Technical Report Documentation Page

1. Report No. FHWA-PL-03-005	2. Government Accession No.	3. Recipient's Catalog No.
4. Title and Subtitle Traveler Information Systems in Europe		5. Report Date August 2003 6. Performing Organization Code
7. Author(s) Bob Rupert, Jim Wright, Pierre Pretorius, Greg Cook, Kelly Hutchinson, William (Todd) Kell, Harry (Mac) Lister, Mike Nevarez, Louis Sanders, Rick Schuman, Rich Taylor, Jake Almborg		8. Performing Organization Report No.
9. Performing Organization Name and Address American Trade Initiatives P.O. Box 8228 Alexandria, VA 22306-8228		10. Work Unit No.(TRAIS) 11. Contract or Grant No. DTFH61-99-C-0005
12. Sponsoring Agency Name and Address Office of International Programs Office of Policy Federal Highway Administration U.S. Department of Transportation		13. Type of Report and Period Covered 14. Sponsoring Agency Code
15. Supplementary Notes FHWA COTR: Hana Maier, Office of International Programs		

16. Abstract

There is a current focus in the United States toward providing travelers with information that enables them to make informed decisions about their schedules, modes, and routes of travel. U.S. transportation agencies are developing traveler information products that are coupled with weather, location, event, and emergency information.

The scan team visited eight cities in Spain, Germany, Sweden, Scotland, and England that have established traveler information products and services that reflect all transportation modes. The timing for the tour also allowed the team to examine European practices that could be applied in implementing "511" telephone traveler information services in the United States. The scan team evaluated findings in information content, customer needs, business/cost recovery models, technology applications, consistency and standards, and legal and policy issues and made specific recommendations for applications in the United States.

17. Key Words Dynamic message sign, advanced traveler information system, traffic management center, signal management system, radio data system-traffic message channel	18. Distribution Statement No restrictions. This document is available to the public from the Office of International Programs FHWA-HPIP, Room 3325 US Dept. of Transportation Washington, DC 20590 international@fhwa.dot.gov www.international.fhwa.dot.gov		
19. Security Classif. (of this report) Unclassified	20. Security Classif. (of this page) Unclassified	21. No. of Pages 100	22. Price Free

Form DOT F 1700.7 (8-72) Reproduction of completed page authorized

Traveler Information Systems In Europe

Prepared by the Scanning Team:

Bob Rupert
FHWA
Co-Chair

Jim Wright
Minnesota DOT
AASHTO Co-Chair

Pierre Pretorius
Kimley-Horn and Associates, Inc.
Report Facilitator

Greg Cook
Ann Arbor Transit

Kelly Hutchinson
North Carolina DOT

William (Todd) Kell
Virginia DOT

Harry (Mac) Lister
FHWA

Mike Nevarez
City of Phoenix Transit

Louis Sanders
APTA

Rick Schuman
PBS&J

Rich Taylor
ITS America

Jake Almborg
ATI, Inc.

and

American Trade Initiatives, Inc.
&
LGB & Associates, Inc.

for the

Federal Highway Administration (FHWA)
U.S. Department of Transportation

and

The American Association of State Highway and Transportation Officials

and

The National Cooperative Highway Research Program
(Panel 20-36)
of the Transportation Research Board

AUGUST 2003

FHWA INTERNATIONAL TECHNOLOGY EXCHANGE PROGRAMS

The Federal Highway Administration's (FHWA) international programs focus on meeting the growing demands of its partners at the Federal, State, and local levels for access to information on state-of-the-art technology and the best practices used worldwide. While FHWA is considered a world leader in highway transportation, the domestic highway community is interested in the advanced technologies being developed by other countries, as well as innovative organizational and financing techniques used by FHWA's international counterparts.

The International Technology Scanning Program accesses and evaluates foreign technologies and innovations that could significantly benefit U.S. highway transportation systems. Access to foreign innovations is strengthened by U.S. participation in the technical committees of international highway organizations and through bilateral technical exchange agreements with selected nations. The program is undertaken cooperatively with the American Association of State Highway and Transportation Officials and its Select Committee on International Activities, and the Transportation Research Board's National Cooperative Highway Research Program (Panel 20-36), the private sector, and academia.

FHWA and its partners jointly determine priority topic areas. Teams of specialists in the specific areas of expertise being investigated are formed and sent to countries where significant advances and innovations have been made in technology, management practices, organizational structure, program delivery, and financing. Teams usually include Federal and State highway officials, private sector and industry association representatives, and members of the academic community.

FHWA has organized more than 50 of these reviews and disseminated results nationwide. Topics have included pavements, bridge construction and maintenance, contracting, intermodal transport, organizational management, winter road maintenance, safety, intelligent transportation systems, planning, and policy. Findings are recommended for follow-up with further research and pilot or demonstration projects to verify adaptability to the United States. Information about the scan findings and results of pilot programs are then disseminated nationally to State and local highway transportation officials and the private sector for implementation.

This program has resulted in significant improvements and savings in road program technologies and practices throughout the United States, particularly in the areas of structures, pavements, safety, and winter road maintenance. Joint research and technology-sharing projects have also been launched with international counterparts, further conserving resources and advancing the state of the art.

For a complete list of International Technology Scanning topics, and to order free copies of the reports, please see pages iii-iv.

Website: www.international.fhwa.dot.gov
Email: international@fhwa.dot.gov

FHWA INTERNATIONAL TECHNOLOGY EXCHANGE REPORTS

International Technology Scanning Program:
Bringing Global Innovations to U.S. Highways

Infrastructure

Geotechnical Engineering Practices in Canada and Europe
Geotechnology—Soil Nailing
International Contract Administration Techniques for Quality Enhancement-CATQEST
Contract Administration: Technology and Practice in Europe

Pavements

European Asphalt Technology
European Concrete Technology
South African Pavement Technology
Highway/Commercial Vehicle Interaction
Recycled Materials in European Highway Environments
Pavement Preservation Technology in France, South Africa, and Australia

Bridges

European Bridge Structures
Asian Bridge Structures
Bridge Maintenance Coatings
European Practices for Bridge Scour and Stream Instability Countermeasures
Advanced Composites in Bridges in Europe and Japan
Steel Bridge Fabrication Technologies in Europe and Japan
Performance of Concrete Segmental and Cable-Stayed Bridges in Europe

Planning and Environment

European Intermodal Programs: Planning, Policy, and Technology
National Travel Surveys
Recycled Materials in European Highway Environments
Geometric Design Practices for European Roads
Sustainable Transportation Practices in Europe
Wildlife Habitat Connectivity Across European Highways
European Right-of-Way and Utilities Best Practices

Safety

Pedestrian and Bicycle Safety in England, Germany and the Netherlands
Speed Management and Enforcement Technology: Europe & Australia
Safety Management Practices in Japan, Australia, and New Zealand
Road Safety Audits—Final Report
Road Safety Audits—Case Studies
Innovative Traffic Control Technology & Practice in Europe
Commercial Vehicle Safety Technology & Practice in Europe
Methods and Procedures to Reduce Motorist Delays in European Work Zones
Managing and Organizing Comprehensive Highway Safety in Europe

Operations

Advanced Transportation Technology
European Traffic Monitoring
Traffic Management and Traveler Information Systems
European Winter Service Technology
Snowbreak Forest Book – Highway Snowstorm Countermeasure Manual (*Translated from Japanese*)
European Road Lighting Technologies
Freight Transportation: The European Market
Traveler Information Systems in Europe

Policy & Information

Emerging Models for Delivering Transportation Programs and Services
Acquiring Highway Transportation Information from Abroad—Handbook
Acquiring Highway Transportation Information from Abroad—Final Report
International Guide to Highway Transportation Information
European Practices in Transportation Workforce Development

All publications are available on the internet at www.international.fhwa.dot.gov

ACRONYMS AND ABBREVIATIONS

AA	Automobile Association, United Kingdom
AASHTO	American Association of State Highway and Transportation Officials
ADT	Average daily traffic
APTA	American Public Transportation Association
ATIS	Advanced traveler information system
AVL	Automatic vehicle location
B2B	Business to business
B2C	Business to customer
CCTV	Closed-circuit television
CEN	European Committee for Standardization
CITRAC	Centrally Integrated Traffic Control
CIVICAT	Catalan Traffic Information Center
DAB	Digital audio broadcast
DGT	Direcion General de Traffic, General Traffic Authority, Madrid
DMS	Dynamic message sign
DOT	Department of transportation
DTLR	Department of Transport, Local Government, and the Regions
EU	European Union
FHWA	Federal Highway Administration
GNER	Great North Eastern Railway
GPS	Global positioning system
GSM	Global system for mobile communications
HOV	High-occupancy vehicle
IP	Internet protocol
IT	Information technology
ITS	Intelligent transportation system
IVR	Interactive voice response
LED	Light-emitting diode
LOS	Level of service
LRT	Light rail transit
MOU	Memorandum of understanding
NRES	National Rail Enquiry Services
OEM	Original equipment manufacturer
PDA	Personal digital assistant
RAC	Royal Automobile Club, United Kingdom
RDS-TMC	Radio data system-traffic message channel
SMS	Signal management system
SNRA	Swedish National Road Administration
TCC	Traffic control center
TMC	Traffic management center
UK	United Kingdom
VID	Video image detector
VMS	Variable message sign
VMZ	Berlin Traffic Management Center
WAP	Wireless application protocol

CONTENTS

FIGURES

FOREWORD

This report presents the findings of the study team that participated in an International Technology Scanning Program tour to the countries of Spain, Germany, Sweden, Scotland, and England. The scanning program is a joint effort of the Office of International Programs of the Federal Highway Administration and the American Association of State Highway and Transportation Officials, in collaboration with the Transportation Research Board's National Cooperative Highway Research Program. This tour was expressly for the purpose of learning about multimode traveler information systems and the business practices surrounding them. The timing of the tour also allowed the study team to examine European practices that could be applied in implementing "511" telephone traveler information services — the three-digit telephone number designated for traveler information in the United States.

An important goal for the study team was to learn about and identify policies, programs, technologies, and techniques that may have applications to U.S. experiences in traveler information services. While there were many opportunities to see various technologies and methods in place and operating, the scanning tour also offered insights toward various implementation methods with differing roles and responsibilities for public agencies and private firms. The scanning tour was also a wonderful opportunity for policy, programmatic, and implementation discussions to take place on a peer-to-peer basis. The study team represented highway and public transport interests from a cross-section of public agencies and private firms, all actively involved in the development and deployment of traveler information systems. The relationships formed and the information exchanged among the host agencies and the study team members will be important legacies of the scanning tour.

The report presents the scanning tour's objectives and a description of the locations that were visited, followed by the study team's findings organized around seven focus areas. The report concludes with recommendations and an implementation strategy for applying some of the information gathered from the host locations. Throughout, the report contains pictures and excerpts from presentations to try to convey the different strategies and approaches used by the host locations to convey traveler information. Finally, the report is intended to facilitate further cooperation between the United States and the countries visited regarding traveler information services. All the countries and locations that hosted the study team recognized that providing traveler information was an integral part of sound transportation management. The host locations are facing many of the same challenges that members of the study team address in implementing and operating traveler information systems. The business of providing traveler information to improve transportation network efficiency, and the various roles of public agencies and private firms, are areas that offer great opportunities for continued cooperation and information exchange between the United States and the host locations.

Traveler Information Systems Scanning Tour Chairmen,
Jim Wright, Minnesota DOT
Bob Rupert, FHWA

ACKNOWLEDGMENTS

The panel members wish to thank all of the host transportation ministries, agencies, researchers, and private firms for their gracious hospitality and for sharing their time and experiences. Without exception, the team was warmly received in every country and by every official.

The panel is also appreciative of the amount of professional preparation, effort, and attention to detail provided by these agencies and their staffs. Much was learned from each country. Furthermore, doors to future cooperation and technology transfer were opened widely.

We also thank the Federal Highway Administration, Office of International Programs, and AASHTO for encouragement, guidance, and support, as well as ATI for assistance and guidance.

Finally, our gratitude goes to R. Leon Walden, Melanie Crotty, Tim Wolfe, Sandra Check, David Lively, and James Pol for their time and assistance in planning the scanning tour.

EXECUTIVE SUMMARY

U.S. transportation agencies are currently adopting a customer service model for updating their business practices. This shift of focus toward the consumers of transportation services is creating the need to deliver a variety of information products so that travelers can make more informed decisions about their schedules, modes, and routes of travel. In response, U.S. transportation agencies are developing traveler information products that are coupled with weather, location, event, and emergency information.

On the basis of literature surveys, eight cities in Europe were identified that have established traveler information products and services that reflect all transportation modes, especially beyond the personal automobile. From October 26 to November 10, 2002, a U.S. panel reviewed and documented the practices, policies, strategies, and technological innovations used in those cities to make traveler information available. The panel was co-sponsored by the U.S. Federal Highway Administration (FHWA), an agency of the U.S. Department of Transportation, and the American Association of State Highway and Transportation Officials (AASHTO). The panel comprised 11 members representing the FHWA, AASHTO, the Federal Transit Administration, and U.S. public and private-sector professional associations.

The panel evaluated systems and services for potential application in the United States. Panel members held meetings with national, regional, and local units of government and, where appropriate, private-sector organizations involved in such efforts. The U.S. participants shared their viewpoints and experiences in the spirit of mutually beneficial exchanges, which could result in new partnerships between comparable American and European agencies and institutions. A summary of the findings of this scanning tour follows.

CUSTOMER NEEDS AND USAGE

Two findings were noted under customer needs and usage:

- The importance of providing journey time to the traveler is widely recognized, and there is a good understanding of the value of this information to the customer. The value of journey time information was found to be high.
- With regard to “511,” no other national three-digit number was used; however, considerable data points were provided at several sites for call differentiation, duration, costs, impact of charging, etc.

Information Content

Three findings were noted under information content:

- Automated parking information systems were available and operated in every city visited. Parking information systems are considered part of the traveler information environment and not as additional services.
- Short-term traveler information prediction for both transit and traffic are pursued in several areas. “Next bus” and “next train” arrival information is available on systems. Short-term traffic condition forecasting is a European Union (EU)

research project, and some cities have developed their own algorithms based on current conditions and using a 5-year archive.

- Significant emphasis is put on collecting and providing quality data as the foundation of a sound traveler information system. Sweden has developed specific data quality documentation to improve the data collection process. The "data gap," as perceived in the United States, also exists in Europe, and the need to address the gap was confirmed by the findings of this scan tour.

Business/Cost Recovery Models

Numerous observations were noted about business/cost recovery models for traveler information systems:

- The state departments of transportation provide guidance on national policies on traveler information. National traveler information databases are generally being pursued and are under development.
- Several business models were of interest. Spain and Glasgow use a strong, public-sector model. Berlin, the United Kingdom's (UK) Highway Agency's Traffic Control Center (TCC), and Munich are following strong public-private partnership models. Sweden allows for private-sector opportunities within its traveler information framework.
- Establishing a sustainable traveler information system requires integration of information. Multimodal and multiagency cooperation are critical for successful deployment of an advanced traveler information system (ATIS).
- Transportation service operator-based call centers are far more extensive than in the United States. Spain, Sweden, and especially the United Kingdom have extensive call center systems in operation.
- The delivery of in-vehicle information is much more prominent in Europe than in the United States. Radio data system-traffic message channel (RDS-TMC) and TrafficMaster service provide traveler information to thousands of vehicles.
- As for customer needs for and use of "511," Spain uses "012" as a general information number, with traffic information as a selection. No other national three-digit number was used; however, considerable data points were provided at several sites for call differentiation, duration, costs, impact of charging, etc., for toll-free and for-fee travel information telephone advisory services.
- Small-scale, innovative business models are tested in a discreet way, almost on a pilot project basis before being considered for larger deployment.

Quality Measures

The major finding with regard to quality measures is the commitment to measuring and improving the quality of traveler information collection and delivery. In most cases, the sites start with quantitative measures and then move (or plan to move) to qualitative measures. In particular, Sweden has developed specific data quality documentation to improve the data collection process.

Technology Applications

There were multiple findings about technology applications:

- As observed by previous scan tours, the application of multiple colors and symbols on dynamic message signs (DMS) appears to improve message transfer and understanding among commuters. This technology should be researched for short-term application in the United States. Over and above the use of multicolor symbols on freeway DMS, further specific applications are being tested in Munich, including DMS to indicate traffic conditions along the ring road and map-type DMS to indicate travel time along alternative routes.
- As a result of the search for improved and expanded data collection, advanced detection techniques are pursued and tested at most sites. Examples include research and testing of technologies and techniques to use vehicles as probes or the use of video technologies to match vehicles. More work should be done in the United States to explore these techniques.
- Automated parking information systems were available and operating in every city visited.
- Real-time information delivery mechanisms are used extensively, from input to modeling for transportation-planning purposes to transit arrival time dissemination, and other applications.
- The delivery of in-vehicle information is prominent in Europe.

International/National Consistency Issues and Standards

Specific findings applied to international/national consistency issues and standards:

- Standards conformance or development was not a major discussion point at any of the sites. There was an acknowledgment, however, of the need for and use of standards and of the work of various standards groups.
- The consistent use of multiple colors and symbols on DMS appears to improve message transfer and understanding among commuters and warrants addressing in the United States.
- Establishing a sustainable traveler information system requires integration of information. A good example is the integrated auto/transit ATIS in Barcelona.
- The data gap perceived in the United States also exists in Europe, and findings of this scan tour confirmed the need to address this gap.

Policy/Institutional/Legal Aspects

The following findings, some of which were mentioned earlier, also relate to policy/institutional/legal aspects:

- As can be expected, the traveler information policies varied by country, depending on the government (i.e., form of government - socialist, federal republic, etc.).

- National policies on traveler information exist as a model where the state department of transportation will provide guidance. A top-down approach is followed. National traveler information databases are generally being pursued and are under development.
- Establishing a sustainable traveler information system requires integration of information. A good example is the integrated auto/transit ATIS in Barcelona.
- The data gap also exists in Europe, and the scan tour findings confirm the need to address this gap.

RECOMMENDATIONS

The panel offers the following initial recommendations:

- The concept of "infostructure" is supported and reinforced by the findings. Give infostructure greater priority and expand it locally to include historic, real-time, and predictive algorithms and data collection.
- Apply additional resources to close the data gap and improve the quality of traveler information.
- Incorporate the principle of traveler information into agency and corporate mission(s).
- Emphasize institutionalization of traveler information within transportation management systems and organizations.
- Continue to pursue deployment of a national traveler information database that is comprehensive, multimodal, and sustainable.
- Monitor the deployment and progress of ongoing European projects.
- Increase the delivery of travel/journey time information systems. Deployment might need to be phased depending on research and technologies. An event to discuss methods to gather data supporting travel/journey times should be arranged within 1 year.

INTRODUCTION

The Advanced Traveler Information System (ATIS) Scan Team comprised 11 members. The members were affiliated with:

- Federal Highway Administration (FHWA)
- American Association of State Highway and Transportation Officials (AASHTO)
- American Public Transportation Association (APTA)
- Intelligent Transportation Society of America (ITS America)
- Minnesota Department of Transportation (DOT)
- North Carolina DOT
- Virginia DOT
- Ann Arbor Transit (Michigan)
- Phoenix Transit (Arizona)
- Kimley-Horn and Associates, Inc.
- PBS&J

TOUR OBJECTIVES

The team identified the following objectives:

- Benefit from European experiences
- Learn new techniques
- Learn how to improve existing methods
- Share lessons learned

Particular topics of interest were:

- Customer needs and usage
- Information content
- Business/cost recovery models
- Quality measures
- Technology applications
- International/national consistency issues and standards
- Policy/institutional/legal aspects

These topics were provided in advance to the host nations as amplifying questions, which are included in Appendix A. Appendix B contains biographic sketches of team members, Appendix C includes team contact information, and Appendix D lists referenced websites.

LOCATIONS VISITED

The panel chose to visit the following cities on the basis of a literature review of traveler information systems in Europe:

- Madrid, Spain
- Barcelona, Spain
- Munich, Germany
- Berlin, Germany
- Stockholm, Sweden
- Glasgow, Scotland
- Newcastle, England
- London, England

Figure 1. Scan tour map.

TRIP ITINERARY

The program was as follows:

Location	Date	Activities
Madrid, Spain Spanish Road Association (SRA) Goya, 23, 4th Floor 28001 Madrid, Spain	Monday, October, 29, 2001	Meetings with the Municipality of Madrid, a visit to the control center of the General Traffic Authority, and site visits to HOV bus lane of the A-6 highway. Discussions with the Consortium for Regional Public Transportation of Madrid.
Barcelona, Spain City of Barcelona Plaza Charles Pi I Sunyer, 8-10 08002 Barcelona, Spain	Tuesday, October, 30, 2001	Visit the Municipality of Barcelona, the Regional Public Transport Authority, and the Catalonian Highway Department.
Munich, Germany City of Munich Hauptabteilung Strassenverkehr Ruppertstrasse 19 80337 Munchen, Germany	Wednesday, October, 31, 2001	Meet with City of Munich officials, BMW, and visit the Bavaria South Traffic Operations Center.
Berlin, Germany Federal Ministry of Transport, Construction and Housing Invalidenstrasse 44 10115 Berlin, Germany *and* Berlin Traffic Management Center (VMZ) Eichhornstrasse 3 10785 Berlin, Germany	Thursday, November 1 *and* Friday, November 2, 2001	Meetings with the Federal Ministry of Transport, Construction and Housing. Presentation on the German philosophy concerning transport telematics, DELFI (a Germany-wide electronic timetable information system), telematics applications in public transport, and of the traffic message channel (TMC). Berlin Traffic Management Center presented briefings on the consortium between Daimler-Chrysler and Siemens AG, which are building the Berlin Traffic Management Center.
Stockholm, Sweden Swedish National Road Administration Regional Office-Solna Hemvarnsgatan 15 Solna-Stockholm, Sweden	Monday, November 5 and Tuesday, November 6, 2001	Program followed the outline contained in the Amplifying Questions. Site visits included Traffik Stockholm TMC and SOS Alarm call center.
Glasgow, Scotland Glasgow City Council Richmond Exchange 20 Cadogan Street Glasgow, Scotland	Wednesday, November, 7, 2001	Meetings with the Glasgow City Council, Scottish Executive, and Strathclyde Regional Council officials followed by a site visit to the CITRAC and NADICS Traffic Management Center and Buchanan Bus Station.
Newcastle, England	Thursday, November 8, 2001	Meet with Nexus Regional Transport Authority, Traveline, National Rail, and Great North Eastern Railway (GNER) officials. Visited the Ryton rural bus transfer station, Traveline, National Rail Enquiry Services, and GNER call centers.
London, England Department of Transport, Local Government and the Regions (DTLR)—formerly Department of Environment, Transport and the Regions (DETR) Great Minster House 76 Marsham Street London, SW IP 4DR, United Kingdom	Friday, November 9, 2001	Presentations on the Highway Agency's Traffic Control Center Project, Transport Direct, RDS-TMC, TrafficMaster, and Hampshire County Council's Romanse.

CITY SUMMARIES

MADRID, SPAIN

Madrid is one of 17 regions in Spain. The city of Madrid has a population of 3 million. The metropolitan ring includes 50 towns and has a population of approximately 5 million. The regional ring includes 179 towns. From the mid-1970s to mid-1980s, transit use declined because of an increase in cars and decrease in transit quality.

The technical portion of the visit to Madrid included:

- Municipality of Madrid
- Consortium Transport Madrid
- General Traffic Authority–Direcion General de Traffic (DGT)

Municipality of Madrid

The Madrid Traffic Control Center (TCC) controls the traffic control system as well as the high-occupancy vehicle (HOV) lanes. The system makes extensive use of multicolor dynamic message signs (DMS). Internationally accepted symbols are used.

Figure 2. Madrid municipal traffic control center.

The signal system includes 1,800 intersections in the city. The center controls 1,000 of those intersections with a hierarchical control system using three levels. At the lowest level, each subcenter controls 20 to 24 intersections.

The first centralized control system was installed in Madrid in 1968. Currently, the city collaborates with British Transportation Road Research Laboratory in signal system research. Three control strategies can be used at any time:

- Fixed-time system
- Time of day or traffic-responsive plans
- Adaptive control

Another benefit of the system is that it includes a maintenance management system. Quality and quantity of detector data are perhaps the most important factors for successful system operations. Quality control measures include continual system monitoring for quality, increased quantity through more detectors to reduce the impact of failed detectors, and the confirmation of conditions with visuals from cameras.

Closed-circuit TVs (CCTVs) are used at 40 critical intersections. The operators at the control center can take over the signals and manually control them at those intersections. The control center also has incident management functions. The center can change control strategies, inform the public, share information with commercial radio stations, connect to TV stations that have connections, and control DMS and the Internet, which is often used by fleet operators. The next step would be applying other means, e.g., wireless application protocol (WAP) and personalized information.

Madrid typically experiences three different traffic peaks: AM, PM, and mini-peaks before and after lunch because many people go home for an extended lunch. Generally, radio is considered the most effective communications medium.

Travel times are provided on the M-30 (inner beltway). The M-30 is operated by the city, but the infrastructure was installed by DGT. Loop spacings on the M-30 are 500 m apart; data are collected every minute, and the 3-minute average is used to calculate average speeds for the link travel time. On the DMS, travel time is typically reported to the next three major exits. International symbols are used for congestion on DMS, because they provide compact representations and can be interpreted by non-Spanish-speaking persons. Eighty CCTVs are deployed on the M-30.

Figure 3. Dynamic message sign on the M-30.

The website can be visited at: **www.cities.munimadrid.es/mapatraficovi.asp**. The website was developed as part of a European Union (EU) cities project and presents volume data on arterials and parking lot status. The center has an operator dedicated to quality control of the Internet site. Information is gathered through detectors at entrances and exits combined with manual reports from the lots. Speed maps and incident reporting also are part of the reporting. Video images will be on the website within 6 months. TV stations have access to all the video. On a normal day, the website attracts 2,000 users, but that number varies. In August, for example, the site had 200,000 hits because it was a vacation month, and there are generally more hits on Fridays.

Consortium Transport Madrid

Consortium Transport Madrid was formed in 1985 as the regional transportation authority and oversees the subways (Metro), buses (public and private), and regional rail. The Consortium focus is on administrative, fare, and modal integration. In 1986, it created a monthly/annual ticket called a *Travelpass*, which is now used on 60

Figure 4. Next train arrival sign in Madrid.

percent of all trips. The transit properties still operate independently, but the Consortium determines the level of quality, measures the demand patterns, and establishes routes, schedules, and fares.

The Consortium oversees four modes: city subway and bus and intercity commuter rail and bus. Metro has 12 routes, 201 stations, and 1,338 vehicles. The plan is to grow from 120 km to 240 km. The current system is at 171 km. City buses have 184 routes, 8,564 stops and 1,824 vehicles. Metropolitan buses have 284 routes, 12,050 stops, and 1,100 vehicles. Commuter rail has 9 lines, 85 stops, and 667 trains.

Madrid has a public transport split of 54 percent. It increased from 29 percent in 1988. There is a 60 percent fare coverage of operating costs across all modes. Transit information relies heavily on printed information, and a computerized information system is connected to 50 kiosks and booths. The kiosks are handicap-accessible and are basically a web page with a touch screen. The information is not integrated with traffic information. The Consortium partnered with banks for the operation and maintenance of the kiosks and for the right to co-locate automated teller machines (Savings Bank of Madrid). The banks provide the hardware and communications. There are 50,000 inquiries per month, mainly for itinerary planning. The kiosks provide origins and destinations, best routes, walking directions, fares and timetables, hotel and restaurant databases, major transit disruptions, but no real-time arrival information. Multiple language options are offered, including English, French, and Spanish. The information can be viewed at: **www.ctm-madrid.es**. The size of the text can be adjusted for the visually impaired. The website has received 178,000 hits since March 2001. Extensive quality control is done on the itinerary planning systems, which are updated monthly for transit, but hotels and streets are not updated as frequently.

The telephone system has a very low usage of about 9,000 requests a month on average. It is not well advertised, and can be accessed through the “012” general information number, which is not just a transportation number.

Next arrival information is being implemented systemwide on the platforms and stops of the subway. The first system indicated how long since the last train departed, whereas the new system shows when the next train arrives. Some buses are equipped with automatic vehicle location (AVL) and next bus arrival systems. The high frequency of service reduces the need and the benefits of real-time arrival information.

The website is advertised on printed information, and a media campaign was conducted for the launch of the kiosks.

General Traffic Authority—DGT

The Direcion General de Traffic (DGT) is part of the Ministry of Interior, which is the public authority for road safety in Spain. DGT also has the authority for licenses and permits, registrations, and is the interurban traffic operator. The DGT budget is independent of the government general fund and is about $600 million annually. About 70 percent is based on fees, and the remainder is from traffic fines. DGT has 7,800 traffic police officers who cover 325,000 km of roads and 7,400 km of freeways. The DGT duties include traffic control and signalization, traveler information distribution, and road safety research and development. Data collection includes weather, incidents, and emergencies, and data are shared with other agencies.

A multichannel delivery system is used, which includes Internet, interactive voice response (IVR), radio, TV, DMS, and the radio data system-traffic message channel

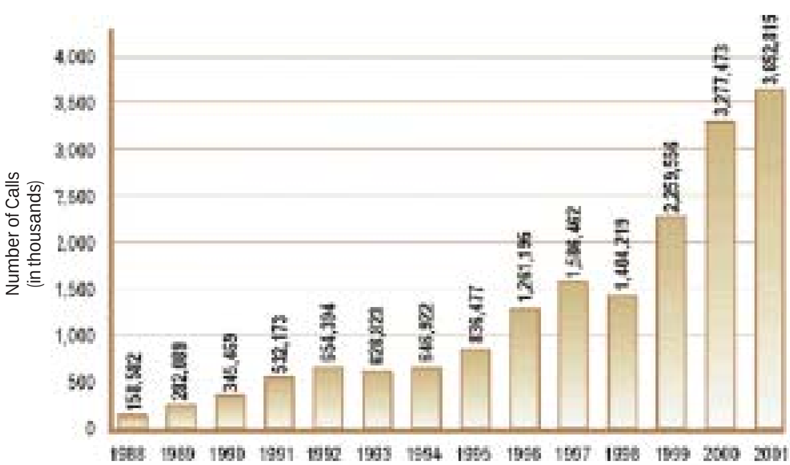

Figure 5. Call volumes for DGT service.

(RDS-TMC). (The dissemination of RDS-TMC/digital audio broadcast (DAB) traffic information by the DGT confronts a problem of a scarce number of end receivers. For example, at the end of 2001, only 800 people were deemed to be potential DAB receivers; hence, the relevance of traffic information delivered to road users through this channel is minimal. WAP information services also face a similar problem. Yearly access through WAP is 15,000. In comparison, access to the signal management system (SMS) is 2.5 million per year. The phone service is nationally available, and 1,600 people can simultaneously request information at a given time. The challenge is to have enough capacity to answer (i.e. the number of lines is the constraint). "900123505" is a free number that began operating in 1988.

Recent growth is attributable to implementation of an automated IVR and the increased use of cell phones. Budget limitations also constrain the number of calls that can be answered. There is likely a latent demand. The telephone company, Telefonica, can handle 400,000 calls in 24 hours, which is about 2,000 calls maximum per minute and 1,600 calls simultaneously. The DGT's IVR can handle 15,000 to 20,000 calls daily with its 32 lines. The average cost per call is 1 Euro. Total costs amount to about 3 million Euros annually, without including data collection costs. For every call, 25 pesetas go to the telephone company and 85 pesetas go to administrative and staff costs.

The call distribution is as follows: 67 percent of the callers call to request information on a situation on a particular road; 22 percent call about administrative issues; 9 percent are journalist/media calls, inquiries, and pranks; and 2 percent are people calling in incident reports. DGT uses the concept of a "transparent operator" in which the caller states the desired request and the operator listens to the request and navigates the IVR on behalf of the caller to yield the desired information. This process has a 90-second average call duration in comparison to 180 seconds for the fully automated system, which increases the system's capacity. Voice recognition has difficulty understanding all different Spanish accents.

The DGT has launched a public offer to outsource its customized information service, which will be created as a "Contact Center," with a maximum cost of 5 million Euros during 2 years. Two levels of information service are intended: the first will be served on an external platform run by a private company, while the second level will be serviced by DGT officers, who will handle only customized requests for information including personal or private data. As a component of this service, information on road conditions in Spain and its border countries (France and Portugal) will be translated into English, French, and Portuguese. The service also will incorporate voice information through the phone (both fixed and cellular) as well as Internet protocol (IP) voice and IP video conference. Other components include on-line assistance for customized navigation of the DGT website and information for handicapped persons. The essential purpose is to increase the current number of 32 phone lines up to 256.

The DGT cooperates in different European projects co-financed by the European Commission that facilitate the exchange of real-time information on traffic conditions in Spain and France via the standard DATES, which is fully operative. Interconnection between Spain and Portugal was planned for 2002. It is envisioned that road condition information will be disseminated not only throughout Spain, but also in France and Portugal.

In parallel, the totally free phone number "900," whose call expenses are entirely paid by the DGT, will be made into a "902" phone number, whose calling expenses are entirely paid by the user. The fee for the "902" telephone call is equivalent to a national call. The change will be accompanied by the creation of a three-digit number exclusively reserved for traffic information. The DGT supports the "115" (similar to "511" in the U.S.) or the "505" (which stands for "SOS"), but the last say on the final allocation of the three-digit number belongs to the Spanish national authority on telecommunications regulation, which has not yet pronounced itself on the subject.

Spain's emergency number is "112," which is the equivalent of "911" in the United States. In 1992, Spain realized it needed more than a phone system and started to expand to the Internet, TV, etc. Journalists were hired to provide information to radio and TV. They are contractors to DGT and are not broadcast station employees. TV and radio stations do have free access to the information, and virtually every TV station has a direct feed from the control room.

The website, which can be viewed at **www.dgt.es,** had 7.3 million user sessions in 2000. More than 10 million user sessions were expected in 2001. For the global system for mobile communications-signal management system (GSM-SMS) service, the user provides the code of the province and the code of the region, and the system will display only messages in those areas. During 2000, 1.76 million SMS messages were sent out, and 2.5 million were estimated for 2001. The GSM-SMS service is offered through a public-private partnership. The DGT provides traffic information, while mobile phone operators offer the service. In particular, Telefonica MoviSatr delivers traffic information through the number "505." Information is free, but the company charges 0.15 Euros to the user for access to the network. In the course of 2001, 2,434,023 messages were delivered through this channel.

Figure 6. DGT traffic management center in Madrid.

DGT has planned/established eight traffic management centers (TMCs) in Spain (six are existing). The regional government manages Barcelona's TMC, but all the others are managed by DGT. Every TMC of the DGT is linked to the local TCC of the cities where they are located, allowing free access to the images provided by television cameras and to the traffic management systems prevailing for urban and long distance traffic in each of them. Operation of these systems and cameras, however, is reserved for each individual TMC. The TMCs are responsible for managing the main trunk roads. Helicopters are widely used for traffic management. DGT currently flies 18 helicopters in all of Spain. Two are used in Madrid during peak times. Four more are on order. The helicopters have a direct video feed to the TMC that provides an extremely high-quality, real-time surveillance tool. DGT owns and staffs the helicopters, and they are used exclusively for traffic information and surveillance.

DGT has 400 CCTV cameras in the Madrid region and 800 CCTV cameras throughout Spain. In total, 250 CCTVs can be controlled by the Madrid TCC. DGT also manages the toll motorways. Automated data collection consists mostly of inductive loops, 400 video image detectors (VIDs), and 16 automated incident detection stations. Figure 6 shows helicopter video in the TMC.

In peak periods, the TCC has 32 staff. The DGT and the Dutch Rijkswaterstaat jointly developed the speed control color-coding representation for the website: white for free flow, green for 75 to 95 percent of free flow, yellow for 25 to 75 percent of free flow, and red for less than 25 percent of free-flow speed. Incidents are entered manually by the local traffic police. The use of the system is part of standard police training. Of about 80,000 DGT police, 8,000 are dedicated to traffic duties. These traffic officers are trained by DGT, which promotes consistent reporting of incidents and accidents.

In addition, DGT operates 5,000 emergency callboxes along a motorway network of nearly 3,000 miles (4,800 km). Callboxes are installed every 2 km, cameras are installed where needed, and detector stations are located wherever possible on the rural roadways.

BARCELONA, SPAIN

Barcelona has a population of 1.5 million in an area of 100 sq km. The metropolitan area has a population of 4.2 million in a 3,200-sq-km area. Six million trips are made daily in the metropolitan area, 25 percent by private car. Four million trips are made daily within the city. The modal split is 36 percent public transit, 38 percent private car, and 26 percent pedestrians and bicycles.

The technical part of the visit to Barcelona included:

- Catalan Traffic Service (Provincial Department of Transportation)
- Municipality of Barcelona
- Regional Public Transport Authority

Catalan Traffic Service (Provincial Department of Transportation)

The Catalan Traffic Service is responsible for regional and interregional traffic management and operates the Traffic Information Center (CIVICAT).

Figure 7. Traffic information center (CIVICAT) in Barcelona.

The CIVICAT has allocated some tasks in the center to public employees, but the operations and management of the service are mainly outsourced to private contractors. Their roles are to operate and manage traffic control, monitor conditions, and disseminate motorist information via DMS.

The system includes 127 CCTVs. The technologies include both digital and analog video. The CIVICAT has agreements with the municipal systems and their motorways, which provides access to 250 additional CCTVs. The images are also provided to TV stations, and are available on the Internet at **www.gencat.es/transit**.

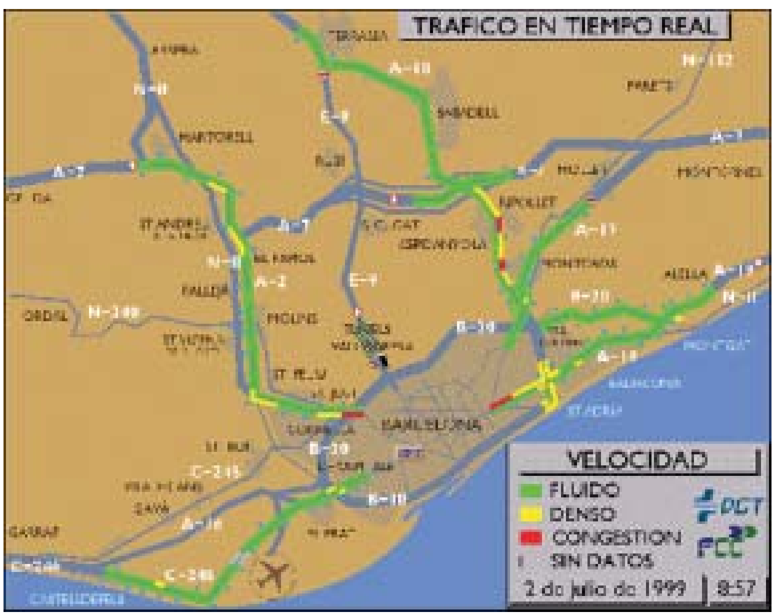

Figure 8. Level of service map.

Detection occurs at 300 stations and includes technologies such as inductive loops and vision processing. Data include speed, flow, occupancy, and vehicle classification, and are collected and sent every minute to the center.

Information dissemination includes a level of service (LOS) map. The LOS map is based on historic, predictive, and real-time data to create the final product. Three colors (red, yellow, and green) are used to display the LOS. The map is displayed on the Internet and for display on DAB devices (on-board navigation).

Motorist information is disseminated through 67 DSMs. They are used for advice, warnings, rerouting, travel times, and also for itinerary recommendations, for

Figure 9. Dynamic message sign showing alternate travel times.

example, by indicating this message: *15 min to City X on route A* or *25 min to City X on Route B*. CIVICAT is working with the municipalities to give combined urban and interurban trip times. This functionality should be available in about 1 month and would be the first available in Spain.

For congestion, two types of messages are “incident at” and “congestion until”.

Figure 10. “Incident at” and “congestion until” messages.

No customer satisfaction surveys are conducted, but not many complaints are received. A survey has found that up to 20 percent of drivers change their normal route when travel time is two or more times greater than their normal travel time. This level was established by comparing loop data to benchmarked data.

The system includes 135 SOS posts for emergency roadside assistance. The increase in cell phones has led to a decrease in SOS use. The telecommunication system includes data flows on a 30-km fiber network around the city, as well as the use of phone lines.

The CIVICAT center includes the Traffic Information Center (CIT) which is a public entity. The CIT produces traffic programs for TV and radio stations as part of public service. Traffic images are broadcast on Catalonia regional TV. Three programs are produced: two weekday programs and one on Sunday evening.

All traveler information is given free to any outlet, but the CIT is considering charging for information to generate revenue sometime in the future. Internet information is provided at: **www.gencat.es/transit**. Information is delivered via a WAP service offered by cell phone companies. CIVICAT actually puts the information in the WAP format for the private partners to disseminate.

The telephone system uses human operators to provide regional information. The system is part of a national system that offers more than just traffic information. Phone calls are currently at the local rate, and 200,000 calls are received per year. In the past when phone calls were 50 cents (US) per call, they received 50,000 calls per year. The service is outsourced (operator procured by request for proposal), and the costs are now 0.54 Euro per call to the user. Of that total, 0.36 Euro goes to the telephone company and 0.18 Euro goes to the system administrator. The amount is not enough to cover operating costs, however, and requires subsidization. The average call length is less than 3 minutes. The total cost per call for the service is 1.08 Euros to provide the content and to deliver it. The subsidy from CIVICAT is 0.90 Euro per call—0.18 is paid by the user as indicated above; 1.08 is paid to the contracted service operator (per call), and 0.36 goes toward the telecom cost per each call.

Municipality of Barcelona

The city controls about 1,000 traffic signals in the municipal area. Barcelona has three TMCs. Two centers belong to the city. One is used for traffic signals and lane control for the operation of reversible lanes. The police operate the system and decide what strategy to apply in any given situation. The second TMC was developed for the Olympic Games and controls part of the expressway system. The third center is the CIVICAT center.

The Barcelona City TMC has the following functions:

- Watching CCTV images before posting to the web
  - urban arterials: 55 pan-tilt-zoom CCTVs and 20 fixed CCTVs
  - ring road: 32 CCTVs
- Quality control of travel times
- Quality control of the speed (LOS) map
- Controlling and opening controlled access areas

Figure 11. Barcelona City traffic management center.

The interurban TMC operates 24 hours a day, 7 days a week. The operators are a combination of civil servants and contractors and consist of operators, public information officers, journalists, and system technicians. The maintenance for the 250 CCTVs and 300 loop installations has been subcontracted.

The system transmits every-minute speed and flow data and uses the data to populate the system map. It does not report travel times when there are no active incidents. The website has 1,500,000 hits per month and 10 billion pesetas are invested in regional intelligent transportation system (ITS) technology. Most large cities in Spain have contracted out their TMC maintenance and operations.

The municipality's system is called the Urban Mobility Management System. It uses single inductive loop detectors to measure occupancy, but not speed, at 193 sites that have 548 loops at 302 detector stations. Single infrared beams are also used to measure occupancy and volume, but not speed. The municipality is working toward a double infrared beam system for the ring road. Infrared is considered better than loops because it is nonintrusive. Detection by image processing systems was found to

Figure 12. Urban Mobility Management System, Madrid.

be too expensive. It also requires too much bandwidth for communications, or one should have an image processor at each device. There are 1,398 traffic signals in the city that are controlled by 44 zone masters.

The TMC controlling the signal system has three main functions:

- Traffic Management—controlling signals, dynamic signs, access control for pedestrianized areas and for reversible lanes, multipurpose lanes, emergency lanes, CCTV image control, and incident detection.
- Traffic Information—providing visual validation of the speed color map and CCTV images that are provided on the Internet, parking information, DMS, and a traveler information phone line for the media or the public.
- Equipment Operations and Maintenance.

Traffic information is provided on the Internet. Traffic cameras on local streets are provided for 19 cameras. Fixed cameras and pan-tilt-zoom cameras are capturing images for the Internet web page where images are updated every 5 minutes (automatically). The ring road has eight cameras, and the images are updated every 15 minutes. Images are only posted after an operator has reviewed and approved them for the Internet. Color speed maps of main streets in Barcelona are provided, and the map also shows Metro stop locations. The map gives current conditions and the expected conditions in the next 15 minutes. The predictions are based on historical information from the last 10 like days (i.e., last 10 Tuesdays). The estimated error is 15 percent and the system works well with normal flow. As expected, the methodology does not work as well during a major incident. It does give travel time and the deviation from normal travel time. The travel time data are verified using a floating car on a daily basis. The city vehicle checks travel times (one street/day), and calibration has yielded a 20 percent error. Travel times that exceed the speed limit are not provided. The web page provides LOS and any total closures. The LOS is based on data from loops and infrared detectors. The loops are primarily for traffic control and are installed downstream 60 m from the intersection. LOS rating is based on predefined thresholds calculated at each of 161 intersections. The thresholds must be changed every time signal timing is changed.

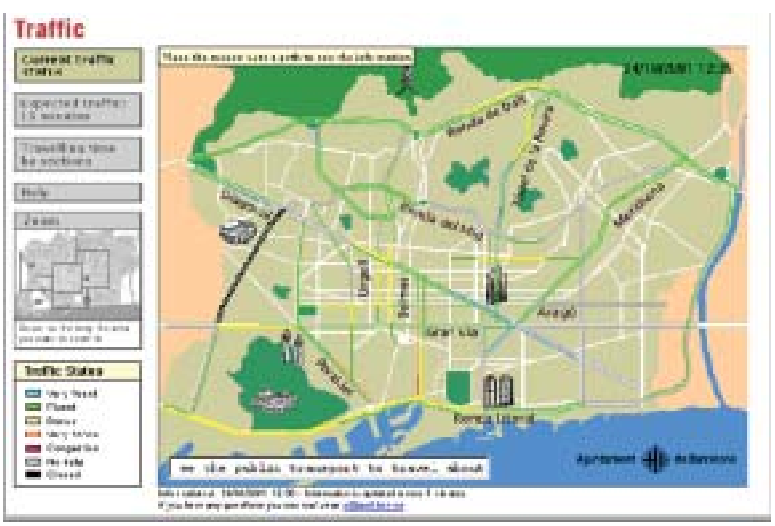

Figure 13. Current traffic status displayed on the web.

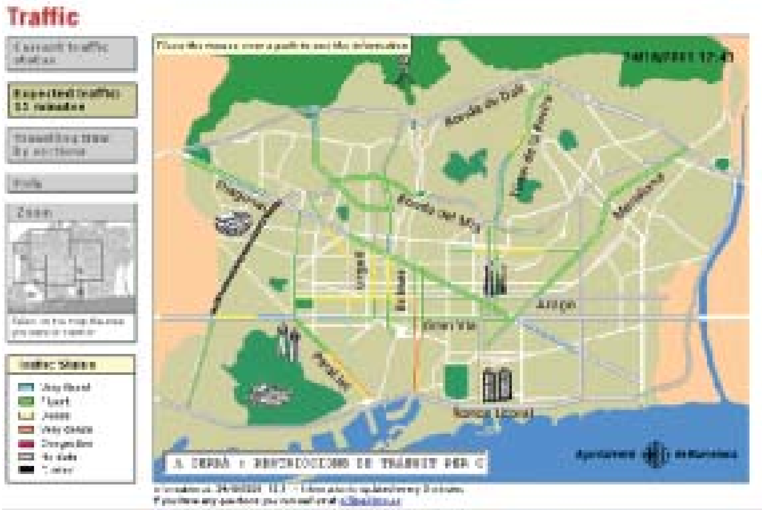

Figure 14. Expected traffic time: 15 minutes.

The tunnel lane controls can be managed from the TMC. The controls can be configured for all traffic to use one tube of the tunnel while maintenance is performed in the other tube.

Changeable warning signs are used for left-turn prohibition at intersections and at multipurpose lanes for parking and loading. General travel is allowed depending on the time of day.

Automated parking information signs are used in two areas of the city. The system provides information for 15 parking garages.

In the city, radio traffic reporting information is made available from the TMC. Information collection includes incident information received by telephone by the police. The police then make reports or provide the data to the media. The radio stations call police at the TMC for information. On weekdays about 100 calls are received. On weekends about 30 calls per day are received. The police also receive calls from other sources at a level of about 40 per weekday and 15 per day during the weekend.

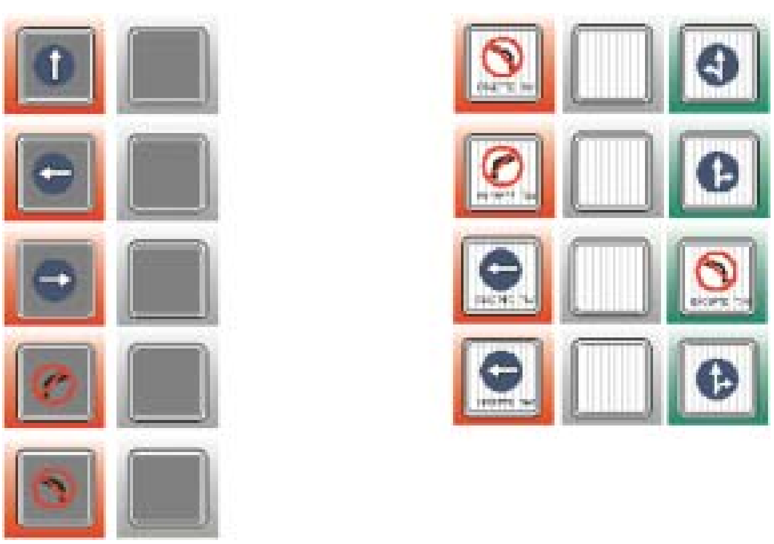

Figure 15. Extinguishable signs.

CCTV images are made available on TV. Regional TV and Barcelona TV broadcast the CCTV images. The TMC can turn off the broadcast images if they are considered inappropriate for broadcast.

Variable message signs (VMS) are used on the freeway and in urban areas. Twenty-three signs are installed on the ring road, and there are 21 smaller signs in urban areas.

The Internet site for traveler information is available at **www.bcn.es/infotransit** and forms part of the City of Barcelona web portal. The city public information office oversees the portal development. Data are provided by each responsible city agency (i.e., the department of transportation [DOT] is responsible for traffic information). The website usage per week is 9,932 user sessions or 37,388 pages visited. The average session duration is 8.37 minutes. No marketing or advertising is done for the site. Use of the site is growing. Users are mostly young people, Thursday is the highest use day, and 8:00 PM is the highest use time.

The portal's transportation information includes public transport, traffic, parking, walking, and biking. Currently, the data are independently provided. There are plans to integrate the data. The information is presented as follows:

- "Walking"—gives travel times by foot, customizable by user type (old, young, etc.)
- "Transit"—gives origin and destination; site tells you how to go
- "Traffic"—gives information on roadwork and other closures. The data are updated daily by checking city permits for information.

Figure 16. Walking web page.

Figure 17. Transit web page.

Figure 18. Traffic web page.

Regional Public Transport Authority

The public transit authority of Barcelona is called the Metropolitan Transport Authority (ATM), and was founded in 1997. ATM is responsible for city, regional, and national transit in Barcelona.

The transit system consists of:

- City Transit: 83 km of metro, 800 buses (400 of which have AVL)
- Catalonian Regional Transit: suburban and intercity buses (150 km)
- National Railroad: 60 to 70 km of routes in region

The ATM is responsible for approximately 750 million trips per year. The patronage is increasing, but not as fast as private car use. The ATM operates park-and-ride lots at the edge of Barcelona. For approximately 800 pesetas the user can park and ride on any transit all day, but only 40 to 50 vehicles use the park-and-ride lot each day. The usage may be low because lots are located too close to the city.

Traveler information data is collected through public transit operators (rail, buses, and Metro) who communicate service information (service disruptions or "normality") every 5 minutes to the Information Center (TRANSMET). The Information Center (created in 1998) transmits information via radio broadcast or to other media by telephone. Real news items are service disruptions or major delays. About 95 percent of the time there are no major news items. Traveler information is requested by telephone by the media. Each station can call in every 2 hours. The information goes on TV teletext, which is currently more ubiquitous than the Internet. ATM does not operate a telephone service. Some companies have real-time information in shelters. In less than 1 year, the interurban busses will have buses with global positioning system (GPS) providing real-time travel information. The ATM does not publish schedules; public and private operators publish their own schedules. The service frequency is 12 buses per hour in urban areas and 4 per hour in other areas. On the Metro, there are 3½-minute headways in the peak hours (15 trains per hour) and 7½-minute headways in the off-peak hours.

MUNICH, GERMANY

The technical part of the visit to Munich included:

- City of Munich
- MOBINET Project
- Munich Traffic Control Center
- Motorway Control Center (VRZ)
- Traffic Information System—BayernInfo

City of Munich

The city and region follow a cooperative transportation management approach. The City of Munich is the capital of Bavaria. The City District Administration, which includes transportation, has 2,500 employees. The city has 45,000 employees. The Road Traffic Division (Division IV) is responsible for traffic lights, local traffic control, traffic management, and driver registration. Munich has a 1.2 million population in an area of 370 sq km. In the outer ring highway, there are 2.4 million people in the region of 5,500 sq km. There are 2,200 km of roads in the city, while the region comprises 3,800 km of roads.

Public transport is well developed, with 79 km of underground and 100 km above-ground fast trains in the city. Each weekday, 500,000 people use public transportation. Another 580 km of rail is available outside the city. There are 21 million passengers using the "new" airport every year. The modal split (1997) is 22 percent pedestrian trips, 13 percent bicycle, 24 percent public transport, and 41 percent automobile.

Various ITS benefits have been identified. DMS are used to tell motorists what is happening up ahead and to provide parking information (park-and-ride) when the sign is not used for traffic management.

Figure 19. Multimodal dynamic message sign in Munich.

Another benefit is the reduction of traffic accidents, as shown in the graphic below.

Political support for ITS is very important. The Lord Mayor of Munich stated: “No one has claimed that intelligent transport technology alone will solve the problems linked to increasing levels of traffic. Quite the reverse is true. But to believe that we can do without intelligent traffic management systems, when we are up to our necks in traffic and transport problems, that is an illusion!”

European initiatives in ITS include Prometheus, specific European Community Research/Technical Development programs, and POLIS, an ITS cities network. Activities in Munich include COMFORT/TABASCO, researching traffic control (15 million Euros); Infoten/CORVETTE, researching traveler information (10 million Euros); BayernInfo/Mobilitat 21, researching traveler information (19 million Euros); MOBINET, researching transportation management; and Motiv/INVENT, researching control and information (20 to 30 million Euros).

Figure 20. Reduction of traffic accidents as a result of ITS in Munich.

Infrastructure-based traveler information systems focus on traffic management (alternate routing, lane control, and urban traffic control), collecting information, public transport (in-vehicle and at stations), and DMS for urban traffic control. Personal traveler information services include telematics applications, Internet/WAP, radio, and RDS-TMC. Certain enabling systems are required, which include TMCs, system architecture, data models, and digital maps.

MOBINET Project

The DRIVE program started 15 years ago, which was followed by Advanced Transport Telematics about 10 years ago. Transport Applications Telematics started 5 years ago. MOBINET is part of the next generation. The European Community is financing the system introduction.

The project will focus on multimodal transportation management, innovative transport technologies, and novel mobility services. The structure of MOBINET includes a data network and urban and regional centers. This structure will aim at optimizing traffic in the primary road network; providing multimodal information services, which will try to shift demand to public transport; and applying innovative concepts for a mobile society.

With regard to intermodal choice, the project will manage parking spaces, improve public transport, reorganize buses to Underground stations, provide more direct links on the Underground, provide alternate routing signage (cooperation between State of Bavaria and City of Munich), and provide information signs. The DMS will show congestion on the network so drivers can choose their ultimate routing.

Information services will include urban information (city information, events) and shortest route algorithms; public transport information such as electronic timetables and the integration of various systems; parking information, including available spaces; and information on recreation and leisure. It is the expectation that people would pay for better quality data.

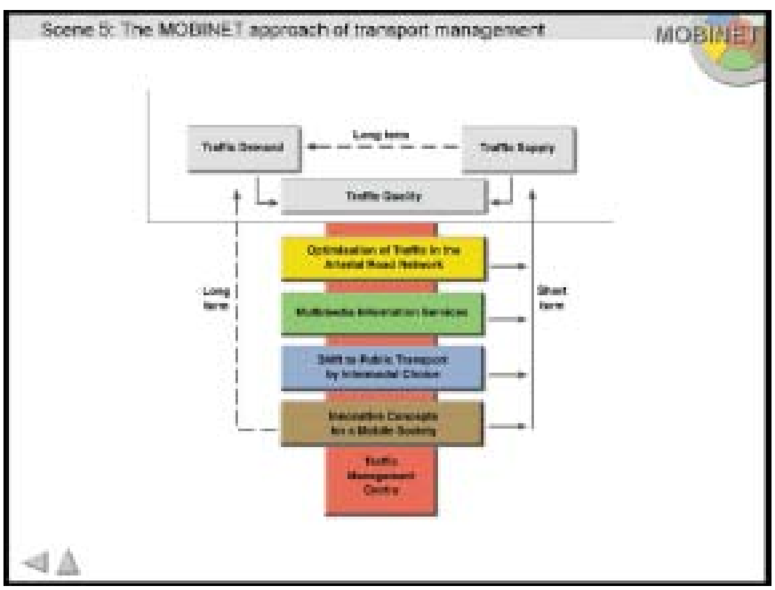

Figure 21. The MOBINET approach.

MOBINET will include data processing and completion (added-value information), traffic and system surveillance, strategic planning, and analysis of scenarios and integrated strategic control.

Four systems will be developed in MOBINET: multimodal infrastructure control; DINO – an on-line traffic model; SAM – strategic management of roads in the Munich area; and PIZ – a parking information center. The multimodal infrastructure control will be a platform to store any traffic data, including event data, traffic data, system operations, and weather and environmental conditions. Strategy implementation will assist with decision rules that will recognize a situation and provide predefined measures. The traffic data analysis will use a spatial filter. Planned types of strategies include large-scale traffic congestion (predicted), local incidents, planned events, environmental situations, weather conditions, and public transport disruptions. The dynamic network modeling will perform traffic assignments in an O-D matrix with 24,000 links, and the output will be estimated current traffic conditions in 15-minute intervals.

The strategic management of roads will optimize the road traffic information for access to Munich. It will provide alternate routes, tunnel information, ring road information, variable destination signs (congestion), ramp metering, and variable lane assignment. The parking information center will provide information on park-and-ride and public and private parking garages. Content providers will use the parking information center computers' dynamic and static information and then develop services for in-vehicle units, the Internet, personal digital assistants (PDAs), and mobile phones. The algorithms use all information for predictions (long term and short term) and also incorporate traffic and weather conditions. The parking information center data transmission will cover five park-and-ride lots (two lots use individual space detectors). There is no constant communication. Once the data exceed specified thresholds, then information will be sent to the parking information center, which is scheduled for implementation in early 2002.

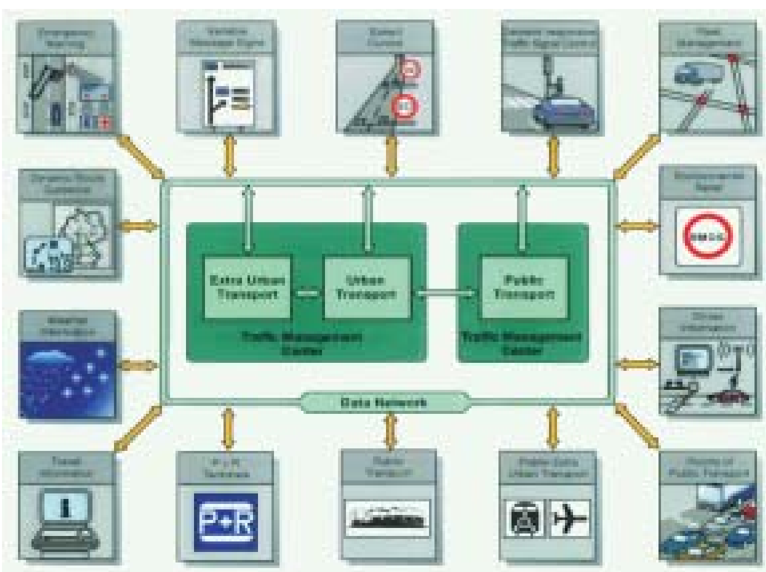

Figure 22. Integrated mobility management.

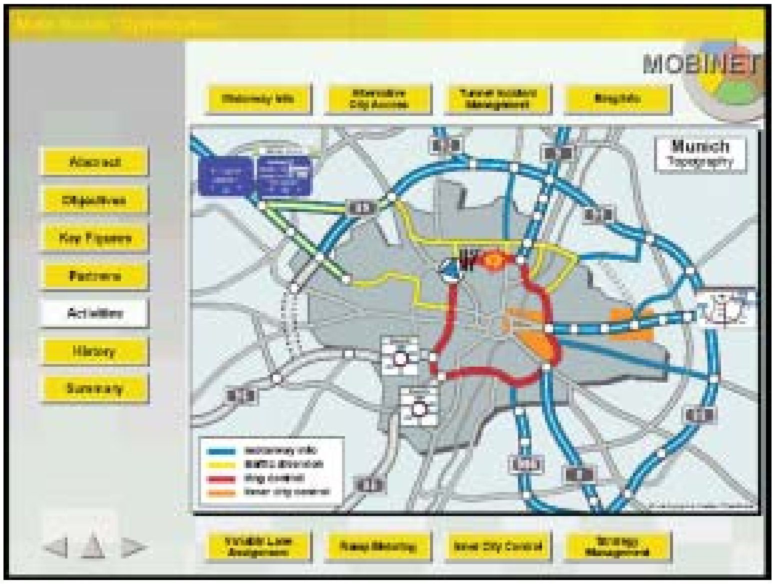

Figure 23. Travel information on MOBINET.

Munich Traffic Control Center

The Munich TCC will be part of MOBINET. The TCC will be located in the police headquarters in Munich, which is the same location where traffic connections are currently made to the traffic signals. The current system includes 1,000 traffic lights and detectors and 77 cameras (traffic and in pedestrian areas).

The TCC will include cooperation among state, city, transit, and rail. Information will include pretrip and en-route information, transportation alternatives, and the optimizing of personal choice of means of transport. Strategy development, coordination, and maintenance is estimated at 80 million Deutsch marks.

Figure 24. Traffic control center, Munich.

Figure 25. Tunnel control, Munich.

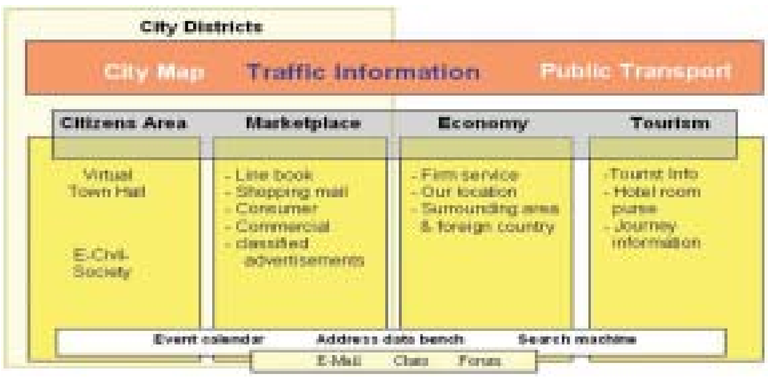

Figure 26. Possible concept of Portal Munich.

In addition, the City of Munich is developing “Portal Munich,” an Internet site. It will include all city services, marketplace, economy, and tourism and travel information. It will be funded 45 percent by the City of Munich (50,000 Deutsch mark maximum), 10 percent by nonprofit organizations, and 45 percent by two banks. The business model is such that information provided directly to consumers will be available for free to commercial providers. Customers will pay if data provided are of higher quality. The two banks currently have a good communications network and want to use it. There are no video camera images on the web. The police are sensitive to this because of security and terrorism concerns.

Motorway Control Center (VRZ)

The Motorway Control Center uses rain and fog monitors as well as speed detectors. Speed enforcement is performed with radar mounted in the DMS. Other detection includes loops, radar/ultrasonic, and ramp metering. The system has 58 weather stations, 120 visibility (fog) meters, 452 sensor loops, and 93 video cameras. Ramp metering has enforceable speed limits and it encourages traffic to merge through different speeds in different lanes. Data are read every minute in the system. It can also accommodate manual settings, such as an emergency call. The system sets up proposed signs/warning messages for a given situation, and the signs can be changed manually or automatically. The algorithm uses variable speed per lane, speed of cars, volume of traffic, and ramp metering.

Figure 27. VRZ traffic management center.

Figure 28. Variable speed control and photo enforcement.

Traffic Information System—BayernInfo

Information about BayernInfo can be viewed on the Internet at **muc.ssp-consult.de** and at **www.bayerninfo.de**. The system is Internet-based. The traffic information center provides traffic forecasts and real-time information. Data are collected from detectors, floating cars, traffic counts, and weather. Other information is provided by police, the German Automobile Association, and TV and radio. Rail and public transport information includes electronic timetables (itinerary planner). Connections are automated among the various systems and modes. Kiosks are available with this service as well. The information includes the Bavarian Ministry information for this region and Nuremberg. Park-and-ride information shows where, when, and how many parking spaces are available.

Personal travel assistants include cell phones, PDAs, etc. Congestion, incidents, and delays are factored in and changes can be sent out (pushed) to people. Personalized and customized information is the ultimate goal. Service providers can add value-added data.

BMW—ITS Applications for Ring Road Control

BMW is a partner in MOBINET. Its responsibility is main road optimization. In Munich, the middle ring road has uneven saturation levels, resulting in frequent bottlenecks and delays, which, in turn, cause air and noise pollution and low safety levels. BMW is investigating the following applications: variable lane assignments, ramp metering, adaptive signal control, ring information, actual traffic conditions, and congestion on a DMS, with red light-emitting diodes (LEDs) indicating “congestion” information on a ring road from the motorist’s entrance point onto the ring road. The spacing of the information is based on detector availability, so the motorist will get the information before entering the ring road. Research is conducted on the provision of travel times on a microscopic level versus the existing model. Information will be synchronized with other elements of MOBINET.

BMW Telematics

BMW has been involved in most of the major projects in Europe, i.e., Prometheus, DRIVE, TABASCO, etc. For RDS-TMC, BMW’s navigation units use icons instead of text to provide information to drivers. Messages are generated by acquiring data from the traffic information center and other sources. The data are then forwarded to the message processing center at the Bavarian Regional Center and then to the German Automobile Association for transmission to the car. The RDS-TMC timeline started in 1989 and uses standards (CEN TC 278, WG 4,7; ISO TC 204) as well as the EN standard for location coding and message format and contents (Alert C, Alert Plus).

BMW also has a beacon warning system along motorways (including Munich) that lights red beacons along the road when there is an incident ahead (warning). BMW also is investing in dynamic routing and expects a revenue stream from this venture. The lobby of the BMW complex has an RDS-TMC terminal that is used extensively by employees as they leave the building, demonstrating a workplace application for travel information.

BERLIN, GERMANY

The technical part of the visit to Berlin included:

- German Transport Ministry
- City of Berlin
- VMZ Berlin

German Transport Ministry

A representative from the German Transport Ministry stated: “Germany may have a different view of the federal government’s role in ATIS than the USA.” The Germans think they are less directly involved in the development of systems.

The scan team discussed four issues:

- Roles of the federal government and private sector
- DELFI—Continuous Germany-wide electronic timetable system
- Telematics applications in public transport
- RDS-TMC

Roles of the Federal Government and Private Sector

Traffic, including the East German expansion, has grown 50 percent since 1990. A further 60 to 64 percent increase is expected by 2015. The growth cannot be handled solely by traditional infrastructure alone, and telematics is considered a key component. For that reason, the Transport Ministry created a Telematics Division in 1995. It is trying to manage expectations on telematics benefits. An intermodal, interlinked network is the goal. The Ministry believes in strong public-private coordination.

In 1995, the Transport Minister convened a high-level roundtable to focus on:

- The federal role on telematics services that are of national/regional importance
- Interoperable standards
- An expansive role of the private sector
- The notion that the federal government sets policies and initiatives, but the private sector leads

The Ministry's Telematics Division budget is much smaller than the telematics budget in the United States The concept is that the public sector will provide data for telematics. A joint public-private partnership has evolved to manage the program. The roundtable meets one to two times per year. Last year's meeting to discuss the impact of e-commerce on traffic volumes was attended by 30 participants. The government provides directives, guidelines, and model contracts. For example, the following guidelines dictate how to develop a navigation system:

- It cannot require both hands to operate
- It should not distract the driver
- It can only provide information the driver really needs
- It cannot disrupt other vehicle functions

The government typically establishes performance-based guidelines. To date it has only had to adjust one legislative act (a slight change in the data protection act). Cooperation between the federal and state governments is considered very important. One aspect of such cooperation is a uniform automatic emergency call system, which is believed to be able to prevent 1,000 casualties per year.

Greater than 1,700 km of the German freeway system are under the Freeway Management System (stretch control—in cases of traffic congestion, alternative routes are recommended to drivers). More than 850 km of the freeways are under VMS control (active control). The Ministry will continue to support small/medium companies in transport telematics. The Galileo satellite location system is an area of strong interest within the Telematics Division. National resources are administered by states for infrastructure investment. With regard to standards, states follow the industry standards process, and they do not want to impose detailed regulations on telematics technology. The federal government has influence on the National Road Network Plan but does not have the funding to influence the states.

DELFI—Continuous Europe-Wide Electronic Timetable Information System

Travel demand in Europe will increase by 20 percent by 2010. Modal split is therefore very important. It is believed that high-quality public transportation information is required to maintain and expand the modal share. At present, transit timetables are independent. Deutsche Bahn provides schedules in 19 different regions. DELFI will introduce a new process through which network timetables from each agency will be coordinated. The DELFI project was initiated in 1996. The goal is a door-to-door public transportation itinerary. Tests were to begin in February 2002. The EU-Spirit program will allow the system to expand from Germany to all of Europe. Highlights of the system include the following:

- It is easier to update small regional databases than a national pool.
- It is better tailored to local needs.
- Not all the data have to be updated.
- Current focus is only on departure/arrival times, not any service information.
- A “search controller” manages the information retrieval process.
- The “meta-information” server manages the route planning.
- It will allow consistency with Transport Ministry policies.
- It will allow application of standards for communications between systems.
- It will be a CORBA-based interface.
- The approach offers dissemination independence.
- Future additions will include pricing information, reservations, and payments and multimodal capabilities.
- It provides the foundation for personal travel assistance.
- Customer beta-tests were set to begin in February 2002.
- It utilizes the telephone, Internet, transport operators, and media.

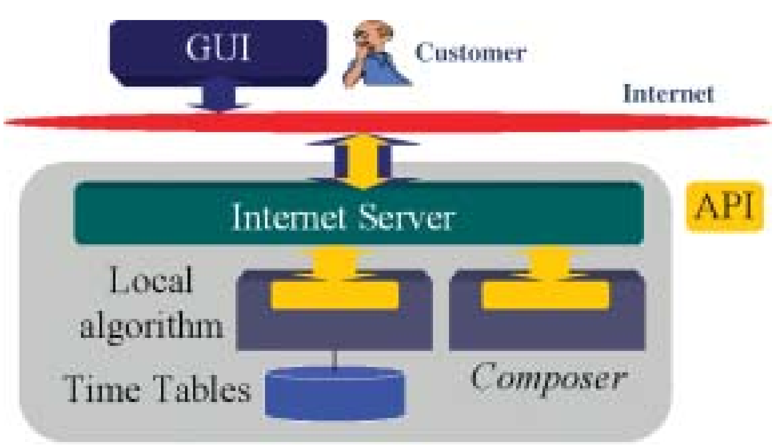

Figure 29. DELFI schematic architecture.

Total project funding is $1.5 million. Funding is provided to assist states/operators to adapt their systems to the standard interface. The interface is freely available to EU and other service providers. A few years ago, transit operations shifted from federal responsibility to a regional responsibility. The Ministry annually provides $7.5 to $8 billion to states for transit. DELFI will use an Internet backbone. Deutsche Bahn will host the meta-data server and will likely take a lead operating/leadership role in the system.

Telematics Applications in Public Transport

The scan team attended a presentation about the status of telematics in public mass transit in Germany. The VDV is an Association of Transport Operators like the APTA. The organization has 550 operators as members and is responsible for 94 percent of the passenger volume in Germany. VDV has 8.9 billion users per year. Fifteen percent of the public uses transit. A survey showed that 17 percent of those surveyed claim they do not use public transportation because they do not have information about it.

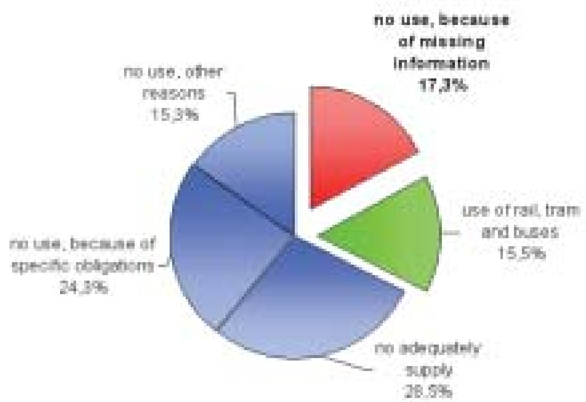

Figure 30. Use of public transportation in Berlin.

Traveler information is considered part of transit service standards. The type of dissemination methods currently used are print media, customer center/mobility centers, shops at stations or malls, mobile phones, WAP, SMS, a few transit providers (Dresden has real-time information available), and call centers.

The information available is traveler information, complaint management, and ticket sales for the German railway.

The trend is to move to providing 24-hour information. In Berlin, Berlin Transport provides one central telephone system for public transport in Berlin. The telephone number is “19449.” This number also is used in other cities. It is a 24/7 service where the caller is forwarded only once. All calls are answered within 20 seconds. Eighty percent of callers will receive their requested information immediately. The service receives 3,000 calls per day (1 million calls annually). The call center has 39 call stations and 120 staff. Operating costs are $5 million annually. The cost per call is $7.50, although some private call centers operate at $3 per call (Lufthansa is $5 per call).

In terms of electronic media, CD-ROMs are available for purchase, and information is available on the Internet at **www.bahn.de** and **www.bus-und-bahn.de**. People are accessing web information at the rate of 200,000 hits per day. Approximately 1,000 tickets are sold per day via the Internet. Kiosks will be installed where the operator website can be accessed for free and other websites may be accessed for a fee.

Surveys indicated that customers want the following information:

- 80 percent want route planning.
- 10 percent want maps.
- 5 percent want fares.
- 2 percent want news (roadworks).
- 2 percent need service.
- 1 percent want leisure information.

At stops, the static information is provided, but real-time information is new and growing. In-vehicle information includes next-stop/connection information that is provided visually and in audio. Television broadcasting is coming to the underground and it has advertising possibilities, but no sound will be allowed. It will mainly be for entertainment, information, and advertisements. Transport operators will have to pay for their advertisements on these screens. The ultimate goal is a self-sustaining service.

When consumer satisfaction surveys were conducted, they showed a slight improvement in customer satisfaction with Berlin Transport, from 3.2 in 1999 to 3.1 in 2000 (1 = excellent, 5 = poor). The emphasis was placed on better data, not necessarily on better delivery. With regard to traveler information, the satisfaction rating was 74 percent. There was a perception of a lack of staff to answer questions, i.e., the human element was lacking.

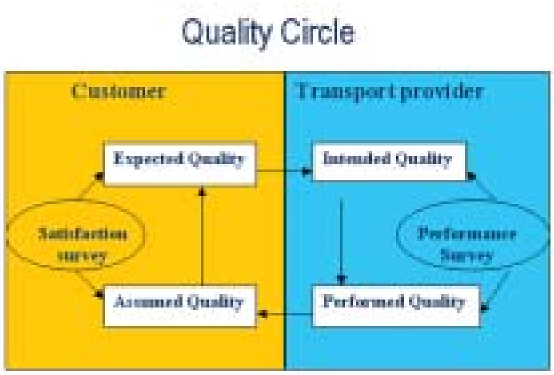

Figure 31. Customer satisfaction.

We observed several trends: the Internet is reducing print media and CD-ROM sales, and customers like next-stop information and prefer intermodal information. Traveler information is considered a core product of a good transit service.

Demand for mass transit declined through the mid-1990s, but has been growing since then by 1.5 to 2 percent annually. With the “19449” phone number, the goal is to provide a nationwide interconnection. This has not yet been realized because of switching issues. Call centers also respond to e-mail inquiries.

Radio Data System-Traffic Message Channel (RDS-TMC)

The RDS-TMC broadcasts information at 1,200 bits/second at 30 to 60 messages per minute. The RDS-TMC is based on standards and encoding (only 37-bit data stream per event). One issue with data quality is that there are more messages than can be broadcast, which leads to competing messages requiring message priority. It has been proved that dynamic navigation sells much better than does static navigation systems. Current barriers to deployment include the fact that the information center to broadcast stations network has not been completed in some states and that the information chain is not automated in all states.

Figure 32. RDS-TMC receivers.

Available ATIS services include VMS that provide on-the-spot information, RDS-TMC that provides early and advanced information, and new telematics services that focus on individual services. RDS-TMC is installed in most countries in Europe. Radio broadcasters were resistant at first, but then it was agreed that the stations could put their call letters on the navigation system in the vehicles. The business model is that everybody pays his or her own costs. The federal government did buy the location codes to make them available in the public domain.

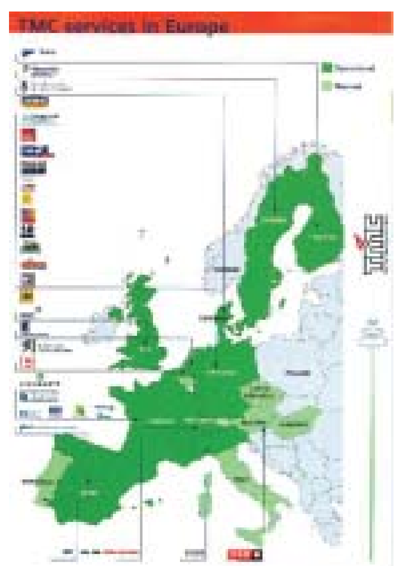

Figure 33. RDS-TMC in Europe.

City of Berlin

The City of Berlin has a population of 3.5 million people driving 1.3 million cars on 5,200 km of roads. Railway construction continues, and traffic demand is increasing. Financial, environmental, and political restrictions have made it difficult to meet demand. It was decided that new strategies such as mobility management are needed to keep up with demand.

The VMZ Berlin project, led by Siemens AG and Daimler Chrysler, is the development of mobility management in Berlin. The goal is to make a profit from selling traffic data.

The city has definite goals regarding traffic/transportation management. These goals include:

- Reducing traffic on the road network by shifting private demand to public transportation.
- Offering additional capacity to carriers and visitors.
- Ensuring accessibility to citizens.
- Prioritizing public transportation on the road network.

As a result, Berlin entered into a 10-year public-private partnership with the Daimler Chrysler/Siemens-led consortium to provide new detection devices, a state-of-the-art TMC, and value-added user services called "The Berlin Model." Development started in November 2000, and the system will be operational in 2003. The partnership is similar to some of the experiences explored in the United States. To be successful, the system must be able to integrate both "hard" and "soft" measures. The city defined hard measures to be controlled by the public sector and soft measures to be controlled by the private sector.

Hard measures include bus lanes, bike lanes, access control, and parking restrictions. Only public authorities can implement hard measures. Soft measures include traveler information and new user services and require coordinated information exchange. They do not need to be performed by public authorities and, in fact, can be better administered by the private sector on the condition that it can make a profit.

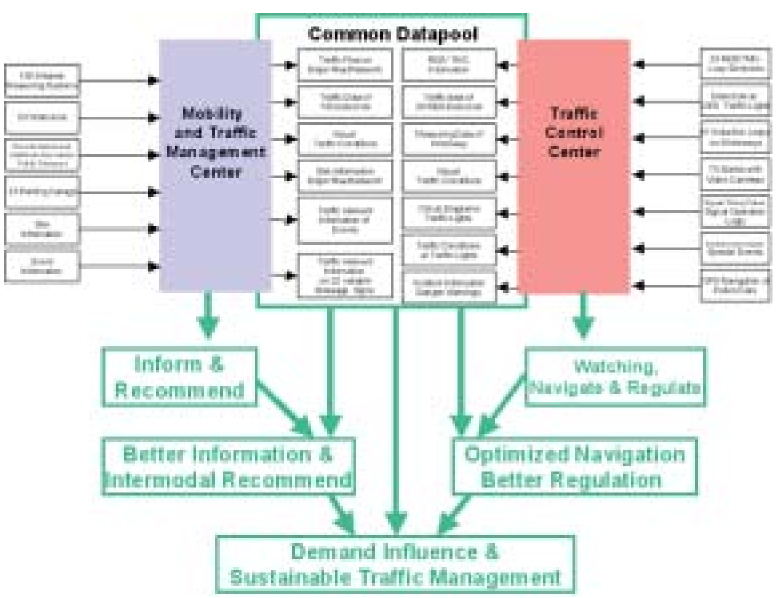

Figure 34. Cooperation in the traffic management center.

However, it is accepted that the private sector cannot be profitable if it is required to pay all capital and operating costs.

Berlin is the first city in Germany with a public-private partnership (The Berlin Model). The partnership covers capital costs (13.8 million Euros). The city owns the system and will provide start-up funding/operating subsidization for the first 2 years (2.5 million Euros) to help the private sector reach its goal. The VMZ will provide 10 years of operating cost.

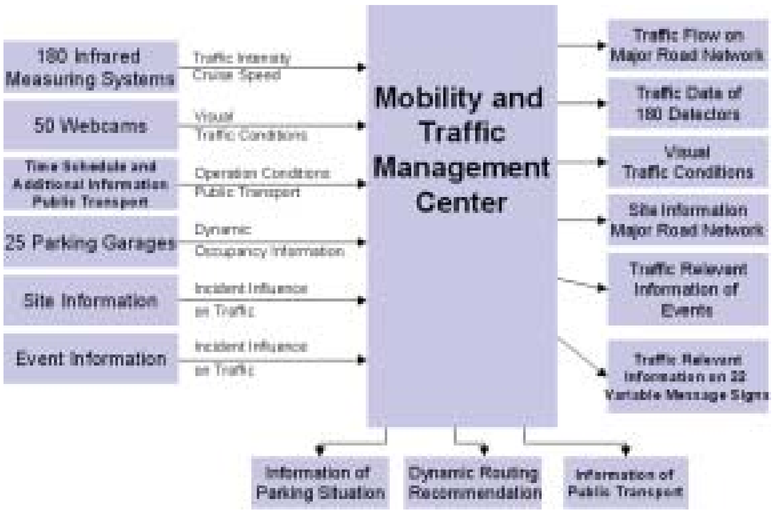

Figure 35. Mobility information and advice.

The city provides all its data from the TCC to the private partner at the TMC. The city is also developing the TCC (public) at the same time, which covers the hard measures and allows for better management and control of road traffic.

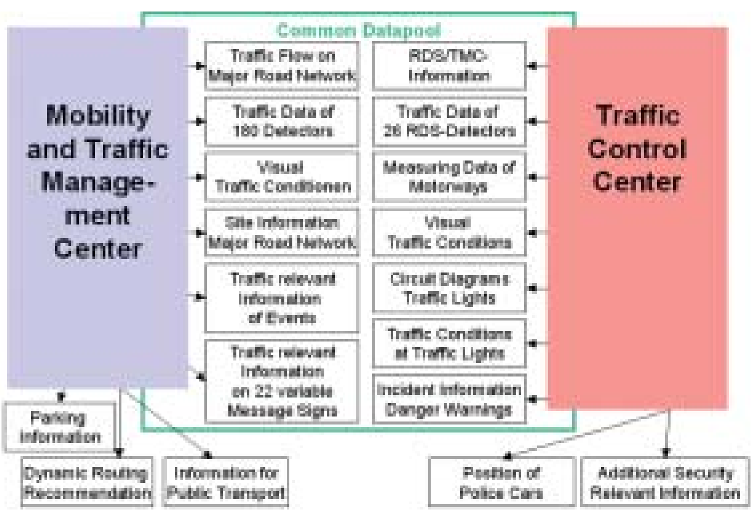

Figure 36. VMZ common datapool.

The TMC and TCC are connected and have a common datapool. All data need to come back to the TCC and be available to the public agencies. Value-added services developed by the TMC would not be available to the agencies. TCC data must be available to everyone—even if another private group comes in. The TMC information will not be available to all. The TMC/TCC share workspace and some equipment. The city would prefer that the TMC be a solely private operation (i.e., with private money), but this was not realistic, so the public-private partnership was created. The TMC will install new equipment that will be maintained by VMZ, which will cover all maintenance costs. Data quality is specifically addressed in the contract. The TMC will provide on-line itinerary/trip planning and traffic forecasting to the users. The overall result of VMZ (TMC) and the TCC combined will be to influence demand and provide sustainable traffic management. Public transport partnerships are still being developed.

The contract contains no profit- or revenue-sharing provisions. The city would prefer that VMZ put profits into new user services or system enhancements. VMZ must provide the TCC with free data and information and make sure that the TMC is state of the art. After 10 years, if the contract is not renewed, VMZ must turn over a “modern” TMC to the City of Berlin. The VMZ is deploying detection devices where there are none—mainly on arterials and not on the motorways. The VMZ must provide information from the motorway and public transport systems as well. The request for proposals and subsequent contract focused on functional specifications and quality of data, not on technical specifications.

The contract term is 10 years; if it were longer, the technology changes would be too numerous. The term couldn’t be shorter because the real operating time is 7.5 years.

The TMC will help to achieve the political goal of increasing public transport ridership.

The procurement process started with a request for information, to which eight interested parties responded. This was followed by a request for proposals, and four teams submitted proposals. Two consortiums were then shortlisted for negotiations. The business model is based on business-to-business (B2B) generated revenues.

VMZ Berlin

Private-sector organizational control of VMZ is held by Daimler Chrysler AG Services (51 percent) and Siemens AG (49 percent). VMZ hopes that the main public transport company in Berlin will become a shareholder at the end of 2001. The VMZ is primarily deploying infrared detectors on arterials. From the financial model, the expected operating costs are higher than the capital costs (60 million Deutsch marks over 10 years versus 30 million Deutsch marks in capital). The VMZ believes it will cooperate and eventually share data/information with other cities and states. Currently, VMZ has agreements with one other city and the adjacent motorways.

The system will be set up 6 months earlier than the agreed-upon date. Internet services started in July 2000, and the full system should be operational in 2002.

The contract has a two-phase deployment. Phases 1 and 2 comprise 500 km of roads. There may be a Phase 3 to extend the network, but it is not in the current contract.

The VMZ in Europe is known as “The Berlin Model”—others may decide to copy it. According to this model, the government has to give some responsibility to the private sector. An option considered in Cologne is for the public sector to become a shareholder in the operating company.

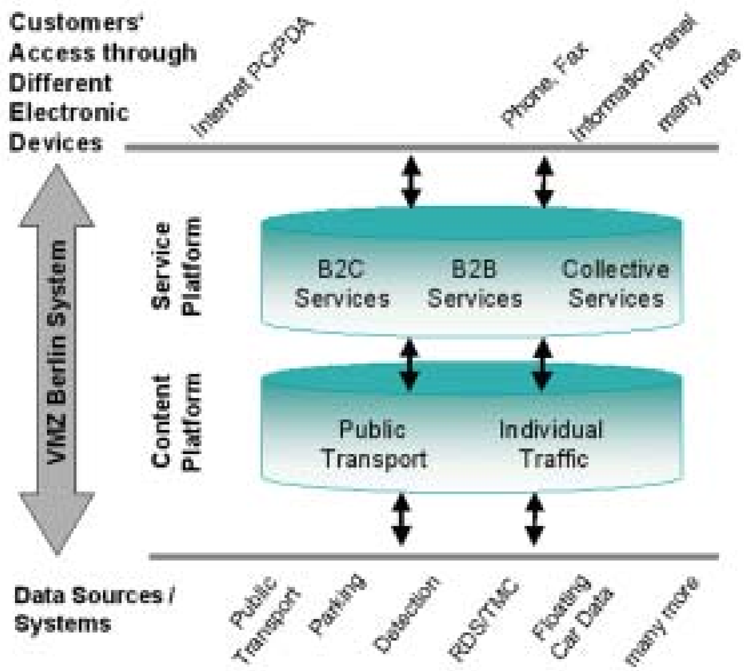

Figure 37. Berlin VMZ.

Data collection consists of the infrared traffic eye. There are 180 infrared detectors on arterials, 25 in parking garages, and traffic information on 25 VMSs in Berlin. Parking garage information is provided by one of the partners, BMW, which is in charge of this element of the project. The infrared traffic eye contains a solar panel and cabinet and can be placed on many types of structures. It provides vehicle speed and length and needs one cabinet for up to six detectors per station.

The data fusion focuses on three functional levels: content, traffic editorial staff, and the service platform of Internet, media, and the provision of data for services. The system uses a geographic information system with road data (where available) and VMS locations. It has clickable icons (i.e., roadworks, traffic count stations) with data behind it. It is Internet Explorer–based, using Concert version 1.1. The trip-planning tool takes dynamic information into account for both public transport and private vehicles.

For data dissemination, VMZ wants to collect and own all information on its website; it does not want to link to others. B2B is the main focus of revenue and requires a sales staff, which is being assembled. There is no escape clause—VMZ is obligated to operate all free services (to customers) for 10 years.

Data sources include public transport, parking garages, detection devices, RDS-TMC, floating car data, and others. The content will focus on public transport users and

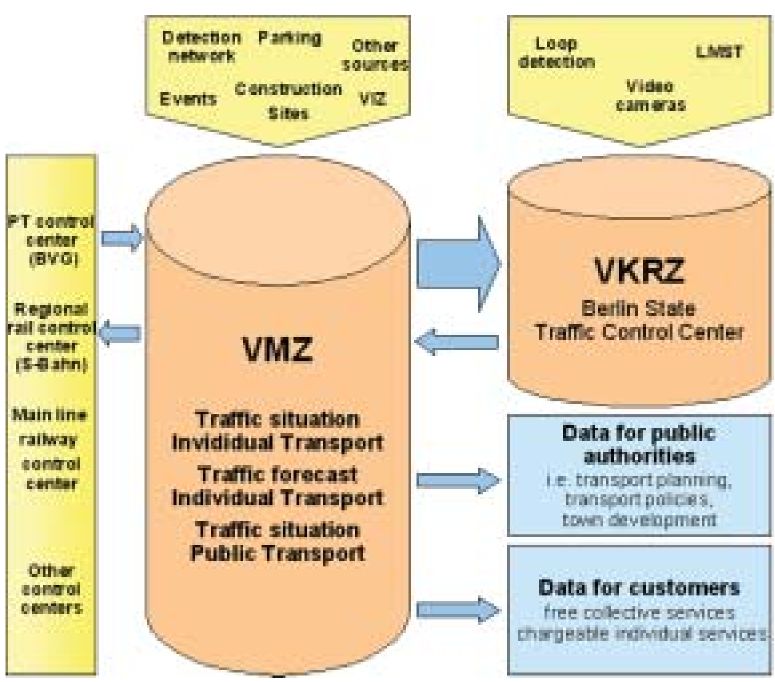

Figure 38. Berlin VMZ.

personal automobiles. The services that will be provided are business to customer (B2C), with other partners; B2B, the main focus of revenue; and collective services (free of charge), for example, via the Internet and VMS.

Customer access will be through the Internet using a PC or PDA, GSM, GRPS/ WAP mobile telephones, print media, TV, radio, telephone, fax, and information panels (VMS).

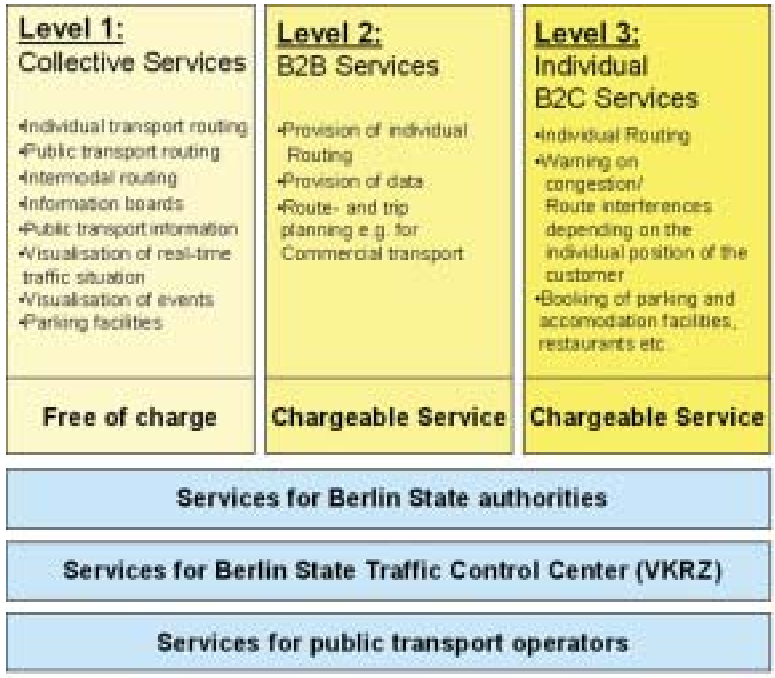

Figure 39. Berlin VMZ.

Marketing and sales will require a sales force, and staff hiring is currently under way. Marketing and sales personnel will work on a salary plus commission.

Figure 40. Multicolor dynamic information panel.

The contractual services include:

- Collective services—free service (i.e., where parking facilities are)
- B2B—chargeable services; customizable premium services
- B2C—chargeable services for individuals; customizable premium services
- Services for Berlin state authorities
- Services for Berlin State Traffic Control Center (VKRZ)
- Services for public transport operators

The Internet service is available at **www.vmzberlin.de,** and the service is free. Customers are anonymous and make their own interpretation of the information available. Only pretrip information is available. Origin-destination routing is available by choosing either car or public transport, and then one receives directions and a map. The results are travel time based on historic patterns and police reports. In the future, travel time will also consider information collected by VMZ detectors. Intermodal routing will soon be available. This capability will enable comparisons of transit versus car travel times. VMZ will be adding airport arrival and parking information. Revenue will be through “upsell” services to consumers and sponsors on the website. Two types of web cams are used.

Future developments include:

- Dec. 2001—dynamic parking information
- Dec. 2001—intermodal routing
- Nov. 2002—SMS/WAP service; can be a push service
- Dec. 2002—dynamic information on public transport

VMZ will create a standard interface where necessary and will make its data feeds available. Currently, it is using XML, SOAP protocol interfaces on data collection and data feeds.

With regard to intellectual property, the City of Berlin can use the data collected and system provided by VMZ in Berlin. Daimler Chrysler and Siemens can sell the data and market the system elsewhere. The city financed the system and it will receive the system, including software, hardware, etc., at the end of the contract (10 years). The city does not have any interest in marketing the system.

The system is organized into three phases: design, deployment, and operations. The framework to design the system is the task of VMZ, because the city wants to receive the correct/desired services and results—it did not want to focus on technical specifications.

STOCKHOLM, SWEDEN

The technical part of the visit to Stockholm included:

- Swedish National Road Administration (SNRA)

- Trafik Stockholm
- SOS Alarm
- Gothenburg Traffic and Public Transport Authority

Swedish National Road Administration (SNRA)

Originally, the SNRA was located in Stockholm for 140 years until it moved 200 km away to help stimulate employment away from Stockholm. Eighty percent of the population in Sweden lives in the south.

The SNRA has five major tasks:

- Road management of state roads.
- Construction and maintenance, as a separate profit center (in full competition with private enterprises).
- Official services—providing and supporting the legal framework for the road network (licensing, etc.).
- Sectoral responsibility—cooperating with and coordinating the work of relevant parties and promoting developments in the road transport system (ITS is part of this task).
- Contracted works—carrying out road planning and design, construction, operation, and maintenance as contracted by the SNRA and others.

ITS plays a major role in network operations. The focus is on traffic information in winter conditions. Congestion is not the major focus. Traffic information is the backbone of the ITS. Road weather data are provided every half hour at 700 stations. The data include dew point, air temperature, precipitation amount, wind conditions, and road surface temperature. The system also provides support for winter maintenance. SNRA is responsible for supplying information for the Internet and other contractors. There are 670 weather stations.

Other ITS programs are the Common Traffic Information System, which works toward a common platform to integrate the data services; and OPTIS, which is a program to provide an optimized traffic information system in cooperation with automakers and the private sector. The SNRA is also involved with EU projects, including Prometheus and DRIVE 123. The general experience has been that implementation is more difficult than the research and development effort. There is a national plan for ITS, and the Swedes are now establishing links with authorities for traffic information. The intelligent car and road system will be a public-private initiative with SAAB and Volvo.

The SNRA operates on both federal and state levels in seven regions. The next level of government is the municipalities. Transit is organized on the county level (in 20 counties).

SNRA's Stockholm Region

Each region has its own programs because of the need to cooperate with the cities. The population in Stockholm grows by 20,000 people per year (1 percent growth annually). Road traffic, however, is increasing at a rate of 3 to 4 percent per year, adding to the current congestion problems. It is estimated that rush-hour traffic will increase by 25 percent by 2010.

Most of the commuting is into the city center. Forty-five percent of all jobs in the region are in central Stockholm. The roads with the highest traffic volume are Essingeleden (average daily traffic [ADT] 130,000) and the Central Bridge (ADT 120,000). During the rush hour, public transportation accounts for 70 to 75 percent of all trips. During the off-peak hours, public transportation accounts for about 50 percent of trips. Growth in traffic in Stockholm is growing faster than in the rest of the country. Traffic in the city center has remained stable because of increased use of public transportation and bicycles.

Another reason to deploy ITS was the "Southern Link (ring road)." A tunnel was the only option. The cost was $700,000,000 for a 5-km tunnel. The state paid 75 percent and Stockholm paid 25 percent. The tunnel is connected to the street system. Because of the need for more comprehensive and advanced systems to manage traffic and incidents and the objective of uniting information about all the roads in the area, a new TMC was built. It is a joint project between the SNRA and the City of Stockholm called Trafik Stockholm. Once it is fully operational, the plan is to connect other municipalities to Trafik Stockholm.

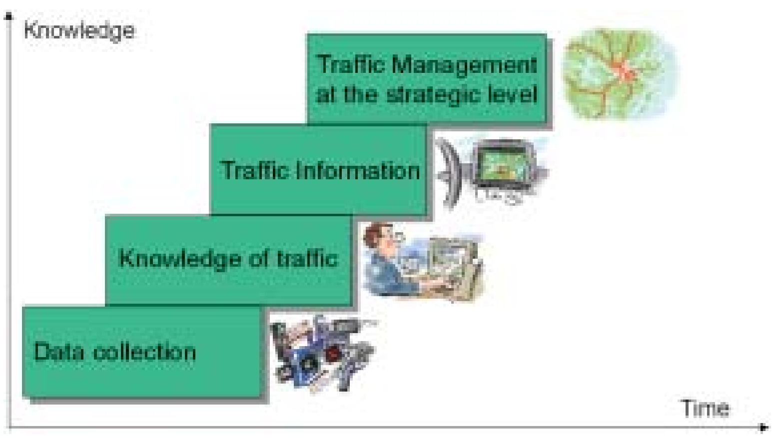

Figure 41. Using ITS is a learning process.

ITS improves as a function of knowledge and time. Traveler information is considered an essential component to enable efficient traffic management.

Traffic operations require coordination among all players. An agreement was developed among SNRA, the City of Stockholm, and transport agencies that strives for optimal use of the whole transportation system. A traveler's journey should be seamless. The plan is to provide multimodal information for "smart" journeys that includes pretrip information as well as information en route. The SNRA is currently trying to find some service providers to customize information.

The SNRA website can be visited at **www.trafiken.nu**. The website receives about 1,000 hits per day. The aim is to describe traffic in greater Stockholm with still pictures on different modes and to present conditions for multimodal travel. It provides information on traffic disruptions; traffic advisories (CCTV, travel times, etc.); travel planning (right now, later); and in the future, information on smart travel (best route, combined modes of transport). Information is currently available on roadworks and construction; traffic disruptions for commuter cars, buses, subway; rush-hour traffic; road surface conditions; ferry information; park-and-ride information; LOS (colored segments); and soon, normal and actual travel times.

The road assistance and emergency team (like the U.S. highway patrol) has cameras on the response vehicle and works with the police, city, and the SNRA. This is the first step toward emergency coordination, and more teams will be deployed for the tunnel.

The SNRA's approach to new systems is to study what has been done elsewhere and then to adapt it for Sweden. For example, the technical systems such as intelligent traffic adaptive signals and the motorway control system are from the Netherlands, whereas the real-time–based traffic models and VMS are based on European standards.

Data collection means include inductive loops, video, microwave, infrared, and Sweden is also looking at using GPS data, mobile telephones, Bluetooth, and others. Microwave is in use on the motorways and south tunnel.

Further research is under way to use real-time monitoring to conduct origin-destination estimates and then to do assignments of the traffic and again feed that into the traffic control algorithm. The researchers are using "slow" and "fast" cycles. The fast cycle uses more information, and each cycle takes 1 or 2 minutes to calculate journey times. The Swedes have not tested the control mechanism yet, which is based on the systems developed for Turin (an on-line model). SNRA is also looking at the British off-line model, Contram, to analyze scenarios for incidents.

SNRA is investigating using a probe system in Stockholm. Public transport vehicles will be used as probes for test purposes (currently around 5,000 vehicles). The probes send information to a communication operator server (Mobitex PMD 8000), and quite good results have been achieved. The project will be expanded to include probes in commercial vehicles and taxis. The information will also be sent to the communication operator server, and then to the SNRA probe server, which will send information to the SNRA traffic database. There is a filtering mechanism between what is sent and what the SNRA receives (speed, directions, coordinates, time, flag for type of vehicle, because of high occupancy lanes for buses). There is no need for a high rate of penetration—less than 5 percent of all traffic will be sufficient for accuracy.

Trafik Stockholm

Trafik Stockholm is the brand new joint TMC between the SNRA and the City of Stockholm. Three operators are on duty on weekdays and two on weekends and at nighttime. They work 6½-hour shifts on weekdays and 12 hours on weekends. The center has been operational since November 1, 2001. There are 20 people working in the TMC: 15 operators, 2 information technology (IT) administrators, and 3 management personnel. There is an emergency response room in the TMC to feed information to the media. The training room and lounge/kitchen is also used by other groups. Consultants have space for system development.

Figure 42. Trafik Stockholm.

Operators communicate with roadside assistance dispatch and monitor the cameras and detectors. They have road assistance cars as well as motorcycles to maneuver easily through congestion, and they provide gasoline to stranded motorists. Staff are from both SNRA and the city. During rush hours, the patrols go 20 km in each direction out of the city.

The signal system is still in the City of Stockholm, but will eventually be in the TMC as soon as all communications are in place. The operators receive 2 months of training and further on-the-job training and have to work for at least a year with another operator before they are permitted to work alone on a shift.

The website at **www.trafiken.nu** is based on information in the database computer system and was designed by the SNRA and the city to provide automated information. A consultant created and operates the site.

The system will help to increase mobility, increase traffic capacity, reduce the number of accidents, and reduce environmental impacts. Areas of activity include traffic monitoring, data collection and processing, traffic information, traffic management and control, management of road assistance, and surveillance of technical systems.

The traffic monitoring and data collection is performed in partnership with the police, SOS Alarm, rescue services, public transport, commercial traffic operators, radio stations (traffic advisories), City of Stockholm, and the SNRA. The system uses surveillance cameras, road weather information system, sophisticated signal systems, and motorway control systems. All data are processed at the TMC and are coordinated, quality-assured, and adapted to different target groups. Data are then sent to traffic advisory radio and the VMS. There is no sharing of camera images.

The road assistance team is on call to help out with minor breakdowns and thereby reduce the number of traffic disruptions. The team is run jointly by the SNRA, police, and the city. The vehicles are fully equipped and also have GPS monitoring and cameras on board.

Figure 43. Road assistance vehicle, Stockholm.

The project funding per year is 20,000,000 Swedish kronas or about $2 million. Seventy-five percent is provided by the SNRA and 25 percent by the city. A Trafik Stockholm Board runs the operation and consists of three SNRA personnel and three city members.

Strategy for Maintaining Traffic Information and Quality Requirements for the National Database

The national traffic information system/database (TRISS) includes road weather, accidents, roadworks, local bearing capacity reductions, and other obstacles, and can be accessed at **www.vv.se** (go to Laget pa Vagarna). This database serves the road conditions website and telephone service.

An evaluation study is done every 3 years. In a recent interview of 3,000 road users, they stated that road weather was of most interest. Radio was considered the most important media for information. About 30 percent had cancelled a journey and 45 percent had chosen another route because of traffic information received. In Stockholm, 91 percent of road users use their radios, and 58 percent choose the radio channel with the best traffic information.

The SNRA has developed data quality definitions and documented them. The definitions include data specifications, including quality declarations for the short term and long term. Examples of the data quality requirements are:

- For roadworks information:
  - 90 percent must be registered when roadwork is started (contractors must have a plan and must contact TMC with changes).
  - Must be updated within 2 hours after a change.
  - Valuation and restrictions are described.
- For weather information:
  - Must be updated in 30 minutes after a change.

- Accessibility of systems for national traffic information:
  - Must be 99.5 percent.

The SNRA has a business model for its ATIS services that includes some exceptions, such as:

- Provide the basic national services such as the website and telephone services. If, however, external actors do it better, SNRA may then stop doing its own.
- For products and services implemented for safety or environmental purposes, and where there are no external actors interested, the SNRA will do it (for example, RDS-TMC).
- Cab companies and logging trucks could save money by having the information. Therefore, fleet management systems should have this information.

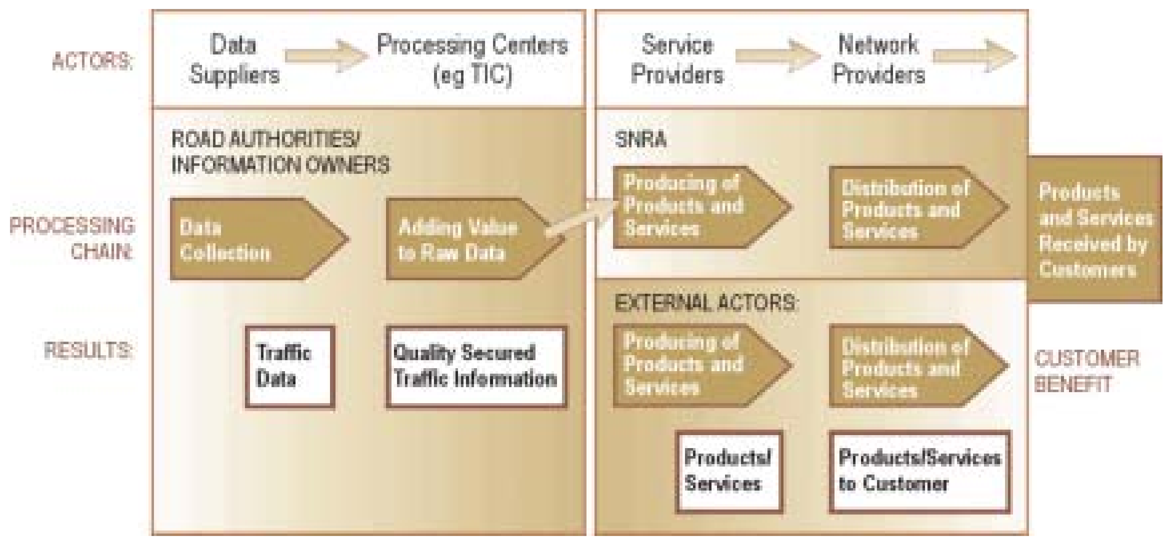

Figure 44. Interface for supply of traffic information, Sweden.

Technology for Exchanging Data (DATEX)

The SNRA has adopted DATEX as the data exchange standard. DATEX was developed by the CEN (European Committee for Standardization) 278 committee. There is a memorandum of understanding (MOU) among 11 European countries to use DATEX according to these standards (including some private companies).

A demonstration project was done at the bridge between Sweden and Denmark. DATEX was used to transfer data to TRISS and also via another DATEX node via an integrated services digital network line to Denmark.

There is an organization behind the MOU that is very active. User forums are held for all players in DATEX. The Trident Project (EU) will demonstrate how DATEX can be used in the future.

RDS-TMC Services

RDS-TMC provides up-to-the-minute information about accidents, roadworks, and congestion. The information is provided in the user's own language. The service is free and available throughout Europe. Many types of receivers are available on the market. More information is available at **www.tmcforum.com** and **www.vv.se/tmc**.

The navigation system with RDS-TMC allows drivers to:

- Know where they are.
- Get notice of road ahead.
- Learn about incidents that might affect them.
- Determine alternate routes.
- Calculate a new route (coming next year).
- Download information.

SNRA registers the information and is responsible for the RDS-TMC message coding. Eighty-five percent of Gothenberg TMC messages are dynamic. Providing map updates once per year is difficult.

DAB is considered a short-term solution. It has a large bandwidth and is a broadcasting one-way protocol.

Current trends in Sweden are that the customers want information everywhere all the time through PDAs, auto PCs, etc. In Sweden, GSM will soon have 100 percent coverage, WAP is growing fast, and all phones will have it in 3 years. PDA sales are booming. RDS-TMC will be an option for navigation systems in automobiles. Manufacturers want to have intimate consumer relations, and the intelligent car will allow all manufacturers to have their own services. The touring clubs are also very active.

SOS Alarm

SOS Alarm is a "company" that was set up and funded by the Swedish government (50 percent), Swedish Association of Local Authorities (fire service, 25 percent), and the Swedish Federation of County Councils (ambulance service, 25 percent). About half of the center's business is public service (fire, rescue, and ambulance) while the remaining 50 percent is for commercial services (commercial/residential alarms, fire alarms, telephone messaging services, technical alarms).

The centers received 16 million alarm calls in 2000. Many calls are not for emergencies (it includes both "112" calls and automatic alarms), and 50 to 55 percent of the callers should not have dialed "112." SOS Alarm has run marketing campaigns to reduce the number of nonemergency calls, but the effort has not been successful. The most common offenders are men in the 25- to 35-year-old age bracket with cell phones who call the number by accident. The center thinks Sweden has a higher percentage of "junk" calls than anywhere else in Europe.

Figure 45. SOS Alarm center, Stockholm.

SOS Alarm had a big problem with the media calling while the center was dealing with big incidents. To eliminate this problem, it created a service that sends incident information to a server that can then send the information (for a fee) via phone, pager, email, etc. This information also is forwarded to the SNRA. No private information is included in the message. The message is delayed to allow the emergency responders to get a head start on the media.

Since 1995, SOS Alarm has had business contracts with 280 of the 289 authorities in Sweden and about 20 county councils.

It is voluntary for the local fire service providers to join SOS Alarm. Each year, 9 or 10 fire service providers do not join. This situation can cause a delay in response time because all "112" calls are answered at the SOS Alarm centers and the calls must then be transferred to these "independent" centers. It is estimated that it costs these local authorities 10 times more to run their own center than it would for them to contract with SOS Alarm.

The Swedish government is responsible for the "112" emergency phone number, introduced in 1996, which is free to the caller. Sweden has 20 SOS Alarm centers, most of which are small and could be consolidated into about 10. The centers alert all fire calls, alert and dispatch all ambulance calls, and transfer calls to many others (i.e., police). Seventy percent of the "112" calls are for police. There are no other three-digit numbers in Sweden; directory assistance in Sweden is "118-118." In most of Europe, it is "118." Fifty percent of the calls are wireless. Sweden has the same issue as in the United States regarding location information for a cellular call—only the tower or cell the call is coming from is known. The Swedes see this as a big problem and are moving toward a solution. DAB is considered a short-term solution; it has a large bandwidth and is a broadcasting one-way protocol.

The total annual budget of SOS Alarm is 500 million kronas or about US$50 million. SOS Alarm also provides the following services:

- Remote control system monitoring and detection

- Visual surveillance—primarily CCTV
- Personal alarm—a portable emergency alarm
- Medical information—the centers have doctors and nurses on staff

SOS Alarm includes the following subsidiaries:

- SOS Flygambulans AB (flying ambulance)
- Youcall Sverige AB (call center, answering service)
- SOS Security (consulting company)

Call length differs depending on the type of call, i.e., a "112" versus a nonemergency call. The maximum answering time is 8 seconds (by contract), and the typical length of a call is 1 to 1.5 minutes for ambulance, up to 2 minutes for a fire, and the rest are transferred to police, sea rescue, etc. "112" calls transferred to police are typically answered within 20 seconds, but it can take minutes to transfer. This transfer time is a problem for SOS Alarm operators because they must stay on the line until the transfer is complete. SOS Alarm wants to further automate some of its systems.

The centers also believe that they need to improve the public education effort on how and when to use "112." The landline calls transferred to the police have the location information, but the police do not use it. The centers have a twin recording system and they save each call for 2 months. The police can use the recordings.

If one call center is busy, then a "112" call can be forwarded to one of five other call centers in the Stockholm area. All call centers are linked. The system uses digital maps and GPS to identify the closest response unit to a call and also helps the unit navigate if necessary.

Operators are tested on their ability to handle simultaneous tasks and stress (women are typically better). Then operators go to SOS Alarm school for 1 month of training on technical equipment, medical training, organizational training to know who all of the players are and how they work together, psychological training, and interviewing skills. That month of training is followed up by 80 hours of training annually. Operators must pass a theoretical and practical test every year to keep their certification. It costs 350,000 kronas or US$35,000 to fully train an operator. Centers compete with each other to attract qualified operators.

The centers require four full-time staff to constantly update the client/profile database (cell phone numbers change, etc.). The CCTVs are IP-based. SOS Alarm is planning to purchase a new computer system over the next 2 years for 200 million kronas or US$20 million.

GoTIC, Gothenburg

In 1990, the Gothenburg Traffic and Public Transport Authority was founded to place all aspects relating to mobility under one authority. This was "extremely lucky" and efficient.

The Gothenburg real-time information system, which began on two light rail transit (LRT) lines in 1984, covers:

- Light rail—the system is expanding quickly and now has 200 LRT vehicles
- Buses
- No subway

LRT has had signal priority for 30 years, whereas buses have had signal priority for 15 years. Parking information is also integrated into the system. Two information kiosks with TV (liquid crystal display) screens display approximately 100 scrolling signs in shelters. The Internet site is available in four languages. The loop detectors are "intelligent" and are used as location devices. Buses outside the city are using GPS because there are no loops or traffic signals. Mobitex is the method used for sending data from the loops to the central and area computer systems.

Gothenburg has performed extensive passenger information–related research. The research allowed for the development of a product based on passenger information needs and requirements and not technical requirements. The primary lesson learned from the research is that public transport passengers worry about their journey all the time. Research shows that the "passenger regards information about disturbances (service disruptions) even more important than minute-by-minute (countdown) information." Research shows that, "after 3 minutes a passenger waiting for a bus that is not coming expects more information and begins to consider alternatives to fulfill their journey."

GoTIC is the Gothenburg Transport Information Center and it is an international demonstration project. The premise is to learn how multiple entities can band together to produce quality transport information. Another purpose is to find out if passenger needs and data requirements are being met.

Scientific research produced in 1993 established passenger information needs and requirements on the basis of 2 years' worth of investigation, research, and passenger observation. The research also determined that access to real-time information relieves passenger doubts substantially. Therefore, the purpose of providing passenger information is to reduce the level of uncertainty for the rider.

In Gothenburg, the passenger information is sent to:

- Shelter displays
- Kiosks and public centers (on monitors)
- Stop posts (LED displays)
- Inside vehicles (LED on buses and LRT)
- PCs (Internet)
- Phones, pagers, SMS, and WAP

It is important to provide travel information, and not just traffic information, to customers and to recognize that transit is different. All such information comes from the Traffic Info Center, which creates messages about disturbances.

Real-time information is provided at transfer points, such as:

- Kiosk-like, three-sided stands with LCD monitors—some screens have maps indicating other stops in the immediate area
- On buses

Figure 46. Travel information kiosk, Gothenburg.

The first generation of on-bus displays showed four lines of information, including the route number, next stop, next stop after that, and a scrolling message sent via Mobitex. The stop names shown on the display are typically cross streets. Displays are now being installed in the LRT vehicles. The system also has voice announcements from the vehicle's computer. New displays with larger screens will be tested soon.

The Travel Index is designed to provide information for information officers so they can be more prepared to make passenger information decisions. The Travel Index provides information on travel quality, not on traffic. Automatic information support sends automatic messages to display boards on the system. System architecture shows inputs from both static information and real-time information from the Traffic Info Center that can be used by information officers. The system has been tested and now is about to be implemented.

Real-time information is available via cell phone and SMS. It takes a long time for the user to key in the request using buttons on a phone. Typically, the user makes an information request and receives a call back with the answer. GoTIC also has a real-time warning service via cell phone and SMS. This is a push service based on a customer profile (bus destination, delay, disturbance).

For the past 2 years, customers have had the capability to use the WAP service. It works much like a web browser, and allows users to select and save "favorites" such as a stop. The service then provides information on which routes are arriving and when (to that stop) via a push of data. A new authority—the Western Region Transport

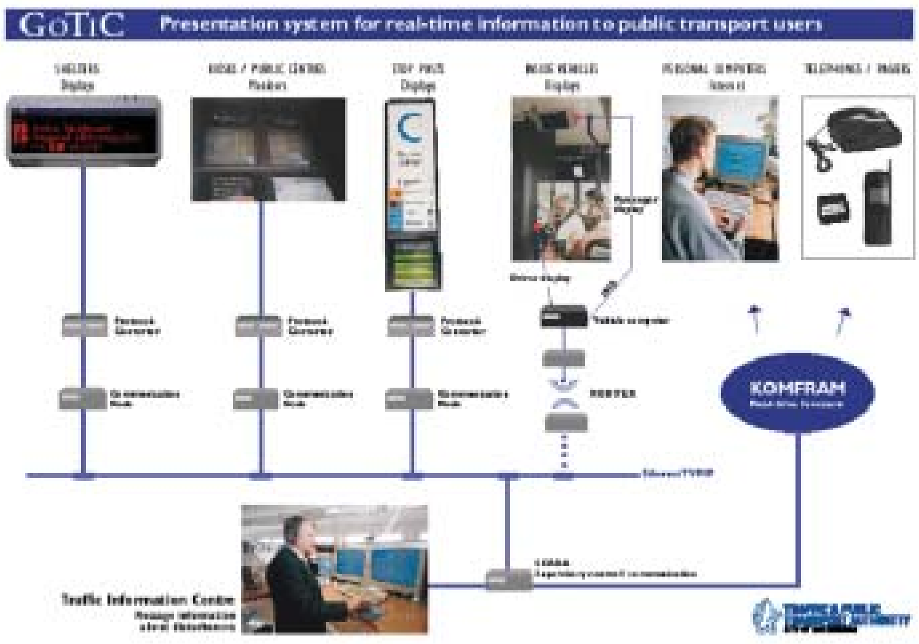

Figure 47. GoTiC system architecture.

Authority—now controls the Gothenburg system. This authority has the responsibility to market the WAP service, but has not yet begun doing so.

A pager service was tested, but did not work because the private company wanted to create proprietary travel time and routing forecasts, which would have been different than any other forecast created by the transit authority, and that outcome was deemed unacceptable.

GLASGOW, SCOTLAND

The technical part of the visit to Glasgow included:

- Scottish Executive
- Strathclyde Passenger Transport Executive
- City of Glasgow

Scottish Executive

The Scottish Executive is the U.S. equivalent of a State DOT. The Scottish Executive receives funding from the U.K. government that includes some earmarks.

For public transport, Traveline is being expanded to Transport Direct for individual information and travel planning services. The nationwide number “0870 608 2608” for Traveline provides information for making local and national journeys. The Scottish Executive funds and operates the call center. Funding is also contributed by transport operators. Transport Direct will be available on the Internet, in kiosks, and on digital television. Purchase of tickets will be available on-line and is funded by DTLR.

For Traveline in Scotland, the cost of a 3-minute call is 24 pence, which is the maximum peak-time rate cost. The “0870” U.K.-wide national rate number system was introduced in January 2001. It is being set up by the Scottish Executive, and operations will be undertaken by a private contractor. The call flow is as follows:

- 1 is for rail, and it transfers the call to the rail information number.
- 2 is for bus, and it transfers the call to the bus information number.
- 3 is for multimodal information.

Currently, Traveline receives 7,000 calls per week and can accommodate an expansion of 35 percent. The system is not yet promoted extensively.

Strathclyde Passenger Transport Executive

The Strathclyde Passenger Transport Executive consists of the City of Glasgow and 12 other council areas. Its duties include developing general passenger policies, reporting to the executive, promoting competition, and providing services for the disabled. Some 44,000,000 rail passengers use 180 stations on 334 route miles per annum. There are 159 subsidized operations for bus services.

Strathclyde Passenger Transport Executive operates the Buchanan Bus Station in downtown Glasgow. It is the largest bus station in Scotland (600,000 buses visit it annually), and it has 57 front-loading bays. The bus service is provided for long distance and express routes. The station provides travel service and information. Electronic passenger information is provided continuously.

Figure 48. Buchanan Bus Station, Glasgow.

City of Glasgow

Transportation in Glasgow falls under land services and is one of 11 departments. The population of the city is 620,000, and there are 2.1 million people in the region.

Figure 49. Bus arrival information, Glasgow.

The extensive motorway system has between three and five lanes per direction. The modal split in the city is:

- 38 percent bus
- 20 percent rail
- 10 percent underground
- 32 percent private

Transportation policy emphasizes parking control and quality public transit services in an effort to mitigate traffic congestion and growth. There is a national policy initiative toward congestion pricing as a means of reducing traffic, but it is not favored in Glasgow. The Glasgow City Council developed a policy approach called the Millennium Plan, which includes:

- Quality bus corridors
- Sustainable transit
- Traffic control

Historically, traffic has been addressed by ITS implementation, and research has been undertaken to estimate the impact of IT on traffic congestion. The research found that a projected 40 percent increase in traffic can be reduced to 17 percent through telecommuting and other soft means by 2017. Additionally, it has been proved that accident rates are reduced as a result of addressing congestion, environment, and safety.

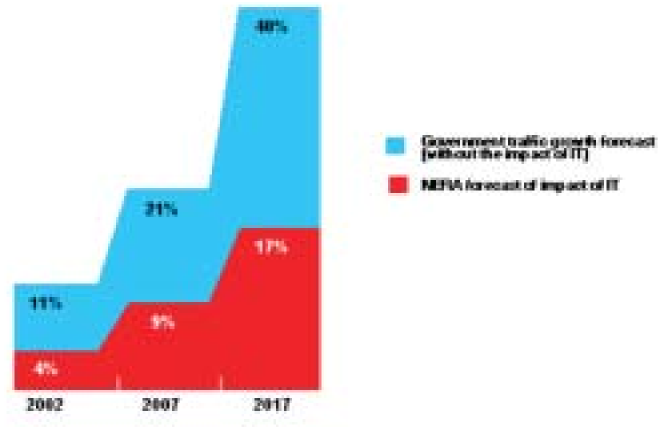

Figure 50. Impact of information technology on traffic flow in Glasgow.

Figure 51. Message sign in Glasgow.

ITS applications in Glasgow include video, ramp metering, and the NADICS driver information system. It also covers the trunk road network with VMS at key decision points. TrafficMaster, the private-sector traveler information provider, also collects data on the road network. The City of Glasgow also participates in other European projects including OPERA, TABASCO, and ISIS. The NADICS system integrates the national motorway and Glasgow urban highways. ALINIA is the project that researched ramp metering. The signal control is a UTC MOVA SCOOT system. Lane-control management is in use in Glasgow through dynamic lane control signs.

The COMPANION hazard warning system provides early warning to motorists. The Journey Enquiry Support System provides point-to-point information for all transportation modes in the Strathclyde region. It provides impartial, point-to-point information and requires a quick response for the 763 routes, 132 bus operators, 1 rail operator, and 3 ferry operators that it serves. The data are captured from bus profiles, 900 stops, and 181 rail stations. At the moment, it is a professional user system and will be expanded to public access at a later stage.

Figure 52. Variable speed limits in Glasgow.

Glasgow CITRAC and Scottish NADICS Systems

NADICS covers most of Scotland's main roads. It is divided into six urban areas. It offers integrated control of traffic, management of roads, and is operated in the interest of road safety and network efficiency. The system provides timely and

Figure 53. CITRAC and NADICS traffic management center, Glasgow.

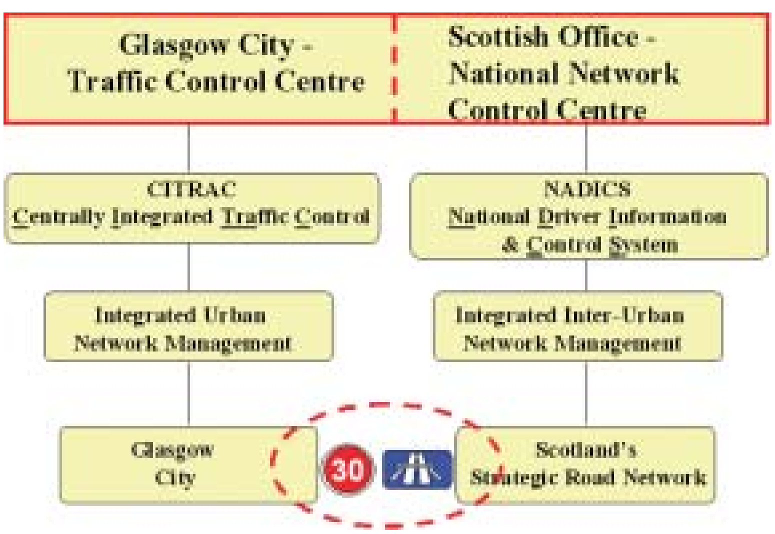

Figure 54. Glasgow CITRAC and Scottish NADICS integration systems.

accurate information and is delivered with a user focus. The six urban areas are Glasgow, Stirling, Edinburgh, Dundee, Aberdeen, and Inverness.

The core functions of the systems include:

- A monitoring network: CCTV, loop detectors, incident detection, etc.
- Traffic control: overhead lane signals, CITRAC, VMS, ramp metering
- Informing users: VMS, lane signals

The NADICS system contains the following parameters:

- Single integrated system
- Multiple functions/responses
- Multiple users (police, operations, etc.)
- Integrated response capability
- Integrated link to CITRAC UTC (traffic signals)

Typical responses are warnings to drivers, using an algorithmic/planned response sequence (control and information), and dynamic tracking of responses and dynamic removal of the response when completed. The ALINEA ramp metering algorithm is used for ramp metering in Glasgow center. It provides great benefits in capacity improvement and shockwave suppression. Alternate routing and signalizing are provided on city streets when ramp metering and queuing ensues.

The NADICS website is at **www.nadics.org.uk**. The website was launched in September 2001. CCTV images are provided to the media as well. In November 2001, 10,000 pages were accessed per day. The media calls in the morning for traffic updates. There is a direct CCTV feed to the British Broadcasting Corporation. The operating and maintenance road agencies get their weather information from service providers and do not provide weather information on VMS.

Police have workstations for NADICS and can control everything in their “precinct,” including signs and CCTV.

The CITRAC system is an on-line signal system that polls information every 24 seconds. It includes the BIAS – Bus Information and Signaling System, and archives the data for 6 years. A trial on real-time information for buses is currently being conducted. An automated parking guidance system exists for car park data. A license plate recognition system is used for journey time monitoring to provide travel times. It uses a specific route with cameras at both ends. The camera sites have loops next to them so they can also categorize (classify) cameras for different types of vehicles (one camera per lane).

The CITRAC system provides:

- Strategic traffic monitoring (web page)
- Correlation of data—journey times by type

- Vehicle speed, length, gap
- Potential for advanced analysis
- Better diagnostics in case of site failure

NEWCASTLE, ENGLAND

The technical part of the visit to Newcastle included:

- Great North Eastern Railway (GNER) Telecentre
- National Rail Enquiry Services (NRES)
- Travel Shop
- Ryton Rural Exchange
- Transpod
- Traveline

Great North Eastern Railway (GNER) Telecentre

GNER is one of the 25 private train companies operating passenger services in Great Britain under franchise to the Strategic Rail Authority. It runs between London, Leeds, York, Newcastle, Edinburgh, and Aberdeen. This center is the GNER phone center for the purchase of railway passes and trip planning information throughout Great Britain. Two call center managers oversee more than 200 employees. The center sells tickets for all 25 railroad companies serving Great Britain. Times of operations are from 7:00 AM until 10:00 PM daily. The railroad ridership has shown growth of 15 to 20 percent this year. The GNER receives a 9 percent commission on ticket sales. Eighty percent of all calls are answered within 20 seconds, and the center experiences a 5 percent abandon rate. There are 20 phone lines available. Employee training consists of 3 weeks of classroom training and 1 week of actual on-the-job training followed by another 3 weeks in the classroom. Sales representatives must be familiar with 80 different rail fares. The call center is independent from the rail operations.

National Rail Enquiry Services (NRES)

NRES is a rail timetable and fares enquiry service provided jointly by the passenger train companies. The NRES call center answers up to 200,000 calls daily, provided under contract to specialist call center operators. The Newcastle location, which is owned and managed by British Telecom, has two major call centers and two smaller ones. More than 500 staff are employed at the Newcastle location and 1,700 are employed nationwide. The center operates 16 hours per day, 365 days per year. The Newcastle location won the latest “mystery shopper” competition and scored 98 percent. This score indicates an emphasis on high customer service and high-quality service. Employees receive a 3-week training course. Railroad timetable information is available electronically. Printed timetables are available in case of computer system failure. All railway fares are available. Ticket purchase requests are transferred to individual train operator call centers such as the GNER center.

Figure 55. NRES call center, Newcastle.

Cell phone calls account for 50 percent of the total calls received. Most cell phone inquiries are received during the evening and weekends (off-peak cell phone period). Special events create an increase in the demand for real-time information from 5 to 50 percent of the calls. The center has 200 phone lines available, and 140 are in service at any time. There are no automated answering systems, because person-to-person service is preferred. The current operation answers 93 percent of all calls with a 14-second wait time.

Information content has evolved from what was required by contract to what is required by the customers. The center uses mystery shoppers to evaluate service quality. Operators have a catalog of answers available on-line for frequently asked questions. All other information is also available on the Internet. NRES is in the process of procuring a real-time information system. It has been estimated that, on average, each inquiry generates 2.45 pounds in revenue for train operators. The NRES is paid 0.55 pound per call by rail operators. The contract for the operation of the center has incentives and penalties. The center notifies the media concerning train service interruptions within 10 minutes of incidents taking place and also notifies the media when normal service returns.

Travel Shop

The Travel Shop is a retail ticket outlet that also provides information for bus and rail services. It generates revenue by commission on ticket sales and gets 4 percent of its sales from rail, 5 percent from Metro and bus, and 10 percent on holiday travel tours. The Travel Shop also provides journey-planning information.

Ryton Rural Interchange

The Ryton rural bus interchange was built because 40 percent of households in Western Gateshead are without a car, which resulted in long journey times to main centers of Newcastle. The existing system had confusing bus service patterns and there was generally a lack of public transport in the rural areas.

The solution was to build an interchange center that provides access to the trunk bus lines. It is a staffed facility providing a safe and secure waiting facility 24 hours per

Figure 56. Ryton rural interchange, Newcastle.

day, and also uses CCTV. It offers real-time traveler information and a flexible bus and minibus service serving the Ryton interchange from rural areas. Through ticketing is provided for all trips even if the passengers use different bus companies. Subsidies for taxis are available if a passenger is stranded. The project was funded through a grant from the national government. The system also encourages the use of bicycles by providing storage lockers. The bus service runs from 5:30 AM until midnight.

Transpod

Transpod is an electronic passenger information kiosk that provides journey planning on a regional basis. It has next departure, timetable, general public transport information, and direct links to taxi companies.

Figure 57. Ryton rural interchange, Newcastle.

Figure 58. Transpod, Newcastle.

Traveline North East

Traveline North East is a regional call center providing information on all forms of public transport (bus, rail, ferry, and national rail). It is one of 29 offices in Britain and has been in operation for 2 years. This center receives approximately 600,000 calls annually and operates from 7:00 AM to 8:00 PM daily. It provides multimodal journey planning from point to point. Traveline North East is funded by contract to 33 private transit operators in the region. All data are provided by the transit operators. The average length of an information call is 1.5 minutes. Operators also provide trip cost information although they are not required to do so. Most trips are planned via local bus. The standard is that 90 percent of the calls are answered within 30 seconds. The center has 20 phone lines, and 15 lines are in use at any time. There is no scripted or electronic answering, and personal service is preferred. Costs are allocated to the shareholders on the basis of system miles. Complaint calls or lost and found inquiries are passed on to the appropriate private operator. All the information is available on the Traveline website (see section below on London).

LONDON, ENGLAND

The technical part of the visit to London included:

- Department of Transport, Local Government, and the Regions (DTLR)
- English Highways Agency
- TCC Project
- RDS-TMC
- TrafficMaster
- Romanse

DTLR

Transport Direct

In 2000 the Labor Government announced a 10-year plan "Transport 2010," which was a platform to take a radical look at transport policy. The result was an integrated transport policy that states that: "In an integrated transport system, information is crucial." It supports the idea that the physical elements of the system need to be planned as soon as feasible and that transport must be integrated with other aspects. Trends were not necessarily considered while developing these policies. The focus is on shifting demand to public transport. The concepts have resulted in the Traveline service. Recent political developments led the Deputy Prime Minister to announce a Transport Direct initiative. The title Transport Direct is based on the National Health Services' hotline NHS Direct.

The vision for Transport Direct is to provide an all-embracing, multimodal, planning, ticketing, and alerting multichannel travel information service that is integrated in the future with a smart card for ticketing.

The vision is to provide travel planning for all modes, integrated travel booking, and actually running a real-time information system based on sound historical information.

The government role in Transport Direct is to harness stakeholders, set the pace and direction in terms of targets and audits of the targets, provide standards support, and offer facilitation. More information can be found at: **www.dtlr.gov.uk/itwp/transdirect/travinfo/index.htm.**

Transport Direct established several target areas:

- Leadership/engagement
- Research
- Standards, codes, guidance
- Data management framework
- Real-time information
- Traveline
- Traveler information highway
- Monitoring and assessment
- Program management
- Financial management

Following are other ongoing DTLR activities:

- A contractor is preparing a standards needs assessment and a report was due in September 2001.

- A transit website best practices guide has been prepared by Southampton University and is available on the Internet.
- A data management framework that includes data ownership will be completed by January 2002.
- A Real-Time Information Group is developing a strategy on real-time transit. Draft requirement specifications have been produced. A communications study will establish how best to undertake real-time communications with buses. Some bus operators see a business case for capturing data, but not for transmitting in real time. The Automobile Association (AA) Route planner is the most popular personal vehicle routing website in England. Traveline can be found on the web at **www.traveline.co.uk.** Another existing booking site is **www.thetrainline.com,** where one can trade off price versus journey time.

English Highways Agency

The Highways Agency manages the equivalent of the U.S. National Highway System. It includes 2,000 miles of motorways and 4,500 miles of trunk roads. Historically, the Highways Agency was responsible for tactical control and safety of the highway system. Now the Highways Agency is moving toward strategic control, with an emphasis on efficiency, LOS, and real-time information. The key government policy is: “Make better use of the roads we have.” In the United Kingdom the police operate the motorways. ITS infrastructure has become a standard for all new projects. Several pilot projects are under way. For example, the M25 Motorway has enforceable, variable speed limits. The benefits are more than a 5 percent reduction in accidents, small reductions in journey times, small increases in throughput, and increased customer satisfaction leading to reduced stress. Ramp metering is being tested on the M27/M3 at six pilot sites, and the benefits assessment is under way. An active traffic management program is being tested on the M4 in Birmingham on a 40-km section of freeway. Detectors are installed every 50 m with a VMS every 500 m. Ramp meters are used, and dynamic use of the shoulder is allowed. Full CCTV coverage is provided.

The strategic management philosophy is to encourage “new driver information services,” but there is agreement that infrastructure is still needed, hence the TCC project.

TCC Project

The motorways are fully cabled (copper and/or fiber). That is not the case for trunk roads. Commercial telecommunication services are expanding.

The TCC procurement process took 3.5 years, with 12 to 18 months being used to develop the business case/model. The Highways Agency had to demonstrate that this approach is more efficient than public-sector operations. The project was advertised throughout Europe for expressions of interest, followed by a consultation exercise with the private sector and interested parties. Then there was a two-stage tender process with detailed level of interest (about eight submittals were received). A shortlist of four was invited to submit detailed proposals, which resulted in two final bidders. The best proposal was selected for final negotiations and a best and final offer. Risk assessment of proposals was a key part of the evaluation process, and both final bids were of good quality.

The TCC project will enhance existing Highways Agency infrastructure. The contractor is developing independent systems and networks and is considering cellular communications to the detectors. A single control center will be built in the central region. The system will only cover England, but it will coordinate with the systems in Scotland and Wales.

The estimated types of congestion on trunk roads are:

- 65 percent recurring
- 25 percent as a result of incidents
- 10 percent as a result of roadworks

DTLR/Highways Agency have selected a contractor on the basis of performance requirements to design, build, operate, maintain, and transfer. The contract did not have functional specifications, but rather requirements. It is a 10-year contract worth 160 million pounds, and a team called “Traffic Information Services” consisting of Serco and Halcrow Fox and several subconsultants was selected. The contract requires the center to be operational by 2003 and to continue operations until 2011. Commercial services revenues are capped. Below the cap, the contractor retains 100 percent of the revenue; above the cap, the revenue is split 50/50 between the contractor and government.

Travel Information Highway

The Travel Information Highway is the method of sharing roadway data between agencies and service providers. It serves as a national data exchange and can be visited on the Internet at **www.tih.org.uk**. A demonstrator was built by the Highways Agency, and the TCC is being tasked to support its development. The TCC must use it, but will not own it. The Highways Agency is currently considering a video information highway. Twenty of 32 police control centers have a CCTV system. The main considerations are technology, data ownership, privacy, security, and acceptable policies.

European Projects

The Highways Agency participates in the implementation of several European projects. The Centrico project is providing data exchange among northern European countries. Streetwise is the British Isles version of Centrico. Trident is a project that researches how to extend road-based data exchange into public transport.

RDS-TMC in the United Kingdom

RDS-TMC is available in the United Kingdom. The cost of a receiver ranges between $500 and $3,000. A demonstration project of TMC was conducted in the United Kingdom. The project was led by a consortium comprising DTLR, the Highways Agency, AA and Royal Automobile Club (RAC), C&MT, Oscar Faber Consultants, and the EU—which funded 50 percent of the project.

Seven transmitters were erected to cover 60 percent of the motorway network of South and Central England. Funding was the constraint. Six hundred receivers were deployed to AA/RAC members. Volvo customers only needed a new disk. Four hundred Bosch radios were bought for Highways Agency staff. Research based on 20,000 journeys found that RDS-TMC influenced 6 percent of trips. While 50 percent of drivers changed plans, 87 percent saved time and reduced stress, and only 3 percent got the same information from another source. Drivers love having access to journey times, seeing the complete network, and getting personalized information.

The business case showed that 37 percent of users would pay $150 per year to continue to use the Bosch radio TMC system, and 80 percent would pay $140 per year to continue to use the Volvo navigation system with RDS-TMC. Commercial products have already resulted from the project, and the AA and ITIS have announced fully commercial services. The net result is that the public sector primed, and the private sector has taken up the opportunity. Toyota is including the price of the RDS-TMC unit in its vehicle price, and TrafficMaster will feed AA service with journey times.

TrafficMaster

TrafficMaster's main business is to establish its own data-collection infrastructure. Its business model requires access to right of way, but TrafficMaster does not receive government subsidies to build or operate the infrastructure. TrafficMaster is initially developing the dissemination networks until others pick up the business. TrafficMaster is in the content business and has forged many strategic partnerships across Europe. It first obtained a national license from the DTLR. The licensing review process focused on the impact of the resulting systems on human–machine interface issues, and made sure that the routing does not go down too-small streets. Research has shown that consumers are most interested in the following information:

- 45 percent want traffic information.
- 21 percent need help with navigation.
- 12 percent need assistance.
- 8 percent want information about points of interest.
- 9 percent want other information.

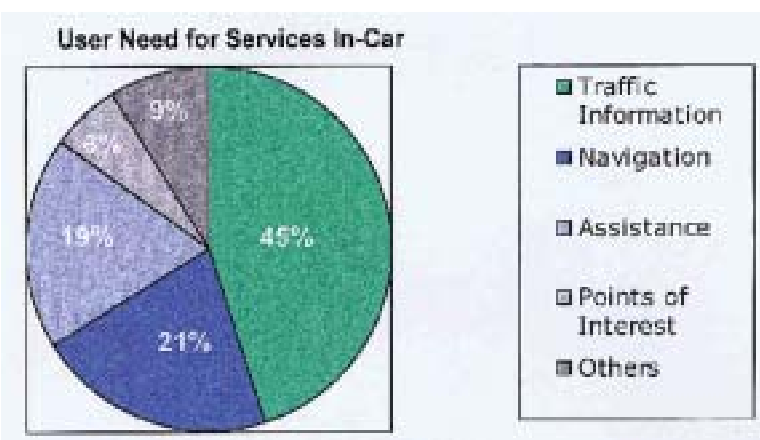

Figure 59. User needs for in-car services.

Deployment of navigation systems is growing rapidly in Europe. More than 1 million units were sold in 2000. TrafficMaster delivers information on a 3-minute cycle. The detection system initially consisted of infrared detectors 2 to 3 km apart using a GSM connection to transmit speed and delay time. The second-generation data collection equipment includes license plate readers that read the center four characters and use infrared at night. GSM is still used for communications. In the United Kingdom, about 60 percent infrared and about 40 percent license plate readers are deployed. The next generation of deployment will look at advanced floating car data and will be geared for lower-class roads.

In other parts of Europe, TrafficMaster installs a "black box" in the vehicle. It is called "advanced" because it does exception reporting, not periodic reporting, which saves communication costs. The Waypoint travel times are programmed into the in-vehicle black box and it compares travel times along links with preprogrammed "normal times." The reduction in communication costs is significant, but it is the most expensive way of collecting data. TrafficMaster is planning to deploy 50,000 units in Italy by mid-2002. The approach is used somewhat in Germany. The best applications for probe vehicles are long-distance trucking and regional/local fleets. TrafficMaster bundles the service with its fleet management system and barters simple fleet management for probe data.

TrafficMaster coverage includes the following:

- In the United Kingdom, TrafficMaster has 7,500 miles of coverage, including all motorways and 95 percent of all trunk roads using 7,500 sensors that provide real-time and forecasted data. Short-range beacons are installed on every other site using low-power transmitters (433 MHz) with a 1-mile range to provide local traffic information.

- In Germany, TrafficMaster has just launched on 9,000 km of autobahn or 90 percent of the autobahn. There are infrared sensors every 2 to 3 km, supplemented by advanced floating car data and additional loop information in certain areas.

- In France, TrafficMaster has a 20 percent stake in Mediamobile. Other shareholders are Renault, France Telecom, and the toll road operator Cofiroute. Government-owned loop data on the ring road around Paris is also used in the system. The system will be expanded in 2002.

- In Italy, TrafficMaster is in a joint venture with Fiat. The focus is on floating car data collection. Deployment will initially be in northern Italy. Negotiations are under way with road operators for right-of-way access, and the plan is to go live by the end of 2002.

- The ultimate goal is a pan-European network. The initial targets are the homes of auto manufacturers. The widescale deployments will eventually result in an economy of scale in Europe. Plans for the United States include the acquisition of Teletrac Fleet management. Teletrac operates in 11 cities and will provide the base for U.S. operations.

Figure 60. Traffic alert devices.

TrafficMaster Products

Alert devices are simple roadside-enabled devices. It is a marketing device that uses the mobile phone system platform. It uses a four-digit number, “1740,” which works for all mobile phones. Some carriers also market their own numbers. It provides cell-specific information and generates revenue from using the cell phone minutes. There is revenue sharing between TrafficMaster and the carriers. This service generates more than 5 million calls monthly. The average length of a call is 30 seconds. The U.K. cell phone services charge per second for calls. Carriers promote the number, and the devices were largely given away. The purpose was to provide early devices to stimulate market awareness and entry.

“Freeway” speech devices receve a data dump from roadside transmitters. The data are filtered for direction of travel and are presented in simple speech. The service only has motorway coverage. It costs approximately $110 to buy, is battery powered, and has a $45 per year fee for the service.

Figure 61. Freeway speech device.

“Oracle” works like Freeway, but it is an original equipment manufacturer (OEM) device. It is built in and can override the stereo audio. To date, about 400,000 to 500,000 per year are being sold. It is becoming a standard on a few auto models. Some OEMs provide a free 1-year trial subscription; otherwise, the owners are subject to the same $45 yearly fee as for the Freeway device.

The “YQ” is an in-vehicle display system (not a navigation system) that provides national information. It costs $225 to buy and has a $150 annual subscription fee. To date, 50,000 units have been sold. YQ offers predefined map views with dynamic data.

Figure 62. Oracle OEM device.

TrafficMaster also has worked with Motorola to develop an off-board navigation system called “SmartNav.” Market research indicated that three user groups are interested in navigation: high-tech/ multimedia-oriented people, comfort-oriented people, and safety-oriented people. These three groups make up the majority of the population. The off-board navigation system targets the latter two user groups. SmartNav is driven by speech and operator interaction, and costs less than half of the price of a navigation system. The user pays for the system when he/she asks for a

Figure 63. YQ display system and monitor.

route. The unit combines live traffic information along with navigation and will be launched in early 2002. The price has not been announced yet, but it is expected to be less than $1.50 per route request. Visit **www.smartnav.net** for more information.

TrafficMaster is also developing an interactive voice platform that will be cheaper than the device-based off-board navigation system.

Figure 64. SmartNav user groups.

Romanse, Southampton

Romanse is a project to develop a ROad MANagement System for Europe. It is deployed in Hampshire County in the United Kingdom. Visit **www.romanse.org.uk** for more information.

Romanse deploys urban congestion signs that use low-power radio and no commercial communications, which provide significant costs savings. Two radio stations broadcast from the Southampton TCC. To

Figure 65. Bus arrival information, Southampton.

Figure 66. Parking and traffic information (top) and bus information (bottom), Southampton.

provide private-sector access to the data, an Internet service provider linkage was created by mirroring the database outside the firewall. The data are provided for free and no license is required.

Romanse also provides substantial parking and transit information to its users.

According to the research conducted as part of the Romanse project, ITS should not be isolated, but it must be part of an integrated transport policy. Surveys related to urban congestion signs showed that satisfactory network improvement could be achieved with a 20 to 30 percent diversion. The public likes the signs, and 10 to 12 percent will divert on the basis of parking data provided. Greater than 80 percent of the public notices and uses the signs. The message on the sign is the key to usability.

Figure 67. Bus information, Southampton.

KEY FINDINGS

CUSTOMER NEEDS AND USAGE

Two findings were noted under customer needs and usage:

- The importance of providing journey time to the traveler is widely recognized, and there is a good understanding of the value of this information to the customer. The value of journey time information was found to be high.
- With regard to "511," no other national three-digit number was used; however, considerable data points were provided at several sites for call differentiation, duration, costs, impact of charging, etc.

INFORMATION CONTENT

Three findings were noted under information content:

- Automated parking information systems were available and operated in every city visited. Parking information systems are considered part of the traveler information environment and not as additional services.
- Short-term traveler information prediction for both transit and traffic are being pursued in several areas. "Next bus" and "next train" arrival information is available on systems. Short-term traffic condition forecasting is an EU research project, and some cities have developed their own algorithms based on current conditions using a 5-year archive.
- Significant emphasis is put on collecting and providing quality data as the foundation of a sound traveler information system. Sweden has developed specific data quality documentation to improve the data collection process. The data gap perceived in the United States also exists in Europe, and the need to address the gap was confirmed by the findings of this scan tour.

BUSINESS/COST RECOVERY MODELS

Several observations were noted about business/cost recovery models for traveler information systems:

- The state departments of transportation provide guidance on national policies on traveler information. National traveler information databases are generally being pursued and are under development.
- Several business models were of interest. Spain and Glasgow use a strong, public-sector model. Berlin and the U.K. Highway Agency's TCC and Munich are following strong public-private partnership models. Sweden allows for private-sector opportunities within its traveler information framework.
- Establishing a sustainable traveler information system requires integration of information. Multimodal and multiagency cooperation are critical for successful deployment of ATIS.

- Transportation service operator-based call centers are far more extensive than in the United States. Spain, Sweden, and especially the United Kingdom have extensive call center systems in operation.
- The delivery of in-vehicle information is much more prominent in Europe than in the United States. RDS-TMC and the TrafficMaster service provide traveler information to thousands of vehicles.
- As for the customer needs and use of “511,” Spain uses “012” as a general information number, with traffic information as a selection. No other national three-digit number was used; however, considerable data points were provided at several sites for call differentiation, duration, costs, impact of charging, etc., for toll-free and for-fee travel information telephone advisory services.
- Small-scale, innovative business models are tested in a discreet way, almost on a pilot project basis before being considered for larger deployment.

QUALITY MEASURES

The major finding with regard to quality measures is the commitment to measuring and improving the quality of traveler information collection and delivery. In most cases, the sites start with quantitative measures and then move (or plan to move) to qualitative measures. In particular, Sweden has developed specific data quality documentation to improve the data collection process.

TECHNOLOGY APPLICATIONS

There were multiple findings about technology applications:

- As observed by previous scan tours, the application of multiple colors and symbols on dynamic signs appears to improve message transfer and understanding among commuters. This technology should be researched for short-term application in the United States. Over and above the use of multicolor symbols on freeway DMS, further specific applications are being tested in Munich, including DMS to indicate traffic conditions along the ring road and map-type DMS to indicate travel time along alternative routes.
- As a result of the search for improved and expanded data collection, advanced detection techniques are pursued and tested at most sites. Examples include research and testing of technologies and techniques to use vehicles as probes or the use of video technologies to match vehicles. More work should be done in the United States to explore these techniques.
- Automated parking information systems were available and operating in every city visited.
- Real-time information delivery mechanisms are used extensively, from input to modeling for transportation planning purposes, to transit arrival time dissemination, and other applications.
- The delivery of in-vehicle information is prominent in Europe.

INTERNATIONAL/NATIONAL CONSISTENCY ISSUES AND STANDARDS

Specific findings applied to international/national consistency issues and standards:

- Standards conformance or development was not a major discussion point at any of the sites. There was an acknowledgment, however, of the need for and use of standards and of the work of various standards groups.
- The consistent use of multiple colors and symbols on dynamic signs appears to improve message transfer and understanding among commuters and warrants addressing in the United States.
- Establishing a sustainable traveler information system requires integration of information. A good example is the integrated auto/transit ATIS in Barcelona.
- The data gap perceived in the United States also exists in Europe, and findings of this scan tour confirmed the need to address this gap.

POLICY/INSTITUTIONAL/LEGAL ASPECTS

The following findings, some of which were mentioned earlier, also relate to policy/institutional/legal aspects:

- As can be expected, the traveler information policies varied by country, depending on the government (i.e., form of government—socialist, federal republic, etc.).
- National policies on traveler information exist as a model where the state department of transportation will provide guidance. A top-down approach is followed. National traveler information databases are generally being pursued and are under development.
- Establishing a sustainable traveler information system requires integration of information. A good example is the integrated auto/transit ATIS in Barcelona.
- The data gap also exists in Europe, and the scan tour findings confirm the need to address this gap.

RECOMMENDATIONS

The panel offers the following initial recommendations:

- The concept of “infostructure” is supported and reinforced by the scan team findings. Give infostructure greater priority and expand it locally to include historic, real-time, and predictive algorithms and data collection.
- Apply additional resources to close the data gap and improve the quality of traveler information.
- Incorporate the principle of traveler information into agency and corporate mission(s).
- Emphasize the institutionalization of traveler information within transportation management systems and organizations.
- Continue to pursue deployment of a national traveler information database that is comprehensive, multimodal, and sustainable.
- Monitor the deployment and progress of ongoing European projects.
- Increase the delivery of travel/journey time information systems. Deployment might need to be phased depending on research and technologies. An event to discuss methods to gather data supporting travel/journey times should be arranged within 1 year.

IMPLEMENTATION STRATEGY

A short-term implementation strategy is described below:

- Arrange an international conference on journey data and data collection techniques at the ITS World Congress in Chicago in October 2002. Estimated cost is $20,000.00.
- Establish a national transit timetable and schedule. Establish a steering committee for a future forum on national timetable and schedule information. The forum could be arranged possibly in cooperation (co-funding) with the I-95 Corridor Coalition or at the APTA meeting in July 2002. APTA might take the lead in steering committee matters. Tentative cost estimate for steering committee activities is $20,000.00.
- Invite three European experts to the “511” deployment launch in Phoenix, Arizona, in March 2002. Estimated cost is $15,000.00.
- Investigate the U.S. adoption of international symbols; initiate a pilot implementation and National Cooperative Highway Research Program/Transit Cooperative Research Program research.
- Investigate signage techniques, including innovative technology, colors, and symbols through research, pilot projects, new or revised standards, and inclusion in the *Manual on Uniform Traffic Control Devices*.
- Establish standards for quality and performance of travel information systems.
- Regional architectures development processes should explicitly address multimodal, integrated ATIS, and standards.

appendix a
AMPLIFYING QUESTIONS OF THE U.S. TRAVELER INFORMATION SYSTEMS PANEL

July 13, 2001

The panel's amplifying questions are categorized into the following seven focus areas:

* A: Customer needs and usage
* B: Information content
* C: Business/cost recovery models
* D: Quality measures
* E: Technology applications
* F: International/national consistency issues and standards
* G: Policy/institutional/legal aspects

The panel recognizes that not all of the questions will pertain to every organization it will visit in Europe; however, it hopes to attain an understanding of how transportation authorities in each country deal with all seven focus areas. The panel requests that the programs in each country devote approximately 50 percent of the time for meetings (to include ample time for discussions and dialogue) and approximately 50 percent of the time for site visits. For site visits, the panel has a high interest in locations that provide traveler information collection, fusion, dissemination, and/or operations services.

A: CUSTOMER NEEDS AND USAGE

A-1. How do you establish your customer needs for transit and highway traveler information? How do you establish usage needs? What data do the traveling public desire?

A-2. How do customers use traveler information to select or change modes of transport? Do you serve any other customers besides end consumers? What information is accessed the most (top five)?

A-3. Do your customers value route-based, travel time-related information more than just incident data? How do your customers see the value of real-time travel information?

A-4. How do you measure customer satisfaction with your traveler information, and how do you use that input to enhance your service? What barriers remain to a broader customer acceptance?

B: INFORMATION CONTENT

B-1. What modal traveler information is provided? Is the information real time, multimodal, and customizable? What data are shared between agencies and with the private sector? Are the data saved or archived, and if so, how is it used?

B-2. How do you provide access to motorist or emergency assistance in addition to traveler information?

B-3. What gaps have you identified in your data collection for traffic management and traveler information? What content is considered basic, “core” information for your systems? What information is considered optional? How do you expect this to change over time?

C: BUSINESS/COST RECOVERY MODELS

C-1. Please describe the traveler information business models/partnering that you use (e.g., fully private, public/private, fee-based, advertising, exclusive arrangements, etc.)? Which models have worked better than others? Does this vary depending on mode? How have agencies worked together to share development or operating costs?

C-2. How is your traveler information service marketed? How much is budgeted for marketing?

D: QUALITY MEASURES

D-1. What formal (or established) evaluation techniques or procedures do you use on your traveler information system? Which apply to the quality of data collection? What tolerances does your agency have for faulty and/or missing data?

D-2. Is information available 24 hours a day, 7 days a week, and is it time stamped? What specifications do you have related to updating of information and system coverage (e.g., how frequently is transit information updated, which roads are instrumented, etc.)?

E: TECHNOLOGY APPLICATIONS

E-1. What technologies do you use for gathering information about highways, traffic flow, transit, etc.? Please discuss the types of technology deployed and the frequency, spacing, etc., of the equipment. How do you plan to fill the gaps in your system coverage (for traffic, transit, etc.)?

E-2. What approach and technologies do you use to combine, or “fuse” the data? What technologies do you use to exchange information with other partners or other providers?

E-3. How do you provide traveler information to consumers or other agencies? How are dynamic message signs used for traveler information purposes? What percentage or number of users accesses your service via Internet versus the telephone? How does telematics and the use of personal wireless devices impact your system? How much does market acceptance for certain consumer electronics dictate what services that you provide?

E-4. How many telephone traveler information calls do you receive and what is the capacity of your system to handle the calls? What percentage of calls comes from landline and from cellular phones? Do you offer different tiers of services through the phone (i.e., basic, additional for fee)? What type of telephone interface do you provide and what is the average length of the call? How does your system use voice recognition techniques?

F: NATIONAL AND/OR INTERNATIONAL CONSISTENCY ISSUES AND STANDARDS

F-1. What technical standards does your system use? What regional, national, or international standardized messages does your system use?

F-2. Is your service available across country borders? How do you provide for multiple language capabilities? What other consistency issues are yet to be addressed, nationally or internationally?

F-3. What specific user interface guidelines did you develop for your traveler information system? How are the messages for telephone information constructed and are these shared directly with other media such as the Internet?

G: POLICY/INSTITUTIONAL/LEGAL ASPECTS

G-1. What issues related to privacy of your customers have you encountered?

G-2. What issues or requirements do you have related to conveying traveler information to those with disabilities?

G-3. What customer liability issues have you encountered? What about safety concerns of conveying traveler information, for example, driver distraction from using in-vehicle devices or cellular phones to access travel information?

appendix b
TEAM CONTACT INFORMATION AND BIOGRAPHIC SKETCHES

Bob Rupert (FHWA Co-Chair)
Technical Programs Coordinator
Office of Travel Management
FHWA HOTM
Room 3404
400 Seventh Street, SW
Washington, DC 20590
Tel: 202-366-2194
Fax: 202-366-8712
Email: robert.rupert@fhwa.dot.gov

Jim Wright (AASHTO Co-Chair)
Executive Director
Minnesota DOT
1500 W. County Road B-2
Roseville, MN 55113
Tel: 651-582-1349
Fax: 651-582-1302
Email: jim.wright@dot.state.mn.us

Pierre Pretorius (Report Facilitator)
Kimley-Horn and Associates, Inc.
7600 N. 15th Street, Suite 250
Phoenix, AZ 85020
Tel: 602-944-5500
Fax: 602-944-7423
Email: pierre.pretorius@kimley-horn.com

Greg Cook
Executive Director
Ann Arbor Transit
2700 South Industrial Highway
Ann Arbor, MI 48104
Tel: 734-677-3902
Fax: 734-973-6338
Email: gcook@theride.org

Kelly Hutchinson
ITS Operations Engineer
North Carolina DOT
Transportation Operations Center
Mail Service Center 1533
Raleigh, NC 27699-1533
Tel: 919-233-9331, Ext. 230
Fax: 919-852-0348
Email: khutchinson@dot.state.nc.us

William (Todd) Kell
ITS Division
Virginia DOT
1401 East Broad St.
Richmond, VA 23219
Tel: 804-786-2451
Fax: 804-786-9748
Email: kell_wt@vdot.state.va.us

Harry (Mac) Lister
ITS Technology Specialist
FHWA Midwestern Resource Center
19900 Governors Drive, Suite 301
Olympia Fields, IL 60461-1021
Tel: 708-283-3532
Fax: 708-283-3501
Email: Mac.Lister@fhwa.dot.gov

Mike Nevarez
Operations Manager
City of Phoenix Public Transit
302 North First Avenue, Suite 700
Phoenix, AZ 85003
Tel: 602-262-7303
Fax: 602-261-8838
Email: mike.nevarez@phoenix.gov

Louis Sanders
Director, Research & Technology
American Public Transportation Association
1666 K Street, NW
Washington, DC 20006
Tel: 202-496-4886
Fax: 202-496-4335
Email: lsanders@apta.com

Rick Schuman
Manager, Traveler Information Systems
PBS&J
482 South Keller Road
Orlando, FL 32810-6101
Tel: 407-647-7275, Ext. 142
Fax: 407-647-4281
Email: rickschuman@pbsj.com

Rich Taylor
Manager, Traveler Information &
Payment Systems
ITS America
400 Virginia Ave., SW, Suite 800
Washington, DC 20024-2730
Tel: 202-484-4669
Fax: 202-484-3483
Email: rtaylor@itsa.org

Jake Almborg (ATI, Inc. Delegation
Coordinator)
ATI, Inc.
3 Fairfield Court
Stafford, VA 22554-1716
Tel: 540-288-9700
Fax: 540-288-9423
Email: j.almborg@gte.net

Bob Rupert, Co-Chair, is the Technical Programs Coordinator for the Operations Office of Travel Management in the headquarters of the U.S. Federal Highway Administration (FHWA) in Washington, DC. Mr. Rupert currently manages the traveler information program and, as such, serves as the "511 Traveler Information Telephone" program manager for the FHWA. Previously, Mr. Rupert was the project manager for the TravTek operational test of in-vehicle navigation in Orlando, Florida, as well as program manager for several other intelligent transportation systems (ITS) projects dealing with traveler information. Mr. Rupert is a civil engineering graduate of Washington University in St. Louis, Missouri. He is a member of the Institute of Transportation Engineers (ITE) and serves as the secretary for the Advanced Traveler Information Systems committee of the Intelligent Transportation Society of America (ITS America).

Jim Wright, Co-Chair, is currently the 511 Director for the American Association of State Highway and Transportation Officials (AASHTO). He is on loan from the Minnesota Department of Transportation (MnDOT). As 511 Director, Mr. Wright directs the national 511 program in partnership with other transportation associations and organizations. Prior to 511 he managed the MnDOT's ITS program called Minnesota Guidestar. From 1991 to 2001 he planned and implemented $100 million in ITS work, including several traveler information systems. His education includes a bachelor's degree in civil engineering from the University of Minnesota and a master's degree in civil engineering from the University of California Berkeley. He is a registered engineer in Minnesota. Mr. Wright is the vice chair of the ITS America Coordinating Council, the English-speaking secretary for PIARC's C16 Committee on Network Operations, chair of the ITE Traffic Management Data Dictionary standards development organization, and a member of several committees for ITS America and the ITE.

Greg Cook is the Executive Director/CEO of the Ann Arbor Transportation Authority (The Ride) in Ann Arbor, Michigan. The Ride has operated with an advanced operating system since May 1997 consisting of an AVL/GPS, mobile display terminals with real-time information between buses and dispatch and the public, video surveillance, automatic passenger counters, and internal and external digital voice annunciation. His current involvement as chair of the Advanced Public Transportation Systems Committee (a joint committee of ITS America and the American Public Transportation Association [APTA]) and work with the 511 Policy Committee peaks his interest in this scanning tour. Mr. Cook is a graduate of The Ohio State University with a degree in urban planning. He also serves on technical committees of the Transportation Research Board (TRB) and APTA.

Kelly Hutchinson is the State Intelligent Transportation Systems (ITS) Operations Engineer for the North Carolina DOT (NCDOT) in Raleigh, North Carolina. In this position she is responsible for operations of the State's ITS program, with a focus on traveler information. As a part of this function she created and operates a traveler information website for NCDOT and is responsible for developing North Carolina's 511 system. She also coordinates the use of the State's ITS infrastructure in response to regional or statewide transportation incidents. Ms. Hutchinson was previously the State Incident Management Engineer for NCDOT and prior to that spent 8 years with the FHWA where she was involved in many aspects of highway engineering. Ms. Hutchinson is a graduate of the George Washington University and holds a bachelor of science degree in civil engineering. She is a registered professional engineer in two States.

Todd Kell is a Senior Policy Analyst and ITS Project Manager for the Virginia DOT (VDOT) in Richmond, Virginia. Mr. Kell currently directs the three advanced traveler information system (ATIS) projects across the State, and is leading VDOT's effort to implement and deploy 511 as a statewide service. He is responsible for developing ITS-related policies, as well as fostering and managing public-private partnerships. Before joining VDOT in 1999, he served as a Senior Transportation Planner at TransCore—a transportation planning and engineering consulting firm. Mr. Kell is a graduate of James Madison University and holds a master's degree in city planning with a specialization in transportation from the Georgia Institute of Technology. He serves on the ITS Virginia Board of Directors and is recognized as a certified planner by the American Institute of Certified Planners (AICP).

Harry (Mac) Lister is an ITS Specialist for the FHWA at the Midwestern Resource Center in Chicago, Illinois. Mr. Lister currently gives technical support to the FHWA field staff and local stakeholders and implementers of ITS projects. His current emphasis is in the area of the national ITS Architecture and Standards Program and traveler information systems, including implementations of 511 traveler information phone systems. Prior to joining the FHWA in 1996 he worked in the field of computer information systems for 30 years in various capacities, including for 12 years as the Information Systems Manager for a public transit agency. Mr. Lister is a graduate of Wayne State University and holds a master's degree in business administration from the University of Michigan. He serves on several committees for ITS America and the TRB and is a member of the Working Group for the 511 National Deployment Coordination Program led by AASHTO.

Mike Nevarez is the Transit Operations Manager for the City of Phoenix Public Transit Department and is responsible for the direction and oversight of private firms providing regional transit, known as Valley Metro. He has been instrumental in guiding the implementation of ITS projects in Valley Metro. Notable projects include Bus Card Plus, the first postpayment transit pass, the acceptance of MasterCard and Visa on buses, and the introduction of digital video recorders on buses. Mr. Nevarez was responsible for the transit element of the award-winning AZTech Model Deployment Initiative, which relies on GPS/AVL to provide advanced traveler information. He is a member of the national Advanced Public Transportation Systems Stakeholders forum created by the Federal Transit Administration, APTA and ITS America, and serves on the national 511 Deployment Working Group sponsored by AASHTO, APTA and ITS America. Mr. Nevarez holds a bachelor's degree in business and economics from Regis University. He is Vice President of the Arizona Transit Association and Treasurer for the Arizona Chapter of ITS America.

Pierre Pretorius, P.E., is an ITS Project Manager for Kimley-Horn and Associates, Inc., Consulting Engineers in the western regional office in Phoenix, Arizona. Mr. Pretorius currently serves as Chair of the ITS America ATIS Committee, vice chair for the AASHTO/FHWA 511 Traveler Information Working Group, and as a member of the ITS America Coordinating Council. He acts as Technical Advisor for ITS America and several ATIS projects in the western United States, including TravInfo in the San Francisco Bay Area, AZTech in Arizona, FAST in Nevada, and the Statewide ATIS deployment in Oregon. Previously, Mr. Pretorius was the program manager for the award-winning AZTech Model Deployment Initiative in Phoenix, Arizona. He is project manager for several other ITS projects. Mr. Pretorius is a transportation engineering graduate of the University of Pretoria, South Africa. He is a member of the ITE.

Louis Sanders is the Director of Research and Technology for the APTA representing the major public transportation operators in North America and elsewhere as well as the supporting industry worldwide. He is APTA's Coordinator for ITS activities and functions as staff advisor to the joint APTA/ITS Advanced Public Transit Systems Committee. He also serves on the ITS America Coordinating Council. Mr. Sanders's experience includes research, design/development, manufacturing, and implementation of advanced systems for ground transportation applications. He holds a bachelor of science degree in electrical engineering from Johns Hopkins University and a master of science degree in management science from George Washington University. He serves as executive director of APTA's private research organization, the Transit Development Corporation, and is active in the Institute of Electronics and Electrical Engineers, ITE, and TRB. He also serves on the advisory boards of the National Transit Institute at Rutgers University and the Center for Urban Transportation Research at the University of South Florida.

Rick Schuman is the Manager of Traveler Information System for PBS&J, an international engineering firm. Mr. Schuman is based in Orlando, Florida, and currently manages consulting projects in the areas of traveler information and ITS data collection planning and implementation for clients including the U.S. Department of Transportation, ITS America, AASHTO, Florida DOT, and Arizona DOT. His current emphasis is innovative data collection, ITS business models, and

511 service definition and delivery. Before joining PBS&J in 1999, Mr. Schuman served as the Director of System Applications at ITS America. Mr. Schuman holds a bachelor's degree in electrical engineering from Boston University and a master's degree in systems engineering from George Mason University. Mr. Schuman is active on several committees of ITS America, including the ATIS Committee.

Rich Taylor is Manager, Traveler Information and Payment Systems, for ITS America in Washington, DC. Mr. Taylor manages the traveler information and electronic payment systems programs, including assisting with ITS America's role in the development of the 511 traveler information number and with traveler information-related telematics initiatives. Previously, Mr. Taylor was an ITS Designer with Wilbur Smith Associates, where he assisted in the planning, design, and implementation of numerous ITS projects. These projects included the design of the Orlando International Airport Roadway Information System as well as transit-related information signage for the Chicago Regional Transportation Authority, both of which featured dynamic message signs. Mr. Taylor also served as a Research Scientist with the VDOT from 1993 to 1997 where he was involved in ITS planning activities, including an evaluation of the Federal ITS planning process. Mr. Taylor holds a bachelor's degree in city planning, a master's degree in planning, and a master of science degree in civil engineering from the University of Virginia. Mr. Taylor is active in the Society of Automotive Engineers ATIS Standards Committee and the National Transportation Communications for ITS Protocol (NTCIP) DMS Working Group. He also is a member of the ITE and the American Planning Association.

appendix c
WEBSITES REFERENCED

Web Address	Agency/Organization	Page Ref.
www.cities.munimadrid.es/mapatraficovi.asp	Madrid traffic website	5
www.ctm-madrid.es	Madrid public transit information	7
www.dgt.es	General Traffic Authority website, Spain	9
www.gencat.es/transit	CIVICAT, Barcelona	11
www.bcn.es/infotransit	City of Barcelona traveler information	17
muc.ssp-consult.de or www.bayerninfo.de	BayernInfo	25
www.bahn.de or www.bus-und-bahn.de	Berlin transport info	30
www.vmzberlin.de	VMZ Berlin travel info	37
www.trafiken.nu	SNRA website, Swedish National Road Administration	39
www.vv.se	National Traffic Information system/database (TRISS)	42
www.tmcforum.com or www.vv.se/tmc	RDS-TMC service	44
www.nadics.org.uk	NADICS website	54
www.dtlr.gov.uk/itwp/transdirect/travinfo/index.htm	Transport Direct	59
www.traveline.co.uk	Traveline website	60
www.thetrainline.com	U.K. booking site	60
www.tih.org.uk	Travel Information Highway	61
www.smartnav.net	SmartNav website	65
www.romanse.org.uk	Romanse is a project to develop a ROad MANagement System for Europe	65