aspects of TTI provision. The three national government departments most closely concerned are:
The Ministry of Science and Technology (responsible for all telecoms and information society issues; and promoting EC policy on private-sector participation in TTI).
The Ministry of Transport and Public Works (responsible for all transport modes and infrastructures, including TTI - the key Ministry for TTI deployment).
The Ministry of Interior (responsible for road traffic management and policing; some functions devolved to regional administrations in Catalunya and the Basque Country).
All road traffic data is collected from equipment installed by public authorities; and from the traffic police. Private companies have not yet been allowed to install monitoring equipment, nor is there as yet a legal framework allowing them to use data obtained with public funds. (The Government has been considering how best to establish such a framework). Private motorway concessionaires are required to provide the DGT (Spanish Road Traffic Authority) with information relevant to road safety.
Interconnection of databases is now emerging, under the influence of the delegation of traffic management competencies to regional administrations and the near standardisation of DATEX protocols (which will also interconnection at the international level, as is already the case with France. Most large cities already enjoy interconnection between traffic control centres (TCCs) and traffic information centres (TICs). There is no comprehensive regulation of the information chain.
Rail transport is currently public-sector. National infrastructure manager RENFE, an agency of the Ministry of Public Administration, provides interurban travel information via displays in main stations, customer service telephones and the Internet (the last enabling remote reservation and trip planning). Planned privatisation will highlight the full potential for TTI.
Overall, TTI deployment is fragmented and progressing unevenly. Public authorities do not see the establishment of a national framework as a priority. (Some have offered free services, a number of which have collapsed owing to their own success. Asking users to pay has received a negative response).

Role of the private sector
TTI services have so far largely developed within in the public sector. Apart from ones provided by some transport operators, those available privately mainly involve telecoms providers. In recent years, GSM operators and companies providing alerts via GSM/SMS have entered the arena, using information from public administrations, private road operators and automobile clubs. The main benefit for them is customer loyalty.
Travel agencies offer a de-facto pre-trip TTI service based on their importance in the Spanish travel market. They sell some 80 per cent of all air tickets, as well as high proportions of tickets for other modes, and most people planning trips use them.

2. TTI service implementation and research

State-of-the-art of TTI service implementation

The DGT (www.dgt.es) is responsible for most Spanish interurban roads (except in Catalunya and the Basque Country). It is in charge of ITS deployment, eg via the Spanish network of TCCs and TICs; and of pooling information from these, from the traffic police, and from centres in neighbouring countries. The results are collated in the CIT-II Concentrator traffic database for general dissemination.
The DGT's free phone number is widely used, particularly for information on winter weather conditions (though a 2002 change in the law to ban the use of mobile phones while driving is expected to reduce the number of calls).

RDS-TMC is now operational nationwide, with own-language versions planned. (Digital audio broadcasting (DAB) is starting to provide a service, in spite of limited receiver availability). Most licensed operators are interested in providing TTI services
RENFE's information system provides national coverage and links with other rail and urban metro operators (www.renfe.es). (See also above). Regional rail operators also provide TTI.
Private coach companies plying long-distance routes offer services similar to those of national rail services, including reservation via the Internet and customer service phone.
Among major private bus operators, Grupo ALSA/ENATCAR provides the most important national TTI service, including timetables, fares, online booking, care rental and couriers (**www.alsa.es**).
Many urban public transport (PT) authorities and operators, including metros in major cities, provide TTI services via phone and the Internet as part of their overall responsibilities. (See, for example, **www.metrobilbao.net** and **www.metromadrid.es**).
At-stop arrival-time information has yet to be introduced on any large scale.
In air transport, national airports and air traffic manager AENA provides free flight information via phone and the Internet (www.aena.es). It is expected to be privatised in the near future. Carriers make effective use of the Internet, which enables them to compete for bookings with travel agencies (see below). National airline IBERIA's information system has been adopted as a model by other carriers, and its website (www.iberia.es) is widely used.
In maritime transport, ports are publicly owned and offer no TTI services. The main operator, Trasmediterranea, provides Internet-based information (www.trasmediterranea.es).

TTI research activities

RENFE is working on an SMS service that will provide information on eg incidents and engineering works.
Providers of services currently offered via GSM/WAP are investigating the use of GPRS.
Projects are investigating an itinerary calculator providing map information via GSM.
Others projects are dealing with the new standards for information exchange, eg XML, which will allow interconnection of databases and uniform presentation of information.

3. Key issues for TTI implementation

Drivers and trends

Institutional (public and private)

Institutional-level TTI development will depend on inter-administration agreements.
Telecoms providers are emerging as key actors (though mainly as promoters of infrastructure).
End users are currently happy with information they receive, especially when free. They expect delays, and only look for better information during eg holiday rushes and major closures or emergencies.
Service providers' commitment to quality of service and provision of personalised information will be critical.

Technological (data acquisition and service delivery)

Spain has one of the lowest European levels of home Internet use.
Access to UMTS terminals and services to access multimedia information is a key factor.
Users have been reluctant to use WAP services, due to poor quality compared with SMS.
The EU's Galileo satellite programme will have an influence in the Spanish market.

Key obstacles to overcome

Spanish public authorities are typically inward-looking and slow to change. There is a need for new inter-administration agreements.
Internet use is low, with service quality (data rate) inappropriate for multimedia services.
WAP has not had the impact foreseen on the basis of European experience, with many users waiting for appropriate terminals. (Solutions may involve PDAs or UMTS-based terminals).

Major potentials to use

While potential for using advanced TTI services is currently greatly restricted, there is scope for their development on the basis of comprehensive databases arising from:
The ever-increasing numbers of people travelling internationally, for tourism or business.
The emergence of alternative route options, eg air/high-speed train (HST).
Increasing delays resulting from congestion across the whole of Europe.

4. Key actors in TTI development

DGT: Federico Fernández Alonso, Adjunct Director of Traffic: federico.fernandez@dgt.es
Ministry of Public Administration: Pedro Tena, Technical Secretary for Transport: ptena@mfom.es
Servei Cátala de Transit (Catalunya) : Leift Torzón: lthorson@correu.gencat.es
Dirección de Tráfico (Basque Country) Iñaki Eguiara: ieguiara@utap.ej-gv.es
RENFE: Maria Dolores CiveraInformation service+(34)-96.3537110
Grupo ALSA/ENATCAR : tel: +(34)-902 422 242

SWEDEN

1. Institutional framework for TTI development

The Government's 1998 Transport Policy for Sustainable Development set the overall goal of ensuring "a socio-economically efficient transport system that is sustainable in the long term for individuals and trade and industry throughout the entire country." Its May 1999 Environmental Policy for a Sustainable Swedish Society set the goal a society in which "the major environmental problems in Sweden have been solved." These policies set the current agendas for two key actors.
The Swedish National Road Administration (SNRA, Vägverket) has overall responsibility for the national road system. It represents the Swedish Government in such areas as environmental impact, road safety, accessibility (eg by the disabled), ITS, public transport (PT), and R&TD. It also plays the lead role in ensuring cooperation between key actors in all modes in goods and passenger transport.
The SNRA is responsible for implementing the National Plan for the Road Transport System 1998-2007, as extended by a detailed 1999 memorandum on safe road transport entitled 'Sweden in the Forefront of a Safe Road Transport System'. (Increased road safety is a high priority for the Swedish Government). Its 1999 National Programme for Road Informatics in Sweden contains a strategy for increasing the use of IT in traffic management over the period 1999-2007.
Rikstrafiken (the National Public Transport Agency, NPTA), created in 1999, coordinates long-distance PT by bus, train, air and water. It focuses on sustainability, service quality, safety, environmental protection and the importance of meeting travellers' needs (eg by coordinating timetables, ticketing and passenger information). It is also responsible for procuring long-distance PT to meet policy aims that are not met elsewhere (eg for travellers with special needs).

The SNRA co-manages the National Road Database (NVDB, Nationell Vägdatabas), to meet immediate and long-term needs for fundamental road information by both public and private sectors. It contains up-to-date, quality-assured information on the entire Swedish road network (including speed limits and relevant traffic rules). It has three major application areas: ITS deployment (in which it is seen as a major driver), social planning, and highway management. It is designed for eventual integration into a nationwide, all-mode database.
SNRA traffic data is collected in a special traffic database, TRISS, together with data from other sources (eg the police and local authorities). It is then disseminated to private- and public-sector actors including radio stations (via the RDS channel) and service providers. Swedish Radio (SR) has used DAB (Digital Audio Broadcasting) in selected areas since 1995, and in 2002 a new Trafik Stockholm channel went live in the capital. SR and national, regional and local traffic departments are responsible for distributing incident information.
Sweden's signing of relevant memoranda of understanding (MoUs) on DATEX and TMC underlines her commitment to international standards activity.

Role of the private sector

The Swedish market is too small to encourage private actors to start their own services. Drivers expect free information from public bodies such as the SNRA and local traffic authorities.
Ongoing R&TD projects are looking at possible public/private co-operation – eg in the larger cities, where there could be scope for combined traffic and PT information, travel time comparisons and multi- modal trip planning. Payment would be via premium phone charges.
Private companies including Gothenburg-based Infracontrol are developing pocket PCs for dynamic traffic information. Navigation systems with dynamic route guidance are available eg from Volvo. In the OPTIS project, SNRA is working with private companies to evaluate the potential of floating car data (FCD) for giving real-time traffic information.

2. TTI service implementation and research

State-of-the-art of TTI service implementation

The main output from TRISS is the nationwide 'läget på vägarna' ('current road situation') service (www.vv.se/triss/trafikinfo/map.htm), which is continuously being improved. There are links to Stockholm's special website, www.trafiken.nu, which is jointly managed by the SNRA, the City of Stockholm and PT company SL, and is under continuous development.

Statens Järnvägar (SJ, Swedish Rail) operates an Internet-based rail and bus trip planner, with ticket booking and payment facilities (www.sj.se).
Real-time PT information is available in cities including Stockholm, Gothenburg, and Jönköping. Systems are based on on-board GPS units or sensors, with vehicle position in relation to timetables distributed in real time to traffic control centres, websites, station monitors and at-bus stop displays. (The system also gives PT priority at traffic signals).
Gothenburg's long-term GOTIC R&TD project involves PT-specific research and practical trials, and aims to develop a purpose-designed system for presenting real-time information, produced and transmitted by the KomFram traffic control system.
Samtrafiken (Swedish Public Transport Coordination) was set up in 1993 by all Sweden's rail operators and county PT authorities to encourage greater PT use. It hosts the nationwide 'TågplusGuiden' ('TrainPlus Guide') intermodality service (www.tagplus.se), based on its national database and offering door-to-door journey information for over 2000 communities.

TTI research activities

WAP is seen as a coming trend. Stockholm PT information can be obtained from wap.sl.se and wap.trafiken.nu, with a similar service planned in Gothenburg, where the main actor is regional traffic authority Västtrafik.
There is strong emphasis on mobility management and multimodal travel, aimed at encouraging greater PT use, eg via smart payment covering different modes and parking.
Sweden is also represented in the EU-funded PRoGR€SS R&TD project, part of which is looking at road user charging (RUC) to encourage modal shift. Success depends on reliable transport information pre- and on-trip.
The 2000 SNRA/Västtrafik IMPULS project aimed to influence morning-peak drivers to switch to trains by presenting comparative travel-time information on roadside signs near a free park-and-ride. Results showed that, even though driving on usually took longer, drivers were reluctant to shift mode owing to loss of flexibility and late presentation of information.

3. Key issues for TTI implementation

Drivers and trends

Institutional (public and private)

Need for cross-cutting cooperation and data exchange, eg between data suppliers and service providers, to improve data quality and consistency.
Need to meet the demand for real-time travel time information.
Emphasis on multimodal and door-to-door services, driven mainly by public-sector actors.
Need for evaluation of the market for transport and travel information service providers.

Technological (data acquisition and service delivery)

Movement towards use of FCD, to increase the number of input data sources and provide wider geographical coverage.
Need to improve quality of in-trip information available via the Internet.
Increasing availability of text and camera information via mobile telephones.

Key obstacles to overcome

Small Swedish market size, as noted above.
Limitations on companies' investment budgets, due to Sweden's present economic situation.
Issues of data integrity, arising from the use of mobile telephones and the Internet for traffic and transport information.
Privacy and security concerns, when car drivers are used as data sources.

Major potential for use

SNRA information on all planned road works, combined with travel-time information and comparisons, could be of market interest if tailor-made for given drivers/locations.
FCD could potentially be of great value or both public and private organisations in developing future high-quality services for the driving public.

4. Key actors in TTI development

SNRA: Johnny Svedlund, Project Manager for Traffic Information: Johnny.svedlund@vv.se
Västtrafik: Gunnilla Wicktor, Information director: Gunilla.wicktor@vasttrafik.se
Øresundsbro Konsortiet: Kundeservice@oeresundsbron.com
SJ: Maria Löf, Manager, Traffic Information Department: sjinfo@sj.se
Trafiken.nu: Alf Peterson: Info@trafiken.nu; alf.peterson@vv.se

Websites

www.vv.se
www.vasttrafik.nu
www.oeresundsbron.com
www.vv.se/triss/trafikinfo/map.htm

SWITZERLAND

1. Institutional framework for TTI development

Legal and public policy context

The Swiss Federal Government lays down the country's broad national transport policy. The Swiss Federal Roads Authority (SFRA/ASTRA, www.astra.admin.ch) is responsible for the planning, finance, construction, operation and maintenance of the national road network, with the 26 individual cantons taking responsibility for their local roads.

Two new sets of national regulations on traffic management and information came into force in 2003. Under these, the cantons are responsible for both activities within their own areas, with the Federal Government exercising responsibility for cross-border heavy goods traffic and the coordination of traffic information across cantonal boundaries.

In 2001, the Federal Government produced a Strategy for Road Traffic Telematics to 2010. A number of projects aimed at developing an architecture for TTI are currently under way. A core problem that has emerged is the need for definition of a data warehouse for all TTI data, to clarify collection and processing responsibilities.

Role of the private sector

Switzerland currently has no official traffic information centre (TIC). Viasuisse (a PPP comprising national broadcaster SRG SSR idée suisse, the Touring-Club Schweiz (TCS), Swiss Railways (SBB), the SFRA and the Swiss Council for Accident Prevention) acts as a national service provider and quasi-official TIC, with support from federal and cantonal police. Traffix collects traffic data and feeds local broadcasters in the cities of Berne, Lucerne, Winterthur and Zurich. Several organisations are testing new services based on data collected by road operators, but none of these are so far commercial.

2. TTI service implementation and research

State-of-the-art of TTI service implementation

SRG SSR idée suisse provides a radio traffic information service at a minimum of 30-minute intervals. A number of regional/local radio stations broadcast traffic information using data from their own resources or from Viasuisse. SRG SSR idée suisse also covers the entire country with RDS-TMC services. All TV stations with Videotext capability give pre-trip traffic information.

Swisscom operates a phone line (#163), which covers the motorway and national trunk road network using data from TCS' Inforoute service. Together with two other Swiss telecoms providers, it also offers a traffic information service via SMS. (www.swisscom.ch; www.orange.ch; www.sunrise.ch).

Motorways are increasingly being equipped with variable message signs (VMS), which are used for re-routing as well as traffic information. The SFRA is investigating the feasibility of adding travel-time information.

No nationwide traveller information service is yet in operation or planned. Several websites, eg www.tcs.ch and www.txt.ch, offer pre-trip information; some also provide a WAP service. At regional level, www.transbasel.com has been set up as a demonstration project with EU funding; Government support is anticipated.

Truck Info is a national travel-planning and traffic information service for heavy goods vehicles (www.truckinfo.ch).

SBB provides rail information covering the entire country (www.sbb.ch).

TTI research activities

National responsibility for transport and telematics research lies with the SFRA, supported by the Swiss Federal Office for Education and Science. The SFRA funds most national research projects, and is helped in evaluating and processing them by the Swiss Association of Road and Transportation Professionals (VSS) and the Swiss Association of Transportation Engineers (SVI). Major TTI research and implementation projects include:

National level:

- Framework Strategy for Road Traffic Telematics 2020 and ITS Switzerland 2012 (SFRA).
- SNS-CH: Traffic Management for Heavy Goods Vehicle Using Alpine Crossings (SFRA).

- GEWI-TIC: Evaluation and Implementation of a Communications and Management System (Viasuisse/SFRA).
- Assessment of Traffic Information Systems in Switzerland (SFRA).
- VSS2001/301: Indication of Time Lost in Congestion (VSS).
- VSS2000/436: Standardised Traffic Information (VSS).
- VSS2001/901: Qualitraffic: Specifications for Collection, Processing and Distribution of Traffic Information (VSS).
- SVI 1999/326: Impact of Personal Travel Assistants (SVI).

International level:

- SERTI (Southern European Road Telematics Implementation).
- CORVETTE (Coordination and Validation of the Deployment of Advanced Transport Telematics Systems in the Alpine Area).
- TRIDENT (Transport Intermodality Data Sharing and Exchange Networks).

3. Key issues for TTI implementation

Drivers and trends

Institutional (public and private)

New regulations for traffic management and information form the basis for financing new services.
The Swiss Strategy for Road Traffic Telematics contains 10 guidelines for meeting political goals in traffic management and information.
Limited resources in both public and private sectors, and user requirements, are creating the need for cooperation and PPPs.

Technological (data acquisition and service delivery)

A number of studies and projects are indicating the need for, and architecture of, an (inter)national data warehouse for traffic management and information.
Standardisation at both national and European levels has been growing in importance for a number of years, and is of critical importance for delivering integrated services.
A number of organisations (public- and private-sector) are using the Internet as a platform for TTI services. The combination of the Internet and communications (eg by mobile phone) is helping the development of pre-trip and in-trip information services.

Key obstacles to overcome

High user expectations of service content are in contrast with reluctance to pay when free public services are available.
TTI services must be highly reliable, to ensure that they do not give out-of-date information.
Information on all transport modes needs to be integrated in a common data warehouse to ensure seamless TTI provision,
While services on interurban networks have reached a high-level, considerable effort is needed to integrate urban networks effectively.

Major potentials to use

High levels of mobile phone ownership indicate a sizeable market for personalised multimodal and intermodal traveller and traffic information services (pre-trip and in-trip).

4. Key actors in TTI development

Swiss Federal Roads Authority (SFRA/ASTRA): Andreas Gantenbein, Head of Division Responsible for Road TrafficTelematics Strategy: andreas.gantenbein@astra.admin.ch
Viasuisse: Mark Bögli, Managing Director: mb@viasuisse.ch
Traffix: Jürg Fleischmann / Managing Director: fleischmann@traffix.ch
Conference of Swiss Cantonal Police Chiefs: Fritz Brigger, Chairman: Info@shpol.ch
B+S Ingenieur AG: Walter Schaufelberger, Head of Division Responsible for the SERTI/ CORVETTE /TRIDENT Projects: walter.schaufelberger@bs-ing.ch

VSS Fachkommission 9: Traffic Telematics: Matthias Rapp, Chairman, Co-ordination of Standardisation: matthias.rapp@rapp.ch

UK

1. Institutional framework for TTI development

The UK's strategic highways (motorways and trunk roads) are owned and controlled in England by the Department for Transport (DfT), through the Highways Agency, HA); in Scotland and Wales by devolved governments; and in Northern Ireland by the Department of Regional Development. London's trunk roads are controlled by Transport for London (TfL); its motorways by the HA. Local highway authorities control other roads. Key international collaborative activities include two Euro-regional projects: CENTRICO (linking with mainland Europe) and STREETWISE (linking with the Republic of Ireland). A major domestic initiative with TTI implications is the English national traffic control centre (TCC) project (www.highways.gov.uk/roads/projects/tcc/index/htm).

The approach to TTI by the UK Government and its agencies is essentially permissive. The primary legislation governing TTI development for drivers, the Road Traffic (Driver Licensing and Information Systems) Act 1989, licenses system operators to install equipment on highways, and ensures that dynamic route guidance does not prejudice safety or good traffic management. The Government has a safety checklist and design guidelines for in-vehicle systems; research on human-machine interface (HMI) issues continues. Government bodies and agencies collect and process large amounts of traffic data.

Regional authorities in Scotland, Wales and Northern Ireland have been proactive in developing telematics systems, generally in partnership with the private sector. Examples include the South Wales Traffic Management and Information Centre's bilingual information phone line, website and associated WAP services (Traffic Wales); and the Scottish National Driver Information and Control System (NADICS).

In the rail sector, the Railways Act 1994 requires privately-owned train operating companies (TOCs) to provide a National Rail Enquiry Service (NRES). Delivery of real-time information is progressing, and is available for many stations on the Internet. The Transport Act 2000 set up the Strategic Rail Authority, which is responsible for steering investment and securing passenger benefits in franchise agreements with TOCs – both can include TTI.

In 2003, new agency Transport for London (T*f*L) takes over London Underground Ltd (LUL), which has invested in real-time at-station information systems and the www.thetube.com website. T*f*L's Countdown provides real-time information at bus stops.

In road-based public transport (PT), the Transport Act 2000 empowers local transport authorities to require operators to make available bus service information. In support, the UK Government has spearheaded the *traveline* phone enquiry service under its Transport Direct (TD) initiative (www.traveline.com). There are a number of regional *traveline* consortia.

Role of the private sector

Government policy is that competition will deliver the most economic and efficient services. (It remains to be seen whether this results in effective regional monopolies, as with bus operation following deregulation). An emerging trend is for information providers to target specific market segments, e.g. trucks or vehicle theft. Quality and accuracy of information are the responsibility of publishers, with end users protected through consumer legislation. Commercial services are governed by Broadcasting Acts and the 1989 Act.

Actors prominent in TTI service provision are:

- Private contractors, pre-eminently TrafficMaster plc and ITIS Holdings plc.
- Motoring organisations (often in partnership with public-sector agencies).
- Broadcasters.
- Telecoms providers (though not, historically, as data collectors or publishers).
- Vehicle manufacturers (In May 2001, ITIS and Toyota (GB) announced the UK's first commercial RDS-TMC service under the 1989 Act).

The private sector provides nearly all PT services in the UK, outside London, and is thus also responsible for TTI. Concentrations of ownerships of rail operating franchises by companies' also running bus or coach services is starting a trend towards integrated bus/rail information (including airport connections and some integrated ticketing). Rail companies have also developed commercial websites to sell tickets for all services (e.g. www.qjump.co.uk and www.thetrainline.com)

Delivery of real-time information to much of the national scheduled express coach network is emerging through a deal between ITIS and main operator National Express, which is using its coaches as 'floating cars' to collect data for ITIS' national RDS-TMC service.

2. TTI service implementation and research

State-of-the-art of TTI service implementation

An indicative cross-section consists of:
The ITIS RDS-TMC service (www.rds-tmc.co.uk).
KIZOOM's mobile public transport information services (www.kizoom.com).
The Institute of Logistics and Transport's Travel Websites Accreditation System and Best Practice Guide to Public Transport Information Websites (www.iolt.org.uk).
The ROMANSE (ROad MANagement System for Europe) project based in Hampshire, using TTI to develop a model for transport management in Europe (www.romanse.org.uk).
The StarTrak at-bus stop real-time information system deployed in Leicester (www.star-trak.co.uk)
TrafficMaster traffic monitoring (www.trafficmaster.co.uk).
Transport Direct (TD) (www.dft.gov.uk/itwp/transdirect).
The Travel Information Highway (TIH) electronic marketplace for date exchange between operators and users (www.tih.org.uk).
traveline.

TTI research activities

Examples of university-based research include:
Wolverhampton University's Intelligent Commercial Vehicle Operation project, which aims to develop new TTI solutions for sustainable distribution.
Southampton University's Transportation Research Group (TRG)'s research into network strategy performance of VMS.
The TRG's global review of traveller information systems research relevant to TD.
Welsh Assembly Government research into bilingual signing and driver response times.

3. Key issues for TTI implementation

Drivers and trends

Institutional (public and private)

The Government is keen to tackle road congestion and make PT more attractive; hence TD. It is also taking an active role in developing smartcard standards and initiatives, to promote integrated transport; and has completed an industry awareness exercise in response to the EU's 1999 statement of principles on HMI issues.

Technological (data acquisition and service delivery)

Huge growth in mobile communications.
Communications advances (e.g. development of the GSM network, with emerging services including digital radio broadcasting and two-way communications by satellite).
Increasing consumer IT use raising expectations and demand for accurate and timely TTI.
Automotive manufacturers increasingly planning to fit TTI equipment in new vehicles.

Key obstacles to overcome

Lack of clear overall ITS strategy or framework.
Need for identification of, and agreement on, public and private sector roles in TTI.
Need for definition of ITS domains at national and local levels.
Current lack of a methodology for determining benefit and risk profiles for investment in ITS.
1995 assessment of ITS benefits now out of date.
Need for review of legislation and standards applicable to ITS.
Need for mechanisms to achieve practical co-ordination between initiatives and projects.
Lack of any regularly updated market analysis studies for ITS.

Major potentials to use

Full integration of multimodal travel information through TD and associated projects (e.g. TIH) could lead to significant modal-shift and faster times on longer journeys.
Bus priority systems and dynamic scheduling could help overcome the problem of unreliability resulting from traffic congestion, the greatest single barrier to bus use in the UK.

4. Key actors in TTI development

Department for Transport (DfT): Eric Sampson, Eric.sampson@dtlr.gsi.gov.uk
Welsh Assembly Government (WAG) Leighton James leighton.james@wales.gsi.gov.uk
Scottish Executive, Ian Anderson, ian.c.anderson@scotland.gsi.gov.uk
Northern Ireland, Brian Maxwell, brian.maxwell@drdni.gov.uk
traveline: Tony Ferguson, Project Director: Tonyf@cpt-uk.org
ITIS: www.itisholdings.com

Websites

www.traffic-wales.com
www.nadics.org.uk
www.drdni.gov.uk
www.tfl.gov.uk
http://www.highways.gov.uk