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**International Transit Studies Program**

Report on the Fall 2001 Mission

**Emerging Trends in European Public Transport**

*This TCRP digest summarizes the mission performed October 12–27, 2001, under TCRP Project J-3, “International Transit Studies Program.” The digest includes transportation information on the cities and facilities visited, lessons learned, and discussions of policies and practices that could be applied in the United States.*

*This digest was prepared by Kathryn Harrington-Hughes of the Eno Transportation Foundation and is based on reports filed by the mission participants.*

**INTERNATIONAL TRANSIT STUDIES PROGRAM**

**About the Program**

The International Transit Studies Program (ITSP) is part of the Transit Cooperative Research Program (TCRP). ITSP is managed by the Eno Transportation Foundation under contract to the National Academies. TCRP was authorized by the Intermodal Surface Transportation Efficiency Act of 1991 and reauthorized in 1998 by the Transportation Equity Act for the 21st Century. It is governed by a memorandum of agreement signed by the National Academies, acting through its Transportation Research Board (TRB); by the Transit Development Corporation, which is the education and research arm of the American Public Transportation Association (APTA); and by the Federal Transit Administration (FTA). TCRP is managed by TRB and funded annually by a grant from FTA.

ISTP is designed to assist in the professional development of transit managers, public officials, planners, and others charged with public transportation responsibilities in the United States. The program accomplishes this objective by providing opportunities for participants to learn from foreign experience while expanding their network of do-

mestic and international contacts for addressing public transport problems and issues.

The program arranges for teams of public transportation professionals to visit exemplary transit operations in other countries. Each study mission focuses on a theme that encompasses issues of concern in public transportation. Cities and transit systems to be visited are selected on the basis of their ability to demonstrate new ideas or unique approaches to handling public transportation challenges reflected in the study mission’s theme. Each study team begins with a briefing before departing on an intensive, professionally stimulating 2-week mission, after which they return home with ideas for possible application in their own communities. Team members are encouraged to share their international experience and findings with peers in the public transportation community throughout the United States. Study mission experience also helps to better evaluate current and proposed transit improvements and can serve to identify potential public transportation research topics.

Study missions normally are conducted in the spring and fall of each year. Study teams consist of up to 15 individuals, including a senior official designated as the group’s spokesperson. Transit properties are contacted directly and requested to

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nominate candidates for participation. Nominees are screened by a committee of transit officials, and the TCRP Project J-3 Oversight Panel endorses the selection.

Study mission participants are transit management personnel with substantial knowledge and experience in transit activities. Participants must demonstrate potential for advancement to higher levels of public transportation responsibilities. Other selection criteria include current responsibilities, career objectives, and the probable professional development value of the mission for the participant and sponsoring employer. Travel expenses for participants are paid through TCRP Project J-3 funding.

For further information about the study missions, contact Gwen Chisholm-Smith at TCRP (202-334-3246; gsmith@nas.edu) or Kathryn Harrington-Hughes at the Eno Transportation Foundation (202-879-4718; khh@enotrans.com).

### **About this Digest**

The following digest is an overview of the mission that investigated emerging trends in European public transport. It is based on individual reports provided by the team members (for a listing of team members, see Appendix A), and it reflects the views of the team members, who are responsible for the facts and accuracy of the data presented. The digest does not necessarily reflect the views of TCRP, TRB, the National Academies, APTA, FTA, or the Eno Transportation Foundation.

### **EMERGING TRENDS IN EUROPEAN PUBLIC TRANSPORT: MISSION 15, OCTOBER 12–27, 2001**

The theme of this study mission was “Emerging Trends in European Public Transport,” with a focus on innovative ways of doing business. The team members were particularly interested in policy and management innovations that might have application in the United States. These innovations included ways of increasing market share by attracting—and retaining—new riders, using new means of tendering and contracting for services (such as public-private partnerships), integrating regional transit planning, improving service quality, ensuring travel and personal security, developing and sustaining effective customer service and passenger information systems, and serving travelers with special needs.

The study team members met with public agency and private company staff in Gothenburg and Jonkoping, Sweden; Zurich, Zug, and Lucerne, Switzerland; and London, Birmingham, and Hampshire County, England. For a listing of host agencies, see Appendix B.

## **TRANSIT SYSTEMS STUDIED—OVERVIEW**

### **Sweden**

#### *Gothenburg*

The greater Gothenburg area has 850,000 inhabitants, making it Sweden’s second largest city after Stockholm (the city itself has a population of 500,000). Gothenburg lies at the center of Scandinavia (which consists of Denmark, Finland, Iceland, Norway, and Sweden), and 50% of Scandinavia’s industry lies within a 190-mi radius of Gothenburg. The port of Gothenburg is the largest in Scandinavia, with more than 12,000 ships and 4 million ferry passengers arriving annually. Gothenburg Landvetter International Airport, where 22 airlines offer 115 departures daily, handles 3.9 million passengers annually.

Gothenburg has a well-developed, functional road, rail, bus, and tram network. The city has a well-deserved reputation for innovation in public transportation. The city has its own Traffic and Public Transport Committee, which is responsible for all traffic in the city. It coordinates public transport services, road traffic, and the management of the city’s roads, streets, and tramlines.

A canal system was constructed in the city in the seventeenth century to serve as a means of transportation and defense. Most of those canals have since been filled in. The Centralstationen, built in 1858 and renovated in the early 1990s, is the oldest railway station in Sweden.

Vasttrafik AB, founded in 1999, is the county authority responsible for public transport in the Västra Götaland region, which includes the city of Gothenburg. More than 600,000 trips are provided each day by five major and several smaller contract operators, using buses and trams in the city of Gothenburg, regional buses, ferries, and trains.

The light rail system is operated by Goteborgs Sparvagar AB, which is owned by the city of Gothenburg. The city’s blue trams first went into service in 1879, when they were pulled by horses. The Public Transport Ring, now under construction, consists of a number of new links that form a ring around the city center. Construction is underway and required the relocation of 2,000 rare snails that were found at one of the tunnel entrances. Two of the new links became operational in early 2002. Forty new Sirio low-floor light rail vehicles have been ordered; the vehicles have a capacity of 83 seated passengers and 96 standing passengers. A new digital communications system—TETRA (Terrestrial Trunked Radio)—is on order, which will also be used to track vehicle locations for the KomFram real-time system.

The bus services are provided by several operators. Retaining experienced drivers is difficult, particularly once a contract is lost (20% of the drivers choose a new means of livelihood if their company’s contract is not renewed). Vasttrafik is thus now involved in helping to educate new bus drivers, which is customarily the task of the operating companies.

Since 1967, Gothenburg has provided a special transport service for senior passengers and passengers with disabilities. The service uses 80 special minibuses from 8 different operators and 175 contracted taxis. The taxis are dispatched with the help of a computer-based system. Approximately 7,000 passengers use the services each day (about one-third of those eligible). A demand-responsive transport system for seniors and people with disabilities is now being tested to see if it can reduce the cost without reducing the quality and efficiency of the system.

### *Jonkoping*

Jonkoping, located at the southern end of Vattern lake about 92 mi from Gothenburg, is a popular tourist destination. It lies in the densely forested, sparsely populated region of Smaland. The town was chartered in the thirteenth century and today has a population of about 117,000, making it one of the 10 largest cities in Sweden.

Five years ago, Jonkoping launched a new transport system featuring a bus rapid transit system on two main routes. The intent was to reverse a steady decline in ridership and growing farebox deficits by planning a system with the efficiency of trams and the inexpensive cost of buses. The result of this plan was a rapid bus transit system with dedicated right-of-way, unobstructed routes, shelters at stops, and other efficiency measures. Jonkoping managers refer to this approach of incorporating the advantages of trams into the bus system as “think tram, use buses.” In the first 2 years of the rapid bus transit system’s operation, transport ridership rose more than 10% and revenues doubled. Public transport’s modal share is now 22% (up from 19%).

## **Switzerland**

### *Zurich*

Zurich is Switzerland’s largest city, with a population of 380,000. It is situated on the northern end of Lake Zurich, and the Limmat River runs through the city.

Tram service was first established in Zurich in 1864, when the trams were powered by horses. In 1893, a company began electric streetcar service to the higher-lying suburbs of Zurich. The municipality of Zurich took over that service in 1896 and established the first community tram network in Europe—the Zurich City Tram Company. The horse-drawn line merged with City Tram Company in 1897, and it was converted to a meter-gauge electric network in 1900. The next two decades saw many new tram routes and companies serving the city and surrounding areas. In 1950, the Zurich City Tram Company was renamed the Verkehrsbetriebe der Stadt Zurich (Zurich Public Transport, or VBZ), and in 1978 it was renamed Verkehrsbetriebe Zurich (the public transport company for Zurich). Today, VBZ operates streetcars of varying sizes, types, and vintages, as well as the bus network (Zuri Linie) within the city.

In 1962 and 1973, Zurich’s citizens voted down the construction of a subway. In 1975, Zurich’s parliament passed a resolution reasserting that priority should be given to public transport. Since then, the authorities have focused their efforts on improving the existing transit network of trams, trolleys, and diesel buses. The Zurich city council reinforced those measures when the country adopted national policies to protect people from noise and to protect the environment by maintaining good air quality. The Zurich authorities aim to reduce the use of cars and improve the quality of urban life through attractive public transport, and they have set a goal of having a tramway stop within 300 m of all city residents.

The Swiss have concluded that what matters most is reliability—the trams must run on time. Ultrasound beacons at intersections monitor passing trams and send the control center accurate information as to a tram’s location; the center can then instruct the tram operator to speed up or slow down. Trams run at 6-min intervals.

For more than 30 years, Zurich has had a transit-first approach to traffic management. More than 90% of intersections are equipped with sensors that detect approaching transit vehicles and give priority to them, creating “green waves.”

### *Lucerne*

Lucerne, lying on the western edge of Lake Lucerne, about 1 h from Zurich, is one of the main tourist destinations in Switzerland. Its Transport Museum receives more visitors per year than any other Swiss museum.

Lucerne is also home to Mobility CarSharing, the largest such organization in Europe. By making a fleet of cars available 24 h per day, the company encourages people to use transit, secure in the knowledge that a car will be available at a reasonable cost when and where they need one. Working with public transit organizations and other business, Mobility CarSharing develops mobility management packages. For example, its “zuri mobil” package allows customers to take a second person along with them on public transit at no extra charge; it also gives the customer lower rates and preferred status for traditional car rentals, as well as access to more than 450 shared-use vehicles at 220 stations in Zurich.

A daughter company, Mobility Support SA, is responsible for transferring Mobility know-how to other countries.

### *Zug*

The town of Zug, with a population of 22,000, lies in the richest canton (also named Zug) in Switzerland and is home to many multinational companies. The town is planning an urban railway—a hybrid tram and regional rail link. The objective is to develop an integrated transport chain, cutting connection times for service over a wide area.

Public transport in the canton of Zug includes a mature

commuter rail system and a new light rail system operating by contract, with the light rail vehicles provided by the municipality.

## England

Public transport is taking on new importance in the United Kingdom since the British government ended new road building. An estimated \$276 billion is expected to be invested in public transport over the next 10 years.

The move toward privatization of England's public transport services has its roots in the economic problems of the 1970s, but only after Margaret Thatcher became Prime Minister in 1979 did privatization of transport (and other) services take off. England's track record is still mixed, however. In mid 2001, the government shut down Railtrack, the company that owns and operates Britain's railway infrastructure—the tracks, signals, tunnels, bridges, viaducts, level crossings, and stations. The government now plans to turn Railtrack into a nonprofit trust. The government is, however, moving ahead with plans for a public-private partnership (PPP) for the London Underground, in which a private company will assume responsibility for operating the track and stations for a 30-year period, despite opposition from the mayor of London and Transport for London (TfL), which believes that the government's proposal for the Underground PPP is less safe, is more costly, and will be slower in delivering improvements than alternative proposals from TfL.

The Strategic Rail Authority (SRA), formed in February 2001, is charged with promoting and developing Britain's rail network and encouraging integration—in short, creating a “bigger, better, safer” railway. SRA provides overall strategic direction for Britain's railways and is responsible for letting and managing passenger rail franchises. SRA is currently involved in replacing all the passenger rail franchises that are due to expire in 2004 with longer (20-year) contracts, which will give train operators greater incentive to invest in the system.

The Association of Train Operating Companies (ATOC) was established by the train operating companies formed during the privatization of the railways under the Railways Act of 1993. With 26 member companies, ATOC is the official voice of the passenger rail industry. One of the association's key responsibilities is allocating the revenues received from ticket sales to the train operators.

## London

Greater London encompasses 1,580 sq km of southeast England and houses a population of 12 million. It is one of the world's major financial centers and Europe's richest city. The Thames River runs west to east through the city. The area suffers from severe traffic congestion (11 million car trips are made in London every day) and associated poor air quality.

In May 2000, Londoners reinstalled a citywide council,

headed by a mayor (Ken Livingstone). The mayor presides over an assembly of two dozen or so members governing transport, economic development, strategic planning, police, fire services, civil defense, environment, and cultural matters. One of the mayor's first acts was to publish a draft transport strategy, which sets the framework for integrating all elements of London's transport system.

Transport for London (TfL), an executive arm of the Greater London Authority (GLA), reports to the mayor. TfL is responsible for most transport in London, in accordance with the mayor's transport strategy. In June 2000, TfL assumed responsibility for all of the services previously provided by London Transport, except for London Underground. The Underground will remain with London Transport, responsible to the Secretary of State (central government), until the proposed PPP is in place, at which time responsibility for the Underground will be transferred to TfL.

London Underground (known informally as the “Tube”), is a wholly owned subsidiary of London Transport. It carries 3 million passenger trips each day, serving 275 stations over 253 mi of track. The Underground is attempting to establish a PPP, in accordance with the central government's March 1998 call for long-term, sustained levels of investment in the system. Under the plan, private companies would be contracted to renew and upgrade the Underground's infrastructure over a 30-year period. Responsibility for driving the trains and staffing the stations would remain with the public sector (currently London Transport, but eventually TfL).

London Buses manages bus services in London—planning routes, specifying service levels, and monitoring service quality. It is also responsible for bus stations and stops and other support services. The buses are operated by private companies under contract to London Buses. More than 4 million journeys are made on London's buses each weekday. Ridership increased by 3% in 2000—the highest increase since 1978.

Two-thirds of London's 17,000 bus stops have shelters. Automatic vehicle location (AVL) technologies are being used to improve the reliability of the system; by 2002, all 6,500 buses will be outfitted with the AVL system.

The mayor's transport strategy includes a BusPlus initiative, which would bring new bus lanes, cleaner buses, real-time schedule information, and bus-priority traffic signals.

The London Transport Users Committee, established in July 2001, assists customers with concerns about transport in London. It works with transport operators and regulators to ensure that the consumer's voice is heard.

## Hampshire County

Hampshire County, about an hour southwest of London, has a population of 1.5 million, making it one of the largest nonmetropolitan counties in England. In general, it is a wealthy area, with a current unemployment rate of less than 2%. Car ownership rates are high. The county has grown

dramatically in population since the 1950s. Over the past 10 years, road traffic in Hampshire has grown at an alarming rate. By 2020, 57% of the road network will probably be over capacity and there will probably be one car for every two people in the county. There is development pressure in Hampshire County, as well. The central government has allocated 131,000 new housing units to be built in Hampshire County by 2016.

A key element of the county's transport plan is bus quality partnerships, which encourage joint cooperation between local authorities and operators in promoting and improving bus service. The quality partnerships are aimed at developing a network of rapid, high-quality services that can attract new users; developing this network will require new marketing strategies and a higher level of integration (such as intermodal ticketing across a broad area and improved traveler information systems).

Quality partnerships are being promoted by the British Government's Department for Transport (formerly the Department of Transport, Local Government, and the Regions), which believes that such partnerships can "point the way forward in effective, successful promotion of bus travel" in rural and urban areas.

### *Birmingham*

Birmingham, with a population of 1 million, is England's second largest city. Located about 110 mi north of London, Birmingham's primary industries are bicycle and automobile manufacturing. Approximately 6 million people live within a 50-mi radius of the city.

Travel West Midlands, which serves the Birmingham area, is Britain's largest urban bus network outside London, carrying more than 1 million passengers each day on more than 1,800 vehicles across 450 bus routes. Travel West Midlands faces competition from 50 other private bus operators in the area, but it has captured 83% of the market. Ninety percent of its operations are funded from the farebox.

Travel West Midlands (formerly West Midlands Travel) was established as a company in 1986, following the 1986 Transport Act and deregulation of bus services in the United Kingdom. The company was a private limited company whose sole shareholder was the West Midlands Passenger Transport Authority. In 1991, the company was sold to its employees in the form of a 100% employee stock ownership plan, the first of its kind in Britain. Travel West Midlands is still distributing shares to employees, and today 90% of its employees are shareholders, giving the company a strong customer-service orientation.

Travel West Midlands is now a commercial operation completely independent of government or local authority grant or subsidy. In April 1995, the company merged with National Express Group, a public limited company listed on the Stock Exchange. The company has 11 garages in the West Midlands region and employs more than 4,000 people (3,300 of whom are bus drivers).

Travel West Midlands also operates the 2-year-old, 12-mi-long Midland Metro, the state-of-the-art tram link between Birmingham and Wolverhampton (the first street tramway to run in West Midlands in 40 years). (ALTRAM, a consortium that includes Travel West Midlands, won the concession to operate the tramway for the first 20 years, under a design-build-operate-maintain contract.) Each electric tram has 56 seats and can carry up to 152 passengers, with space for two wheelchairs.

## **PUBLIC POLICIES SUPPORTING PUBLIC TRANSPORTATION**

### **Sweden**

#### *Gothenburg*

Enhancing mobility is a key objective of the government and businesses in Gothenburg (and West Sweden). Public transport facilities and services must be of such a high standard that the citizens of Gothenburg will be able to choose where they want to live with the assurance that they will have a reasonably quick and simple means of reaching their work place and necessary services by public transportation.

Swedish national law requires that every province provide public transportation. There are two ways for public transportation to be owned. Either the province owns it wholly (as in Stockholm), or the province and municipalities own it equally (as in Gothenburg). The legal responsibility for public transportation in Gothenburg is thus shared by the county councils and the municipalities through the formation of public transport authorities. These authorities decide on the level of service, plan the services and timetables, and set both local and regional fares for all modes of public transportation.

Vasttrafik is the regional and local authority for public transport in Gothenburg. Vasttrafik, formed through a merger of five regional organizations in January 1999, is responsible for all public transportation (buses, trams, regional trains, and ferries) in the west Sweden region, including network planning, service standards, finance, and fare policy. Vasttrafik also purchases transit services through competitive tenders. Fifty percent of all trips in Gothenburg are made by public transport, bicycle, or walking.

Sweden, along with other Scandinavian countries, has undertaken national public transportation policy reforms over the past 15 years. One of the main thrusts of the reforms has been to reduce unit operating costs of services by contracting out (i.e., tendering) services through a competitive bidding process. The results in Gothenburg include lower unit operating costs, improved quality of the bus fleet, and improved customer satisfaction.

There are 35 bus routes and 30 special bus services in Gothenburg, all of which are contracted out in a deliberate, closely managed manner. Standards are employed in the ten-

dering process to consider quality and age of buses, driver performance, reliability of service, and bidder's managerial competence. Vasttrafik is responsible for policy, financing, marketing, tenders (i.e., bids), and contract supervision. Vasttrafik prepares tenders, awards contracts on the basis of quality and price, and supervises and evaluates the contractors' performance under the terms of the agreements. Vasttrafik retains strict service standards and fare policy supervision. The contracts cover 5 years, with an option for another 5 years. The companies that are awarded contracts hire and employ the drivers and other operational staff.

Farebox recovery has climbed since competitive tendering was instituted. The main result of the first bus tender in the city in 1992–1993 was a 50% cost reduction (despite the higher quality of service offered). In the most recent tender, evaluation was based 55% on quality and 45% on price. Tendering has resulted in a considerable reduction in the age of the bus fleet and an increase in environmental quality. The operators have to devise a mixture of different types of buses in their fleet for each contract in order to fulfill the age-of-bus requirement and to meet tough environmental requirements related to nitrogen oxides (NO<sub>x</sub>) and particles. The contracts now have quality requirements, and Vasttrafik is considering quality incentives for future contracts.

Decentralized responsibility for planning and management of regional public transport services makes it difficult for regional public transit authorities to achieve economies of scale in procurement and operation of train services. Investing in new trains is a major financial undertaking. It is unrealistic to expect operators, who have only a several-year-long contract, to invest in new rolling stock with a service life of up to 30 years. As a result, the Swedish public transport authorities, including Vasttrafik, took a new approach to the supply of rolling stock. They formed a company, AB Transitio, that is completely owned by the public transport authorities. Transitio funds and procures the necessary rolling stock and provides for its maintenance; it then hires the rolling stock out to contract operators or regional transport authorities. Vasttrafik and other authorities hope that this new way of financing vehicles will lead to economies of scale that will, in turn, reduce the costs of regional rail services.

In addition to its bus, regional rail, and ferry services, Gothenburg has a light rail system that is accorded intersection priority. Trams run on nine different routes along a well-designed, well-managed system on nearly all major arteries.

The Gothenburg Agreement is a large investment package with national grants of \$500 million, of which 75% will be paid by the national government and 25% by the city. All projects have to start before the year 2003. The agreement will result in the largest expansion of light rail ever. The most important project for public transport in the agreement is the Public Transport Ring, the building of a number of new links for the light rail system that forms a ring around the city center. The circular tracks, however, will not carry a

circular tram service. Rather, the idea is that many tramlines will each make use of the circle, but none will become exclusively a circular line. It is hoped that the new public transport ring around central Gothenburg will greatly increase the tram's attractiveness as a means of transport. The city's efforts to encourage more people to take public transport have resulted in a doubling of the number of journeys by public transportation in the Gothenburg region over the past 35 years.

Purchase of 40 new light rail vehicles for \$87 million is also part of the agreement. The tender documents for the vehicles gave functional specifications from the passenger's point of view and the operator's point of view. Much attention was paid to aesthetics. The specification called for a well-designed, spacious-looking tram, which would harmonize with Gothenburg's attractive cityscape. Trams are seen as an enrichment of the visual quality of this clean, almost graffiti-free city.

In January 2002, two additional tramlines are scheduled to start operating over existing tracks, bringing the system's total to 11 lines. There are plans for a twelfth route to be introduced in 2003. All routes have individual color combinations for easy recognition by passengers.

Gothenburg early on made a commitment to traffic restriction in the central business district (CBD) in order to preserve the historical and delicate character of downtown. The city government instituted a pedestrian-only zone. As stated by Ragnar Domstad, Vasttrafik's development director, "In Gothenburg, the pedestrian is king." It is Gothenburg's policy that pedestrians, cyclists, buses, and trams be given priority over cars in the city center in order to improve the quality of life in the city and to enable a living city center.

Even though overall traffic levels in the Gothenburg area are increasing, the number of automobiles in the CBD is the same as it was 15 years ago. Motorists can circle the CBD by car, but they are not allowed to travel through the CBD; they must turn right at the central intersection in the CBD. Limited parking is still available in the CBD, but it is very expensive. These measures have helped to ensure a living city center and have yielded benefits to the environment.

The city's policy of priority for public transportation has primarily meant trams. Trams always have the right of way; if there is a crash involving a tram and a car, the driver of the car is assumed to be at fault. Dedicated bus lanes provide commuters with fast and easy access to the city center, where they can then hop on the tram if necessary.

The hundreds of bicycles parked along the streets provide ample evidence that the bicycle is a significant factor in Gothenburg citizens' daily commute (even in cold weather).

In Gothenburg, there is a notable orientation to seeing things from the passenger's point of view. Reliability and speed are uppermost concerns. A service attitude by staff and the feeling of security are important to customers. A single fare structure governs the entire province of West

Sweden, with the cost of monthly passes set by each municipality in the county.

Vasttrafik and the city of Gothenburg strive for the best travel service for passengers, regardless of mode. Vasttrafik does not refer to bus terminals, but rather to *passenger* terminals. Drivers don't drive buses; they drive passengers. System managers believe that passengers must be in control of their traveling situation, with real-time information, during normal operations as well as during disruptions of service.

In designing its public transportation system, Gothenburg did not start with technical requirements; it started with passenger requirements. Overall, there is an emphasis on traveling, not on traffic.

Public transport managers in Gothenburg believe that public agencies should operate using sound business principles. Strategic analysis and a business plan are absolutely crucial. Gothenburg Tramways now has 204 trams and 1,900 employees, down from a high of 3,000 employees. As the company shifted from a monopolistic situation to that of open competition, it became more business oriented, incorporating new organization principles and concentrating on basic operations to increase productivity.

Vasttrafik, with 135 employees, is owned 50% by the county and 50% by the municipalities within the province. Farebox recovery has steadily climbed since competitive tendering was instituted, and today farebox receipts cover 56% of the operating costs; Vasttrafik covers the remaining 44%. The 44% of the cost that is paid by the 50 Vasttrafik owners comes out of the general fund—that is, from revenues collected by the city tax (i.e., general tax revenue).

Vasttrafik owns the bus terminals; the municipality owns the ground under them. The operators (on contract) own the buses and the ferries. The trams are leased.

Swedish national policy states that provinces must provide transportation for people with disabilities in a way that ensures mobility and that is comparable in price to other transportation services. In Gothenburg, high-quality, demand-responsive service is provided by the city's own Special Transport Services (STS).

### *Jonkoping*

Ninety-two miles (150 km) north of Gothenburg lies Jonkoping, a city of 117,000 residents. The city is situated with a lake at one end and a narrow valley at the other end. Jonkoping Lanstrafik AB, the county transport authority, is governed by a nonpolitical, seven-member board. Lanstrafik is owned 50% by the county council and 50% by the municipalities. It provides 16.5 million trips per year, of which just under 1 million are by train. A total of 250 buses run every day; the bus operators own the buses. Lanstrafik's budget is \$30 million a year, and it enjoys a farebox recovery of 62% (up from 40% 15 years ago).

Lanstrafik's traffic director talks daily with each municipality. If a city requests additional bus services, the municipality must pay 50% of the cost.

Jonkoping's leaders believe that an alternative to the private car is needed in their city if they are to reduce traffic congestion. Municipal policy has been geared to creating and sustaining a living city center. The city center must be pleasant for pedestrians, and bicycles must enjoy safe, efficient bikeways. Investments in public transport are a priority.

Prior to 1996, public transport ridership in Jonkoping was dropping at a rate of 1.5% each year. In 1996, the decisionmakers in Jonkoping instituted a new "think tram, use buses" system, which gave passengers a brand-new bus network serviced by a fleet of low-floor buses. The transport authority worked with the city to make travel by bus more attractive, concentrating efforts in four areas: route networks, vehicles, travel efficiencies, and information systems.

Jonkoping public transport officials believe that continuous improvement is necessary—that is, if a transport system stays the same, it loses customers. As a result of Jonkoping public transport officials' continuing quest for top-quality service, buses today account for 22% of all travel. While Jonkoping is ranked tenth in population in Sweden, it is ranked fifth in the use of public transportation.

Jonkoping policy states that public transport is useful for developing the city and the region. A new travel center recently opened right beside the existing train terminal and a large shopping mall, making intermodal movement of passengers very convenient. In addition, passengers can walk from either terminal to the shopping mall without going outside—an attractive amenity in this northern country.

### **Switzerland**

Since the 1880s, Switzerland has been investing in public transport. The country's small area and dense population make optimizing the transport network imperative, as developers can no longer construct new roads in urban areas. The Swiss people want public transport—pointing out that one tram or three buses can carry 300 people and remove 177 cars from the road—and politicians support public transport.

Switzerland established a national policy that limits the use of cars by restricting traffic in CBDs. In addition, Switzerland imposes a gas tax, which contributes to the high cost of fueling a private car. The gas tax is used as a financial base to support the cost of operating transit in each of the cities and cantons.

### *Zug*

Zug currently is experiencing considerable traffic congestion, especially during the rush hour. There are eight times as many cars in Zug today than there were 40 years ago. By 2020, if present trends continue, Zug will have 45% more traffic jams than today. Zug has a public transportation system, but the bus system is reaching its limits. Demand is growing, and capacity is limited; as a result, the quality of transportation is getting worse. Travel times are getting longer and longer.



The solution is a competitive and ecological public transportation system named “Stadtbahn Zug,” an ultra-modern urban railway. An urban railway is a hybrid tram/regional rail link. It can travel on roads used by other traffic, much like a tram, but it can also use the existing tracks of the Swiss Federal Railways (SBB).

Stadtbahn Zug Phase 1 uses the existing railroad and rail stations of the SBB, plus 10 new stations it will construct. The project will consist of two lines running on 20 mi of track—Line 1 running from Baar through Zug to Rotkreuz on the west side of Lake Zug, and Line 2 from Zug to Walchwil on the east side of the lake. Service on Line 1 between Baar and Zug would be four trains per hour (one every 15 min), with less frequent service to Cham and on to Lucerne and Freiamt to the south. From Zug, a train on Line 2 would depart every hour to Arth-Goldau, with service to several suburbs. Later, service frequency on Line 2 would increase to every half-hour. In addition to the construction of 10 new stations, the project will include modifications to four existing stations. The project will also include new rolling stock.

The train will network with other regions, making connections to Lucerne and Freiamt, as well as the Cantons of Schwyz and Uri. Currently, there are 10,000 workplaces connected to rail stations; in 2020, there is projected to be an increase of 170% to 27,000 workplaces so connected. The population connected to stations is projected to grow 115% as a result of the project, from 13,000 today to 28,000 in 2020. The stations will be small, functional, attractive, and well designed. Station equipment will include bicycle shelters, electronic online timetables, ticket machines, and telecommunication equipment. There will be bus connections to the rail stations and park-and-ride lots at the stations.

Phase 1 of Stadtbahn Zug is scheduled to be completed by 2004. Travelers using the new system are expected to see travel times cut by up to 50% (compared with car or bus). The aim of the project is an integrated system of transportation covering a wide area with very quick transfer times (including connections with longer distance rail links). The services offered by all the public transportation systems (SBB, Stadtbahn Zug, and bus) are all to be adapted in such a way that they enhance and strengthen each other in providing an optimal service to the public.

The investor of this project is the canton of Zug, and the canton’s public transport office and the SBB will manage the project. Contractors will design and construct the stations.

The total price for the new stations is \$40 million. This price does not include rolling stock, which will also be financed by the canton. The canton will let a tender for operation of the system, and the operator will be responsible for maintenance.

The urban railway can be viewed as an alternative to expanding the existing bus services. At the end of April 1997, the cantonal parliament agreed to provide funds for the development of a preliminary project for the first stage

of the urban railway. The 11 communities in the canton reviewed which urban railway links should be set up, and this review was the basis for the development of Lines 1 and 2.

The project, by mixing light rail and regional train services, takes an innovative approach to public transport. Phase 1 provides service on existing tracks. Phase 2 adds track and rolling stock. The project demonstrates the canton’s commitment to quality public transportation services. The canton recognizes that public transportation must be high quality if it is to successfully compete with the private automobile and attract riders.

Built into the project schedule was a 30-day period of public consultation. The project had received 20 letters of opposition from the public. Project staff worked with the opponents and addressed their concerns. As stated by the project manager, there are always some compromises that are possible. Rarely do project protests find their way to the courts in Switzerland.

### *Zurich*

People use public transport frequently in Zurich. On average, each citizen of Zurich makes 470 public transport trips per year. More than 18% of all miles traveled in the city are made by tram, bus, or train. Free loaner bicycles are provided at kiosks at various points in the city. Shared cars are available for use at more than 100 locations in Zurich (and another 700 locations throughout Switzerland). Public transportation tickets are frequently packaged with tickets for concerts, sporting events, and exhibitions, thus encouraging people to use public transport and cutting down on traffic jams during special events.

There are 800 public transport fare machines in Zurich, located in train stations and at major tram and bus stops. The machines sell all kinds of tickets, ranging from a single ride to a yearly pass. In addition, one can buy most multiride tickets and monthly passes at newspaper kiosks throughout the region that display the Zuri-Linie logo.

All public transport companies in the canton of Zurich are members of the Zurcher Verkehrsverbund (Zurich Transport Association, or ZVV). ZVV integrates not just mobility services, but also prices. A user-friendly zone system with a standard price ensures that a person can use all forms of transport with just one ticket.

The Executive Cantonal Council of Zurich determines guidelines for development, services, fares, and budgets for public transport. The 171 municipalities in the canton are consulted on fares and participate in planning the public transport schedule. This system of political partnership between the canton and the municipalities works well. Both the political leadership and the general public support public transport. Indeed, no public vote supporting public transport has been defeated in Zurich since 1988.

Beat Cagienard, deputy chief executive officer (CEO) of VBZ, indicated that without public transport, not much

moves in Zurich. Public transport is considered as important to the city as its water supply. The people of Zurich believe that decreased congestion, reduced noise levels, and improved air quality are valid reasons for national policies supporting public transport.

Funding for public transport reflects this public commitment. Fare receipts of \$106.7 million cover 50% of the system's current annual operating costs. The canton and its 171 communities cover the shortfall. Calculation of the local contributions involves a complicated formula that takes into account the number of daily departures from station stops in each community and the community's tax base. If a community wants more service, it has to pay more. VBZ implements the service requested by the community and sends the community the bill. Fully 10% of Zurich's annual budget is spent on public transport.

In Zurich, one organization is in charge of transit and land use planning, and coordination of these two functions is considered a high priority. Parking spaces in the CBD are deliberately very limited to discourage automobile use.

VBZ is very conscious of air and water quality and noise control. Indeed, 13% of the VBZ budget is spent on environmental technology, such as low-solvent paints. Electricity powers 75% of the VBZ vehicles; the rest run on ultra low-sulfur diesel fuel. Believing that urban dwellers deserve a good night's sleep, VBZ runs no buses or trams between 12:30 a.m. and 4:30 a.m., except on Friday and Saturday nights, when there is increased demand for such services.

## England

The Strategic Rail Authority (SRA), established on February 1, 2001, operates under direction and guidance issued by the central government. SRA sets the overall strategic vision for the national railway and is responsible for using public funding to attract private-sector investment to enhance the railways. The key role of SRA is to promote and develop the rail network and encourage integration.

Railtrack is the privatized operation that owns and operates the infrastructure (tracks, signals, tunnels, bridges, viaducts, grade crossings, and stations) of Britain's rail system. Railtrack has been the monopoly owner and operator of the rail infrastructure and has operated under a network license issued by the government. In order to run trains on Railtrack's network, train operators must first reach agreement with Railtrack on their mutual rights and obligations. The train operators are held to certain performance standards, which include timeliness and safety.

Railtrack ran out of money in July 2001. Officials of the Association of Train Operating Companies (ATOC) with whom the team met believe that this running out of money resulted from 40 years of under-investment by the British government. The amount of public funds that Britain invests in its railways is about halfway between that invested by governments in continental Europe and that invested in the United States.

## London

Ken Livingstone, the mayor of London, has stated that his top priority is "tackling the transport crisis facing our city." *The Mayor's Transport Strategy*, published in July 2001, details his vision for London as an exemplary sustainable world city for people: be prosperous, accessible, fair, and green. London has seen two decades of rising population and a decade of expanding economic growth and employment. However, Livingstone believes that growth has not been matched by the investment necessary to provide public transport essential for economic efficiency and the well-being of London's population. He maintains that London's transport system is facing a growing crisis, with some roads approaching gridlock and severe overcrowding, discomfort, unreliability, and equipment failures on the Underground and National Rail network. In short, London's transport networks are underperforming and inadequate.

The mayor's transport strategy outlines a very ambitious and comprehensive plan for the improvement and expansion of transport in the city. The clear policy choice in this strategy is that, in central London in particular, increasing the capacity of the transport system cannot be based on the private car. The strategy instead envisions the biggest expansion and improvement in public transport that London has ever seen. Key policies of the strategy include improving bus speeds and reliability, reducing traffic congestion, integrating the rail network, overcoming the backlog of investment in the Underground, and reducing dependency on the car. The mayor believes that if the strategy were implemented through partnerships with key agencies and transport operators, it would accomplish the following:

- Increase the capacity of the Underground and rail systems by up to 40% over the next 10 years and
- Increase the capacity of the bus system by 40% over the next 10 years.

According to the strategy, the mayor and TfL would work with SRA, the rail industry, and the London boroughs to better integrate the National Rail system with London's other transport system to facilitate commuting, reduce overcrowding, increase safety, and move toward a citywide, high-frequency London metro service.

A controversial congestion charging program is slated for implementation in 2003. It would impose a £5 (\$7.80) charge per vehicle per day for any travel within the area bounded by the inner ring road. The charge would be in effect from 7 a.m. to 6:30 p.m., Monday through Friday. Cameras would be used to record all vehicles traveling in the area. The money raised by this program would be earmarked for public transport improvements in Greater London for at least 10 years.

Other features of the transport strategy promote major new cross-London rail links, improved orbital rail links in inner London, and new Thames River crossings in east Lon-

don. The strategy vigorously promotes improvements to encourage walking and cycling, and it includes an accessibility action plan with scheduled proposals to comprehensively improve the accessibility of transport in London.

The intended results of the public transport improvements and the congestion charging scheme are

- A 15% reduction in traffic in central London,
- A halt to further traffic growth in inner London, and
- A one-third reduction of traffic growth in outer London.

The mayor recognizes that the pace and delivery of these projects will be closely linked to levels of funding. Funding has been increased by the central government, though more is needed to keep up with London's economic and demographic growth. Additional funding is justified by the fact that London makes a large annual net contribution of \$29 billion to the U.K. economy. Partnership with the public, the boroughs, and businesses would facilitate implementation. Projects slated for 2001–2002 and 2003–2004 would be based on the \$4.35 billion allocated in the central government's spending plan. For each year from 2006 onward, \$726 million more per year would be needed for projects, excluding those on the Underground. This amount would be partly offset by the projected \$290.5 million in revenue from congestion charging. Access to a share of the National Rail funding (\$87 billion) in the national government's spending plan for rail projects would be needed. Government funding would be supplemented by financing through the private sector or bonds.

#### *Hampshire County (Winchester)*

The Transport Act of 2000 provided a mandate for the Hampshire County Council and other local authorities to develop safe, integrated, efficient, and economic public transport. Local authorities are to develop a local transport plan and a bus strategy, and they are encouraged to implement quality bus partnerships. Quality bus partnerships involve formal and informal agreements between local authorities and bus operators to improve bus services in a defined area. The local authority, for example, can improve bus service by implementing traffic management schemes that make buses travel faster and thus more attractive to riders, and bus operators can improve service by providing modern, attractive, dependable vehicles and frequent schedules.

The Hampshire Local Transport Plan for 2001–2006 was published in July 2000. It was produced by the Hampshire County Council in partnership with all the district councils and other organizations. The plan presents the council's vision for a safe, efficient, clean, and fair transportation system that is fully integrated with the county's broader goals in the areas of health, environment, community development, and economy. The plan's aim is to create a modern, fully integrated transportation system to ensure the vibrancy and vitality of Hampshire's towns and cities and meet the

special transportation needs of rural areas without damaging the environment. The Hampshire County Council hopes to put in place sensible investment programs to tailor local solutions designed to provide people with real choices about how they travel for work and leisure. The overall aim is to change people's attitude and travel behavior by broadening travel choices and encouraging a range of reliable, attractive, and accessible alternatives to car travel.

The central government announced in December 2000 that it would provide significantly increased funding in support of local transport plans. Major policy initiatives of the plan include wider choice of travel options, improved highway maintenance, and social inclusion. The plan supports new partnerships with the private sector and extensive public participation to ensure that the plan can be implemented.

By national law, the local authorities have to introduce targets to reduce traffic. The Hampshire County Council has set the following targets:

- Reduce traffic growth by 50% by 2020.
- Increase passenger transport use by 25% by 2020.
- Increase walking trips by 25% by 2020.
- Meet national air quality targets and contribute to the United Kingdom's climate change targets.
- Reduce road accident deaths by 40% of the average 1994–1998 level by 2010.

The Local Transport Plan was issued in April 2001. It projects a cost of £415 million (\$650 million) over the life of the 5-year plan, but there is no guarantee that funding will be appropriated at the planned level. The overall transport strategy outlined in the plan has four key themes:

- Maintain the road network.
- Make the network safe.
- Make the best use of the network.
- Widen travel choice.

An individual area transportation strategy was developed, consistent with these overall goals, for each of 10 specific areas of the county, with customized solutions for each area. Joint member panels—whose members are appointed by the county councils and represent the Hampshire County Council parent committee, the district council parent committees, and the private sector—determine how the money will be spent.

As Tony Ciaburro, head of transportation policy for Hampshire County, explained, the approach has been to address people's "hearts and minds." Public transport use is up 12%, and cycling is up 3,000%. County staff members focus on working with people to change behaviors, instead of constructing infrastructure. Some of their specific programs include the following:

- A Headstart transport awareness campaign—that is, a public involvement program to increase awareness of

the transport problem, to publicize the true costs of owning and operating a car, and to reduce people's dependency on the car by using public transport, by walking or cycling, and by car sharing;

- Green travel programs, including school travel plans, commuter travel plans, and car sharing programs;
- Quality bus partnerships;
- Rail quality partnerships;
- Freight quality partnerships;
- The Road Management System for Europe (ROMANSE) Program, which involves the use of new technology, infomatics, and telematics to manage the congested road network and contribute to improved air quality;
- Town-center programs, which help maintain the vibrancy of town centers (e.g., road space has been reallocated to allow for bus priority lanes); and
- Private car parks, maximum rather than minimum parking standards, and decriminalization of parking so that parking compliance is monitored by the transit authority rather than the police.

The Local Transport Plan calls for an expenditure of \$30.5 million for public transport in the next 5 years to accomplish the following:

- Improve the quality and image of travel by public transport.
- Continue to provide subsidies for services that are not profitable.
- Promote and provide comprehensive travel information.
- Provide full integration between buses, trains, ferries, bicycles, walking, and cars.
- Implement a rapid transit system for South Hampshire.

One policy initiative is the quality bus partnerships. Since bus transport was deregulated in the United Kingdom in 1985, bus ridership has decreased and bus travel is generally regarded as a second-rate means of transport. The Transport Act of 2000 provided quality bus partnerships as a tool for improving bus service. The Hampshire County Council's policy on bus partnerships emphasizes the following factors:

- Building successful partnerships,
- Maximizing the use of public transport,
- Ensuring continuing improvements and quality of service,
- Meeting local transport plan targets, and
- Providing socially inclusive and accessible transport.

Hampshire County Council now has agreements with four main operators for six specific routes. The aims of the partnerships are to enhance the "total journey" experience, provide high-quality bus services, increase ridership numbers, improve the financial performance of operators, shift

travel away from the private car, and reduce traffic congestion and pollution. To help achieve these aims, the county offers bus priority measures, including bus lanes, bus gates, selective vehicle detection, interchange improvements, electronic information screens with real-time passenger information at 52 stops, improved bus shelters, and access improvements at bus stops. Hampshire County Council has made a policy decision to reallocate road space to the bus. The operators, for their part, offer new "easy access" vehicles with low-emission engines, improved frequency of service, route-branded services for easy customer recognizability, improved timetable information at every stop, driver "customer care" training, and data monitoring.

To date, the quality bus partnerships have yielded a \$2.18-million investment in vehicles by Stagecoach (one of the operators), increased service frequency from 15 min to 10 min, created a 25% growth in ridership, created \$363,000 in investment from Hampshire County Council, provided raised boarding curbs and passenger information at every bus stop, and built new bus shelters.

### *Birmingham*

There are 5.3 million people in the region known as West Midlands, which spans an area about 50 mi wide and includes the city of Birmingham. A recent focus has been on densification—that is, providing more housing in the city center of Birmingham.

Travel West Midlands's company values include safety, investment, innovation, information, integration, and customer service. In all, 97% of the network is commercially sound—that is, the routes are profitable and require no subsidy. Riders must have exact change to speed up loading and avoid delays. Sixty-three percent of passengers use a pre-paid (i.e., "flash") card. Headways are only a few minutes, and buses operate 18 h a day, 7 days a week, except Christmas and Boxing Day, on 23 routes.

The company provides a high quality of service in order to develop a loyal customer base, which is critical if the company is to retain market share. Costs are tightly controlled, and services that are profitable are expanded.

In an effort to encourage more people to use buses in the region, Travel West Midlands has introduced color branding on bus exteriors. Route, stop, and frequency information are incorporated into the color branding on the exterior of vehicles so that passengers can easily identify services.

In 1999, Travel West Midlands agreed to invest \$43.6 million over a 3-year period in an effort to get buses moving more freely around the region. The funds are used to "prime the pump," by giving money to local governments for the express purpose of improving bus service by providing bus lanes, signal priority, bus gates, and queue relocation (i.e., jumpers) at congestion hot spots.

Two new extensions to Midland Metro are being planned—one right into the heart of Birmingham City Center (2-mi route) and the second from Wednesbury to Brierley

Hill (7.3 mi). Extending Metro around Birmingham City Center will cost an estimated \$80.6 million, and the Wednesbury to Brierley Hill extension will cost around \$201 million.

## **AUTOMOBILE CONTROL POLICIES**

To encourage the use of public transport, the European cities visited provide disincentives for the use of privately owned automobiles. These disincentives take many forms, including land use planning, building codes, traffic patterns, parking or access fees, and fines. Roadway expansions and parking facilities that cater to privately owned vehicles are considered a misappropriation of public funds for private projects. Transit enhancements are, in contrast, considered an appropriate public expenditure. Similarly, there is an underlying acceptance that all public transportation trips begin and end as pedestrian travel.

### **Sweden**

Having the foresight to introduce automotive control measures 30 years ago, Gothenburg's city planners have reduced auto traffic in the CBD by 40% and kept auto traffic levels in the surrounding downtown area from increasing at the same time that the region has seen significant increases in automotive traffic.

The Gothenburg approach begins with land use and planning. In 1978, the directional patterns of downtown streets were changed so as to reduce auto access and discourage auto use in the CBD. Public transit facilities and pedestrian-only streets divide the city into sectors. Some of these streets are open to bus and streetcar traffic, while others are promenades, which have become the heart of the downtown area.

Auto access between sectors is possible only by a ring road on the outskirts of the CBD. Auto traffic has free access within each sector, but cars arriving at the central point in the CBD must turn right—there is no through access.

The Gothenburg approach extends to automotive parking. The city limits the number of parking spaces that can accompany new construction, and all parking facilities must have off-street access, which will keep motorists from blocking traffic as they queue up to enter the facility. Garages are only permitted outside of, or on the fringe of, traffic control zones. On-street parking is permitted only in designated areas, and vehicles are allowed to park only in marked parking spaces; violators are ticketed and towed. The parking limitations are very effective in reducing the number of privately owned vehicles in the downtown core.

In 1978, Vasttrafik investigated means of improving its tram system. The result was an early light rail system with signal priority, coupled with signal priority for buses. In the 1990s, Vasttrafik coordinated and then merged the region and city's systems and planning departments, which enabled Vasttrafik to control peak vehicle movements. Working with

the city staff, Vasttrafik was able to implement a variety of public transport priority schemes.

Vasttrafik vehicles have an exclusive right-of-way on streets containing tram tracks; these streets also serve as bus lanes through the CBD. These dedicated lanes allow Vasttrafik to redirect traffic on major access ways; in the morning peak, streets might be for CBD-bound traffic only, and in the afternoon peak, outbound only. Redirecting traffic, combined with signal priority, has resulted in a 50% increase in travel speed during peak hours. The combination of enhanced public transit services and reduced private vehicle access is cited as a major contributor to the agency's 55% cost recovery.

In Jonkoping, Lanstrafik sees the keys to its success as being cooperation with the operating unions and urban planning that promotes public transit access. In 1996, after a multiyear planning study, the company made significant infrastructure changes, giving priority first to bike and bus projects and then to car projects.

Facing greater competition from regional shopping malls, the Jonkoping planners do not feel they have the same leeway to control parking as in Gothenburg. Nevertheless, no public funds are expended on public parking facilities in the CBD. One privately built, privately owned, and privately operated off-street facility serves the urban core, and there is a parking facility at the bus and rail terminal (to accommodate transit users who must use a car to reach public transport services). On-street parking in the CBD is permitted only in designated areas, and most spaces are metered.

Lanstrafik has made a \$5 million capital investment in transit projects since 1996, mostly in vehicle access and traffic priority systems. It has developed and built exclusive access roads to provide buses with easy access to major roadways and shopping centers.

### **Switzerland**

In Zurich, the main commercial street is for transit vehicles only (predominately trams). The absence of automobile traffic, coupled with the prevalence of cafes and sidewalk seating, makes the street attractive to pedestrians, which makes the area more commercially viable. On streets with large amounts of automobile traffic, businesses typically close at 6 p.m., but transit-oriented streets, with their bustling pedestrian activity, remain open until late in the evening. Reducing auto traffic through the downtown core not only enhances transit, but also encourages economic vitality.

Complementing the very visible transit presence are restrictive parking policies. Off-street parking facilities are located only at the fringes of the CBD, and the major municipal parking facility is adjacent to the main transit offices. The preferred method of on-street parking control is the central parking meter, where a single dispensing unit serves one or more blocks. A motorist walks to the central meter and prepays for parking (\$1 per hour, in half-hour

increments); he or she is then given a timed and dated ticket, which must be placed on the car's dashboard. Parking enforcement personnel walk along the street checking the times on the tickets.

## England

Perhaps the most controversial policy to restrict automobile access is TfL's congestion charging scheme, in which the government will impose a £5 (\$7.80) fee on all vehicles traveling in central London during the hours of 7 a.m. to 6:30 p.m., Monday through Friday. The congestion charging scheme is scheduled to go into effect in February 2003. Signs in and around the congestion charging zone will make it clear exactly where the congestion charging zone starts and finishes. Motorists will be able to pay the charge in advance, but they must pay it no later than 10 p.m. on each day they drive in the zone, or else they will be further fined. Fixed and mobile cameras both around the boundary and within the charging zone will capture vehicle license plate numbers, which will be used to check whether the fee has been paid (there are no tollbooths or gates). Residents who live inside the zone will also have to pay the charge if they drive their car in the zone during those hours, but they are eligible for a 90% discount. There are special payment terms and discounts for commercial vehicles, taxis, motorists with disabilities, and others. Revenue from the congestion charges (and any fines) is to be used strictly to fund improvements to public transport (the scheme is expected to raise about £130 million [\$203 million] per year).

The introduction of congestion charging will be accompanied by a wide range of measures designed to make public transport and other alternatives to car travel easier, cheaper, faster, and more reliable. The charging scheme is expected to cut traffic levels in central London by 10–15% and reduce vehicle delays by 20–30%.

Parking in most of the city of London is tightly controlled, and curb space is metered. Escalating fees and time restrictions will be applied to control scarce on-street parking spaces. Residential permit zones are also limited to discourage intraborough journeys. In central London, 55% of car trips during the morning peak end at a private parking space, and most of these spaces are free to the user (they are provided by their employer). Boroughs are being urged to control the amount of parking provided in new developments by placing maximum limits on parking.

The city of Winchester focuses on controlling auto traffic and parking. Winchester's Main Street is a pedestrian thoroughfare, and parking in and around the city is tightly controlled. A comprehensive system of on-road cameras and sensors is monitored by a traffic control team, which can quickly take action to ameliorate any bottlenecks or problems. In addition to controlling signals and managing traffic, the system provides information on the location and

availability of parking. The information is available both on the Internet and on variable message signs along the roadway.

## PUBLIC-PRIVATE PARTNERSHIPS

Public-private partnerships (PPPs) have been in existence in the United States and other countries for many years and serve many purposes. The transit systems in Gothenburg, Zurich, London, and Hampshire County (Winchester) operate with slightly different versions of PPPs, and each has a different method of evaluating and defining a PPP's success.

In the broadest of terms, a PPP can be defined as a relationship between the public sector and the private sector that is mutually beneficial to both parties. Formal relationships are defined as relationships that require a contract and a complex evaluation methodology to determine the continuing validity of the partnership and the continuing benefit to the parties involved. Not all PPPs are so formal, however.

### PPPs in Zurich

Zurich's transportation system is an example of a regulated PPP in which the private operators take direction from the governing body and receive operating subsidies. Current operating subsidies (50%) are provided by a farebox return, with the remainder provided by the canton of Zurich and the community served. The community's subsidy is weighted, with 20% coming from the amount it collects locally for the service and 80% based on the amount of service the community receives.

Operating contracts are let through a tendering process that requires the operator to work in partnership with the city administration for the provision of a quality service. Tenders typically have a 5-year duration, with an option to extend. The city administration can, however, terminate a contract early because of poor performance by an operator.

Evaluations are very straightforward. Reliability and quality are of utmost importance. Passengers are surveyed twice per year to determine the quality of service in the following categories: reliability, staffing (i.e., information), convenience, drivers, cleanliness, and safety. These criteria are weighted for importance as determined by the passengers. Typically, reliability, staffing (i.e., information), and convenience account for 90% of the importance to the passenger, while safety accounts for only 2–3%. These factors are more important than operating cost when determining whether the operator should continue serving the public.

The ratings are then compared with ratings from previous surveys of the operator, as well as from surveys of other operators. The ratings form the basis for determining whether the contract will be extended or whether more immediate and drastic action must take place.

## PPPs in Gothenburg

Gothenburg first contracted out transit services in 1992. At the time, the cost of transit services was skyrocketing. Operations suffered because of complacency, high turnover, high absenteeism, neglected and deferred maintenance, and unresponsiveness to demands of the market. Gothenburg's answer was to establish a market-based process that forced the operators to adapt to a competitive environment. The operator was to concentrate on basic operations and market needs.

The performance indicators showed favorable results. Cost per vehicle-kilometer was reduced by 35% for bus operations and 15% for tram operations. This model allowed the workforce to be reduced from 3,000 employees to 2,000 employees. The budget went from a loss of \$3.5 million to a profit of \$9.8 million.

Although operating performance indicators were improving, operating quality was not. Operators bid with such tight margins that driver pay levels were not competitive in the market. Trips were often missed because of a lack of drivers. The rising costs of fuel and wages made it difficult to expand service offerings, and large operators could not compete in the marketplace.

Recent tenders allow for some changes to mitigate these market-based problems. Contracts are 5 years long, with 5-year extension options. This arrangement gives the contracts some stability and allows the operator to earn a return on its investments. The contracts are also indexed to fuel costs, inflation, and labor costs. Vasttrafik has begun educating drivers and other employees of the operators as a means of increasing quality without further burdening the transit operator.

Current tenders are evaluated with weighted criteria. Quality measurements are rated at 55%, while price is rated at 45%. The quality of the operator is measured by surveying the customers twice per year, as well as by using onboard inspectors to ensure that the operator is performing as expected.

Technology is also used to ensure quality on Gothenburg's transit system, particularly through another PPP—the Gothenburg Traffic Information Center (GoTIC). GoTIC is responsible for developing a transportation information system that offers a variety of high-tech solutions for optimizing mobility. It takes into account all modes—bus, tram, and automobile—to ensure that users have complete information and complete control over their transportation trip. The government benefits by having an efficient transportation network that allows for a more livable city, more appropriate use of land, lower infrastructure costs, and better information from which to plan the future. The private sector benefits from having an ever-expanding marketplace for this type of technology and allows testing of equipment and technology under real-life conditions.

## London Buses

Although bus service elsewhere in England has been deregulated, it remains regulated in London. London Buses

manages all of the bus services in London; it plans routes, specifies service levels, sets fares, markets the system, and monitors service quality. It is also responsible for bus stations and stops and other support services. The bus services are operated by private operators, which work under contract to London Buses.

London Buses is also responsible for managing the competitive bus route tendering process. Private operators bid on tenders to provide services along routes established by London Buses. Each year, 20% of the route network goes out for tender. The private companies that are awarded tenders are responsible for vehicles, garage facilities, drivers, and fare checkers (to identify and fine passengers who avoid paying fares). The operators range from large international companies to small local companies.

Currently, 37 operators offer services in London. Although many initiatives are in place to make journeys as reliable, quick, convenient, comfortable, easy to use, and affordable as possible, such a large number of operators makes consistency among services and integration difficult. As a result of tendering, many key performance indicators increased, such as passenger trips and kilometers per passenger. At the same time, service quality in terms of reliability and on-time performance decreased.

As a result, London Buses has changed its perspective on tendering and is now focusing on quality rather than cost. New tenders include quality incentives, wherein operators are offered a graduated pay scale based on their ability to meet performance targets set by London Buses. If an operator's performance is above the target, the operator is offered a bonus of 1.5% for each 1% over target. If an operator's performance is under target, 1% of the contract is withheld for each 1% under target. Under this contracting scheme, operators will be able to earn 15% more than the contract price in bonuses. Two-year contract extensions are available if performance targets are exceeded. Customer satisfaction measures will also be quantified for qualification for contract extensions if performance targets are not exceeded.

Bidders are prequalified on the basis of their financial status, safety record, previous operating experience, and management system. Bidders are then evaluated on whether they provide the best value for the money. This quantification effort requires the bidder to provide a detailed cost breakdown; staffing proposals, including terms and conditions of employment; quality requirements, including a service control strategy; staff training proposals; and vehicle maintenance and engineering proposals and safety requirements, including safety management proposals and a safety track record.

Service on the street is evaluated in a number of ways. The operators themselves monitor the number of missed trips. In addition, on-street checkers track on-time performance by operator and route. If a company fails to meet basic standards, London Buses might step in as an operator of last resort during the tender process to avoid interruption in services.

A PPP is also an element of London's BusPlus program, which is designed to make a difference in the quality of some of London's key bus routes. BusPlus is being run by the London Bus Initiative (LBI), a partnership of all organizations responsible for delivering bus services in London. These organizations include a mix of public and private entities, including TfL, the London local authorities, the police, private bus operators, and the London Bus Priority Network. The program includes upgrading 70 key bus routes across London to make service more reliable, safer, cleaner, and more comfortable within 3 years.

Another significant PPP issue in London is the planned PPP for the London Underground. London's Underground is the oldest underground railway system in the world. It has 11 different lines, and only 2 of those are less than 50 years old. The system carries over 866 million passengers per year. Under the planned PPP, the operations of the London Underground will remain the responsibility of TfL, but track maintenance, systems improvement, and station redevelopment will become the responsibility of private providers, who will be awarded 30-year contracts.

The mayor of London spearheaded opposition to the planned PPP, as he believed that total responsibility for the Underground should lie with TfL and that operations should not be separated from maintenance. The mayor's arguments against the PPP involved the financing strategy; the schedule of improvements; and the lack of shared vision among TfL, the private providers, and the central government. Under the PPP plan, the mayor said, aesthetic improvements will be placed ahead of line and vehicle improvements.

The central government, however, believed that only a PPP could provide adequate funding and expertise for the necessary upgrades to the system. The central government also believed that the PPP would contain costs by shifting the burden to the private sector, which would also be more successful in attracting and retaining skilled, knowledgeable staff.

### PPPs in Hampshire County

Unlike Zurich, Gothenburg, and London, Hampshire County does not regulate public transportation services. Eighty-five percent of the bus service in the county is operated by four commercial operators. The operator determines which routes it will run and does so for a profit. This profit motive is thought to motivate quality improvements as a means of attracting and maintaining passengers.

The Hampshire County Council pursues quality partnerships with service providers, which yield measures that will improve bus services and promote ridership. The partnerships emphasize the quality of service in terms of reliability, convenience, journey time, and vehicle design. They also delineate the responsibilities of the private operator and the county in terms of an exchange of services for infrastructure improvements. Quality partnerships are thought to achieve better service through collaborative efforts.

Both the county and the private operator have specific responsibilities within the partnership agreement. Among other things, the operator is responsible for purchasing and maintaining the vehicles, determining fares and payment methods, driver training, and passenger information. The county is responsible for identifying, developing, implementing, and monitoring bus priority measures to reduce bus journey times; determining where priority measures can be incorporated into the highway and reallocating road space in favor of buses; improving infrastructure in order to improve accessibility, particularly for people with mobility problems; and improving and maintaining stops and shelters.

The private operators and the county are jointly responsible for evaluating funding options and developing transport strategies.

Quality partnerships remove the implication that the operator is subordinate to the public body and recognize that good service is in the best interest of both parties. They also provide a basis to develop a network of rapid, high-quality services that can attract new users, which benefits both the public and private sectors.

Hampshire County also hosts a project called the Road Management System for Europe (ROMANSE). ROMANSE is a multi-million-pound, pilot research-and-development project based in Southampton. It provides real-time traffic and travel information to the traveling public and offers the traveler timely information on the array of travel options. The system increases awareness and use of public transportation, maximizes the efficiency of the transportation system, and provides high-quality information for use in strategic policy decisions.

ROMANSE is a partnership of public and private entities, including Hampshire County Council, Southampton City Council, Siemens Traffic Controls Limited, the Transportation Research Group of the University of Southampton, the Ordnance Survey, the British Broadcasting Corporation, Ford Motor Company, Atkins Wootton Jeffreys Consultants Limited, and the Transport Research Laboratory. Most of the funding came from the partners and the central government, with a small percentage coming from the European Union. The project developed the following services:

- A traffic and travel information center coordinates the different elements of ROMANSE and collects, collates, and disseminates information.
- A strategic information system provides an overview of the transport environment in the form of a clear, digital map display. Integrated layers of transport-related data give comprehensive geographical and statistical information.
- A public transport information system (Stopwatch) provides real-time bus service information to passengers waiting at bus stops. Stopwatch uses automatic vehicle location (AVL) technology to pinpoint the exact loca-



tion of buses as they travel and then displays estimated arrival times on electronic signs and “talking” signs at bus stops along the relevant route.

- Freestanding computer terminals have been developed to provide up-to-date trip planning information in and around Southampton. Fourteen units are currently operating in three languages (French, German, and English) at public sites in Southampton.
- Variable message signs provide route guidance and parking guidance.
- Closed-circuit television (CCTV) cameras have been installed at 30 key locations around the city and on the surrounding motorway network to monitor traffic flows. Using an advanced remote control facility, operators in the traffic and travel information center can control the movement of cameras, directing pan, tilt, or zoom actions to gain a clear picture of traffic conditions. Operators can switch easily from one camera to the next, allowing them to track the progress of vehicles from one stretch of road to another.

Surveys have shown that ROMANSE has had a marked effect on public attitudes toward public transport because of perceived and actual punctuality and the provision of service information.

The ROMANSE partnership increases the county’s ability to manage traffic and resources, while offering the private sector the ability to test this type of equipment in a coordinated fashion within a real-world environment. It also allows the private sector to showcase its efforts in a growing market niche.

### Other PPPs

Less formal relationships also exist to meet the broad definition of a PPP. These informal relationships may require an agreement or permission to provide a service that complements the existing service currently being provided by the government or another PPP. These relationships provide a necessary element of an attractive public service, while reducing costs or increasing benefits to the government and increasing profits for the private company. These benefits include the following:

- **Transit newspapers.** All of the systems visited by the mission team provided riders with a newspaper marketed primarily to riders. The newspaper publisher typically has an agreement that allows the paper to be distributed at or near transit facilities; in return, the paper often provides the transit agency with advertising or editorial space for disseminating information about the transit service. The newspaper allows the transit agency to communicate with its passengers in an attractive, professional, and desirable medium; it provides an attractive distraction for transit users; and it provides the publisher with a market niche attractive to advertisers.

(These types of publications can also be found in larger U.S. markets.)

- **Transit shelters.** Shelters, a necessary amenity at most transit systems, can be costly for the operator. Transit agencies in the cities visited by the mission team allow private companies to supply and maintain transit shelters. The companies earn revenues from advertising posted at the shelter, and those revenues offset the cost of installing and maintaining the shelter, provide a small stipend to the transit operator, and allow the company to reap a profit. (This service is also offered in larger U.S. markets.)
- **Bicycle loaning stations.** Bicycles complement transit services because they allow a transit user to extend his or her trip to an area not served by transit. Zurich accommodates this type of travel through the provision of bicycle stations, from which a traveler can “borrow” a bicycle at no charge (the bicycles are paid for by revenues from advertising placards attached to the bicycle). The user is expected to return the bicycle to the station on an honor system. Private companies provide the bicycles and earn income from the advertising revenues.

## INTERMODAL TRANSPORT AND TRANSFERS

While improving intermodal connectivity is a stated objective of every agency visited, the overall policy and operational framework for achieving this objective varies widely from one property to the next. Some agencies manage their regional operations as entirely government-owned enterprises with little outsourcing and no competition, while others have introduced competitive bidding for routes. The policy framework (deregulation versus regulation, public service versus private service) has some bearing on the success of intermodal connectivity, but it is not the sole determining factor. The communities most successful at improving modal connections were those that took a holistic approach to traffic management, as well as a reasoned and rational perspective on the different modes of transport.

### Sweden

An example of successful transport service integration can be found in the southern Gothenburg neighborhood of Frölunda Torg. Frölunda Torg is a place where people from all walks of life come together to shop, eat, and make quick and easy connections to anywhere in the greater Gothenburg area. The station is fully integrated into a major mall and shopping area. A total of 13 bus lines converge into the light rail station every 15 min so that quick and easy connections can be made from one route to another.

The “Star” system, as it is called, is not a completely novel concept (hub-and-spoke concepts are used in many cities), but it is applied at many terminus stations on the outskirts of the city with a high rate of success. It is also a

guiding principle at many commuter rail stations. The Frölunda Torg station also has an extensive park-and-ride lot, as well as a substantial number of bike spaces. In addition, the station serves as an end terminus for the city's Flexline service, which is a minibus service for elderly and mobility-challenged customers.

On June 10, 1996, the city of Jonkoping launched the "Comfort 1996" initiative, which dramatically reshaped the public transport system in the region. The initiative involved the following elements:

- A modernized bus network based on two main routes (the City buses);
- New low-floor articulated buses;
- A real-time information system based on global positioning system (GPS) technology that provides the exact position of all city buses, real-time information to passengers at bus stops, and signal prioritization at street crossings;
- New "links" that shortened the distance between terminals; and
- New bus stops with modern equipment.

The "Comfort 1996" program, together with other features of the Jonkoping network, is a crucial factor in determining intermodal effectiveness. Express and regional buses feed the main rail terminal, and there is coordinated scheduling for the first and last daily departures. The fare system is integrated within the county. Schedule adherence has greatly improved because of the implementation of the signal prioritization program, which means that passengers wanting to transfer to the national or regional rail system at the main station have more confidence that they will have adequate time to transfer. The main railway station was architecturally designed to ensure close physical proximity between the bus berths and the rail platforms.

Cooperation between the local public transport authority and the city has been an important factor in the rebirth of public transport in Jonkoping. Public officials responsible for land use planning, public transport, and traffic operations work closely together and understand the significant interrelationship between their organizations.

## Switzerland

Switzerland has one of the most well-integrated public transport networks in the world. The frequency, ease of use, and reliability of public transport in Switzerland is second to none. A large majority of Swiss residents live within 1 mi of local, regional, or national rail transportation.

The cooperation that exists between the federal rail carrier (SBB), local public transport agencies, and organizations committed to improving mobility within the country is excellent. The Swiss Pass and Swiss Flexi-Pass are successful examples of this cooperation and demonstrate the lengths

to which the Swiss go to ensure modal integration. The Swiss Pass gives unlimited travel on the entire rail, bus, and boat network of the Swiss National Travel System, including the trams and buses operated by urban transport systems in 36 cities and towns. It is valid for 4, 8, 15, or 21 days or for 1 month. The Swiss Pass also entitles holders to discounts on many scenic mountain railways. The Swiss Flexi-Pass allows a customer to freely travel for 3 to 9 days on the whole Swiss National Travel System network, enjoying the same facilities as found with the Swiss Pass. With either of these passes, one can arrive on a flight to Zurich, make a quick rail connection to the city center, connect to a light rail train or bus to a hotel, and in the morning travel on the Glacier Express to St. Moritz for lunch and tour the city by bus, all on one ticket. This type of flexibility and ease of use is what makes public transport on the Swiss National System so attractive.

In Zug, 4 of the 10 new rail stations for the Stadtbahn Zug will be fully integrated bus-rail facilities that will provide timed transfers and include extensive park-and-ride lots. A real-time information system will provide passengers with up-to-the-minute information on departures and connections. Although private operators will provide the feeder bus service, the fare system and schedules will be fully integrated. The system will be complete by 2004.

In terms of fare integration, time sequencing between service modes, and physical integration at major transfer points, the public transport system of Zurich is first rate. Approximately 1 million people live in the canton of Zurich; of these people, 500,000 live in Zurich proper. All public transport providers in the canton are linked together in the Zurcher Verkehrsverbund (Zurich Transport Association, or ZVV), which provides a dense route network of light rail, trolleybus, diesel bus, ferry, and regional rail service. The underlying service delivery philosophy can be best described as "networked mobility."

Travelers arriving at Zurich International Airport can walk directly to the underground railway station located inside the airport. Travel time to downtown Zurich is only 10 min, with 10-min headways. Most of the 13 lines of the light rail system can be accessed from the main railway station downtown without climbing up or down any steps.

The ZVV offers a user-friendly and fully integrated fare structure system that ensures that its customers can ride all types of transport with just one ticket. For commuters who travel during peak periods, there is the "Rainbow Card," a season ticket that allows unlimited trips within established zones. An annual Rainbow Card gives the best discount, as one pays for the equivalent of 9 months but gets to travel for an entire year. The ZVV offers an array of fare instruments designed to meet the needs of everyone from tourist to commuter, and tickets can be purchased at more than 2,000 easy-to-use machines located at stations, post offices, and SBB and regional rail stations throughout Zurich.

The typical ZVV customer takes 470 journeys per year

on the public transport system. This average is the highest in Europe and compares favorably with the 150–200 journeys that are made by customers on systems in similarly sized cities. On average, each citizen of Zurich uses public transport twice a day. There is an extremely high consensus on public transport in Zurich, as evidenced by the fact that not a single referendum on public transport has failed in the canton since 1973.

## England

Public transport in Birmingham is unregulated. One operator, Travel West Midlands, has emerged as the dominant service provider with an 83% market share.

Travel West Midlands has placed considerable emphasis on making the entire public transport network as integrated as possible in the unregulated environment. It has done so by forging partnerships with the West Midlands Passenger Transport Authority, train operators, and other local bus companies to provide integrated ticketing in the West Midlands. Under the fare scheme, bus drivers can issue bus, rail, and tram tickets to passengers.

Travel West Midlands's dominant position in the Birmingham region is largely due to the operator's family of Travelcards. In many respects, Travel West Midlands was a pioneer in the use of Travelcards. These days, its multimodal Centroc card and its Busmaster card are widely used. One can also purchase a Midland Metro Add-On Regional Travelcard, which allows unlimited travel on Travel West Midlands bus lines, as well as on the recently opened Midland Metro light rail system.

The Midland Metro light rail transit is a 12-mi system that runs along the former Great Western Railway route from Birmingham Center through West Bromwich, ending at Wolverhampton. Opened in May 1999, the system operates 6-min service during peak periods, with a total fleet of 16 low-floor light rail vehicles (LRVs). Travel West Midlands is responsible for operation and maintenance of the system and provides integrated feeder bus service at 9 of the 23 stations. Each feeder bus is prefixed with the letter "M" for easy identification. There are four park-and-ride lots, and each station has a facility for bicycle storage to encourage car-free journeys.

Two extensions are currently being planned for the Midland Metro. Service integration for the next phases could be somewhat more difficult because the existing franchisee may not be the successful bidder on the extensions.

Hampshire County, south of London, is building a 10-mi light rail transit project that will link the towns and key public transport interchange points of Fareham, Gosport, and Portsmouth in the southeastern part of the county. The first phase will consist of 16 stops and include a tunnel beneath the Portsmouth Harbor. The project will also connect to the regional and national railway stations at Fareham, Portsmouth Harbour, Portsmouth, and Southsea.

Integration is not easy to coordinate in an unregulated

public transport environment where the competition between operators often works against the needs of the traveler for good connections and ultimately a seamless journey. The Hampshire County Council's visionary investment decisions on intelligent transportation systems (ITS), park-and-ride facilities, and interchange points is helping to make the best of a challenging situation.

In contrast to the rest of Great Britain, public transport in London is regulated. This regulation means that, although private bus companies are responsible for service delivery within the city, they deliver service under strict contractual controls with respect to performance and service levels. Private bus companies are granted *de facto* monopolies for their contracted routes, which means that none of their competitors can operate along the same routes.

British Rail is no longer a national monopoly. Instead, it is part of a national network of 26 different operating companies offering services under a common name and logo—National Rail. National Rail is regulated in a similar manner as London buses, with no two competitors competing for the same fixed routes. The operating companies offer fairly effective service integration.

ATOC has effectively forged some semblance of integration out of the National Rail network by getting the different operating companies to understand the importance of integration from a customer service standpoint. There is uniform marketing for rail service, which includes the publication of schedules and maps, as well as franchise agreements between the 26 companies to carry and sell the others' tickets. ATOC was also instrumental in establishing the National Rail Enquiry Service, which assists rail customers with reservations, lost property, connecting services, and during-service disruptions.

At major transfer points and stations, it is easy to move between different modes. Arriving at Waterloo Station on the Eurostar from Brussels, for example, one can make quick connections to national or regional rail service to anywhere in Great Britain or to the London Underground. There are also plenty of taxis at the major rail terminals. In recent years, express rail service has opened directly to both Heathrow and Gatwick International Airports, and this service has become an attractive alternative to taxis and private automobiles. The Heathrow Express service and Gatwick Express service depart every 15 min from Paddington Station and Victoria Station, respectively.

Improving the integration between the different modes of public transport is a key theme throughout the mayor's Transport Strategy. One scheme currently envisioned is known as Cross River Transit. This project will most likely involve light rail transit and will offer more direct connection from several of the major rail interchange terminals on the south side of the River Thames to those on the north of the river. The Transport Strategy also calls for improvements in speeds and journey times for London Buses.

## SERVICES FOR PEOPLE WITH DISABILITIES

The principle of “access for all” is increasingly becoming a priority for transit services in the cities visited, but not yet to the degree that is mandated in the United States. The transit agencies expressed concern about the issues of mobility for an aging population, as well as for people with disabilities.

### Sweden

Tram cars in Gothenburg have been remodeled to incorporate low-floor center sections in order to improve accessibility. Current policy requires wheelchair users to transfer to a seat from their wheelchair once onboard a vehicle, as there is no means for wheelchairs to be secured in place. At customer transfer centers, audio systems have been installed to assist visually impaired people, but there are no plans to implement the systems at bus stops. The public transport system is not fully accessible, but real-time sign boards at stops display a wheelchair symbol to indicate vehicles that are accessible to people with disabilities.

The Swedish Transport Act has mandated that, by 2010, all forms of public transportation must be accessible. Unlike with the Americans with Disabilities Act (ADA), which set a national standard for compliance, many of the specifics for compliance with the Swedish Transport Act have been referred to the local authorities. Vasttrafik has formed a committee consisting of people with disabilities and representatives from the community to identify issues and provide guidance. The committee is dealing with conflicting needs, such as a person with allergies to animals traveling on a transit vehicle that is also carrying a service animal.

Under current law, regional transit authorities must provide transportation for people with disabilities. The city of Gothenburg, however, still operates the Special Transport Services (STS) in response to a strong lobbying effort by people in wheelchairs. STS provides 7,000 trips per day through a combination of programs, including taxicab service, special lift-equipped and low-floor buses, and flex service. Individuals wishing to use STS must submit an application. Eligibility is determined on the basis of age or on a physical or cognitive disability supported by a certificate from a physician. The application must state why the applicant cannot use regular public transportation services. Denials can be challenged, but are adjudicated in a court of law. Most successful applicants are granted eligibility for a period of 3–5 years, but a very small number are granted permanent eligibility. The rationale for the 3- to 5-year period lies in the Swedish belief that modern technology and medicine will help to improve mobility for people with disabilities and that regular service routes will benefit from continued improvements in equipment and services for people with disabilities.

Curb-to-curb service is the norm with STS, but individuals can request door-to-door service. Approximately one-

third of rides are requested the day prior to service, and standing reservations are accommodated. The other two-thirds of rides are arranged on the same day, with requests coming in anywhere from several hours to a few minutes ahead of time.

The software program that supports STS (from Planit Sweden AB) was developed in Sweden and uses a “just in time” concept for scheduling. The software helps STS schedule a 55% rate of shared rides. Although reservations can be made on the Internet, most reservations currently are made by phone.

To complement the fleet of specialized vehicles, STS also contracts with taxicab companies, basing the cost of the trip on the estimated travel time, rather than on the direct meter rate. The software provides a means of prioritizing vendors so that rides will be assigned to the most economical provider available at the time of dispatching. The software assigns a trip to a vendor at the last possible moment in order to achieve the most cost-efficient ride.

STS uses special fares to help even out peak demand—that is, off-peak trips cost only half as much as peak-period trips. Planning is underway to provide feeder service as a means of transferring persons with disabilities to fixed-route vehicles once those services improve in accessibility. In Stockholm, a travel training program has been in development for a year that will target 300 visually impaired patrons who travel twice a day in order to improve their mobility and reduce specialized service costs.

From 1996 to 1999, a specialized service route, titled Flexijen, was tested in Gothenburg. The service proved successful, and the service route now operates Monday through Friday from 9 a.m. to 5 p.m. within a corridor of a 20-min direct travel time. Two small, low-floor vehicles are used, and each one is permitted a total travel time of 55 min, with 5 min used for turnaround. Pickup places are designed with the goal of no more than 150 m of walking required to reach the stop, and only 80 pickup points are designated in a corridor. Patrons must provide at least 15-min advance notice for a ride. The city has set up automated telephones at key points, such as shopping centers, so that customers can use their identification card, with a magnetic strip, along with the telephone keypad to request a ride home. The service’s efficiency is seven passengers per bus-hour. Customers tend to be repeat riders and get to know the drivers, which increases overall customer satisfaction. After implementation of Flexijen service, use of taxicab service for STS customers in the area dropped by 68%.

In Jonkoping, the vehicles have wheelchair wells, where the seats are designed to remain in the flipped-up position unless a passenger pulls a seat down and sits on it. This design tends to keep wells open for patrons in wheelchairs. The bus transfer stations are all designed with access in mind, including Braille designators, customer-activated voice announcement boxes, and tactile flooring. The blind community in Jonkoping had helped to design the flooring, but once the stations were in use, the blind community found

that the stations did not perform as expected. The city is preparing to change out the floor to make the tactile path wider, with deeper grooves, and in a lighter color.

### Switzerland

In Switzerland, the emphasis on accessible transportation services is geared more to the needs of an aging population. In Zurich, where the tram system is being upgraded with new, sleek, low-floor vehicles, efforts are also underway to begin to convert older tram stock to include a low-floor section in the middle of the vehicle, similar to the conversion seen in Sweden. Throughout the city of Zurich, vibrating boxes were attached to pedestrian signals to assist visually impaired individuals in determining when it is safe to cross the street.

### England

The Disabilities Discrimination Act of 1995 (DDA) aimed to eliminate discrimination of people with disabilities in England by permitting the government to set minimum standards in public transportation; however, there has been some delay in defining all aspects of the standards. Smaller communities have been slower to move forward in the concern that what they implement may not meet the standards and may have to be changed. The act, which was updated in 2000, mandates that transit fleets be converted to low-floor vehicles by 2016.

London Buses's vision focuses on improving accessibility to public transportation and creating an improved road network on which to move the buses more quickly. London Buses is ahead of schedule in meeting the DDA requirements, and most of its buses will be low-floor vehicles by 2004.

The London Underground is very difficult to maneuver for people with ambulatory restrictions. Some stations are equipped with elevators, but the equipment is, in many cases, in poor condition and frequently breaks down or requires the assistance of a staff person, who is not always available. Another difficulty is the gap that often is in evidence between the station platform and the Underground car. While "Mind the Gap" is a very effective marketing campaign to remind people to take a full step into the car from the platform, it is a significant barrier to people using mobility devices. During the team members' 3 days of regular use of the Underground, no people using mobility devices were observed using the system.

The DDA did not include trains in the legislation, but later legislation addressed that omission, requiring all new rolling stock introduced after January 1999 to be accessible. Regulations also require that ticket machinery be accessible, but these regulations do not spell out specific specifications, which has led to some difficulty for manufacturers.

Twenty years ago, British Rail introduced a railcard for people with disabilities, but continuation of a reduced fare

for people with disabilities was not provided for in the law. Nonetheless, the National Rail Network has chosen to continue to offer the pass, and sales have continued to grow, indicating that the gradual improvement to rail accessibility is encouraging more people with disabilities to use rail.

By law, all information materials must be in formats accessible to all. Most commonly, these formats are audiotapes and large-print brochures and maps.

An accessible transport strategy was developed by Hampshire County and distributed to organizations and interested parties. The strategy outlined the county's position on service delivery and committed the county to a framework of fulfilling the demand for service. The strategy outlined the following types of services that would be used to improve accessibility:

- **Community transport systems.** A volunteer organization runs a range of transport services, including car scheme, dial-a-ride, and Shopmobility.
- **Car scheme.** Volunteers who own their vehicles provide one-on-one service for a fee, usually based on mileage or zone rates. The passenger pays the fee.
- **Dial-a-ride.** Door-to-door service for people with disabilities of any age.
- **Hail and ride.** At safe points, customers can flag the bus to stop to help reduce walking distance.
- **Semischeduled services.** Regular bus lines will deviate up to 1 mi to pick up riders.
- **Shopmobility.** Customers can "spot hire" mobility devices (i.e., they can rent or borrow mobility devices on the spot without having to make reservations) to make shopping easier in localities serviced by accessible transportation services.
- **Taxicard schemes.** Subsidized taxi payment coupons give the customer a discounted taxi ride (the government agency pays the difference).

In the northern part of the country, Travel West Midlands introduced low-floor buses to its fleet well before enactment of DDA. Travel West Midlands's buses are designed with easy access in mind—not only for wheelchair users, but also for parents with strollers, senior passengers, commuters, and shoppers. All bus drivers are given disability awareness training as a part of their customer focus philosophy.

In order to improve the community image of public transportation, Travel West Midlands initiated a showcase route that included upgraded double-decker, low-floor buses with wheelchair wells and flip-down seats. As noted in Sweden, this design, where seats rest in the flipped-up position, tends to keep the area open for wheelchair passengers. Noteworthy in Birmingham was the community's choice to offer people 60 years and older free rides. The new light rail system incorporates accessible stations and cars where wheelchair wells are large and capable of handling people with disabilities, seniors, people using shopping carts, and families traveling with strollers.

## COMMUNICATING WITH THE PASSENGER

### Passenger Feedback

In each of the cities visited, governments and private service providers are implementing new methods of collecting, providing, and using information. Transit professionals are sometimes wary of customer satisfaction surveys or focus groups because these surveys and groups rarely yield new information. The public does not waver from its stated desire for frequent, reliable, safe, convenient, clean, and comfortable transit service.

However, although the new methods of gaining input have resulted in no surprises, they have extended the breadth of the input process and have given the customers the feeling that their input is important. In Zug, for example, public hearings were held on a proposed tax to finance new train routes. In London, telephone surveys were used to discover why people choose not to use transit, and onboard surveys were used to determine customer satisfaction levels. In Gothenburg, the Internet is used to provide information on routes, schedules, and fares, and visits to the website are tracked to determine which parts of the website are most useful. Savvy users of the computer have learned to bookmark the webpage with their particular bus's real-time information. One user of the system described how he used the web to monitor the progression of his bus at the end of the day and left the building just in time in order to avoid needless standing in the cold.

In providing real-time bus information, Vasttrafik has found 3 min to be a decisive point for passengers in Gothenburg. After more than 3 min of delay, passengers want more information than just the arrival time of the next bus or tram. Vasttrafik's response to this finding was to post recommendations for alternate routes and services, along with times. To post these recommendations, Vasttrafik added an information officer to its staff. In addition to developing the recommendations on alternate routes and services, the information officer also contacts the traffic operations center as necessary to request adjustments to traffic signals to help get buses back on schedule.

### Passenger Information

#### *Sweden*

In Gothenburg, the premise that the traveler should know as much as possible about traveling conditions and that the more he or she knows, the more likely is the use of public transit has been accepted since 1984. The result has been continual improvements to the ways information is disseminated to the public about real-time conditions in the public transport network. Gothenburg uses vehicle-detection loops in the pavement and radio communications to transmit the location of trams to the central control or dispatch operations center. Gothenburg will soon be switching to a new

digital radio system known as TETRA (TErrestrial Trunked RADio) for the light rail system. GPS technology is to determine vehicle location in the bus fleet.

In partnership with the Institute for Consumer Technology and Transportation Technology at Chalmers University of Technology, the public transport authority in Gothenburg has been testing and demonstrating methods to disseminate real-time information to the traveling public. These tests and demonstrations have shown that, among other things, an effective real-time information system must be able to alternate between two main functions: displaying when the next vehicle is expected to arrive and displaying text messages concerning delays and disruptions to traffic. Further work has examined methods for effectively displaying the information using various technologies, including video screens, liquid crystal displays (LCDs), and light-emitting diode (LED) displays. Problems with light reflection have led the researchers to recommend against conventional video monitors. Extremely high-resolution monitors are currently being considered for testing in Gothenburg. The public transport authority has also experimented with different typefaces and the resolution of LCDs and LED displays for ease of readability in outdoor applications.

Another finding by the technology research group is that real-time information must be available in the immediate vicinity of the bus stop. Gothenburg was the first city to put real-time information on the Internet in 1995. Initially providing information showing the next two arrival times for all streetcar lines, the system successively added corresponding information for bus services, with real-time next bus information for all bus stops on the web by the end of 1997. Although helpful, this information would be useful if it were available to a person on the go (not only through a home or office computer). Further demonstration projects are underway to test the use of the telecommunications network to transmit real-time information using cellular telephones and pagers.

Increasing traffic congestion and declining public transit ridership led Jonkoping to adopt the philosophy "think tram, use buses." Because the city was too small to support light rail, in 1993 the city began planning for a new public transport system that would be as convenient and reliable as light rail, but using buses.

When Jonkoping's new transport system was unveiled in 1996, the system included an AVL system for all buses, and the vehicle location information is translated into estimated arrival times at all 130 city bus stops.

#### *Switzerland*

Zurich has had real-time tracking of electric streetcars since 1971, using loop detectors in the street and radio transmission via four frequencies. For years, the information was used by central traffic control to determine when to instruct vehicle operators to slow down or speed up in order to maintain on-time performance and to direct operators around ac-

cidents or other service disruptions. The prevailing philosophy was that as long as the service was frequent and operated on time (as it did more than 90% of the time), then no real-time passenger information was needed. Lack of available technology to easily get information to the public was likely no small factor contributing to this philosophy. More recently, however, with advances in technology, real-time passenger information has been made available at major transfer points in the system and in areas with less frequent service. Zuri-Line has begun planning upgrades to the now-antiquated central traffic control center. As part of the upgrades, Zuri-Line will expand real-time passenger information for the public to more locations.

The urban railroad being planned in Zug will also incorporate real-time passenger information systems.

### *England*

Real-time passenger information is provided in some stations of the London Underground. The arrival time of the next train, determined from information gained from loop detectors on the track bed, is posted on electronic signs along the station platforms. Central dispatch can also post messages on electronic signs in some stations to inform the public of current system conditions.

With about two dozen contracted operators, extreme traffic congestion, and the public's lack of respect for the bus priority lanes, TfL is busy trying to maintain a fragmented surface transportation system. Although a large percentage of bus operations are provided by contracted operators, TfL is responsible for bus stations, shelters, stops, and service parameters. Electronic real-time passenger information displays are deployed at approximately 1,000 of the 17,000 bus stops in the city. Microwave beacons on selected signposts detect buses equipped with transponders and transmit the bus position to a control center, where the data are translated into expected arrival times at bus stops. The cost of hardwiring the beacons has prohibited expanding the system beyond a trial project. Furthermore, the upkeep of the bus equipment necessary to transmit vehicle location to the information displays appears to be deficient. TfL is currently considering replacing the real-time passenger information electronic signboards at bus stops with web-phone technology.

Hampshire County has tested real-time vehicle location systems and is ready to proceed with implementation countywide. The county is waiting, however, for a decision on a national common platform for data transmission. Because private bus operators may bid on operating contracts all over the country, operators are hoping for the establishment of a national standard, which will allow operators to invest in one communication link for buses. This link will apply throughout Great Britain.

As a private operator in Birmingham, Travel West Midlands makes investment decisions on the basis of benefit-to-cost ratios. Time savings that will reduce the resources

needed to operate or that will increase service frequency without the need for additional resources are the driving factors behind investment decisions. This free-market approach to providing transit service is a disincentive for the major operators to focus on certain passenger conveniences, such as real-time passenger information, unless the investment will ensure that people board only their buses.

## **SAFETY AND SECURITY**

The tragic events of September 11, 2001, have resulted in an increased concern for the safety and security of patrons and employees of public transportation organizations throughout the world. In response to this concern, many public transportation organizations have begun to evaluate their readiness to respond to potential acts of terrorism that may affect infrastructure and service delivery.

### **Sweden**

Sweden is just beginning to acknowledge that international terrorism could, in fact, become a threat to the Swedish citizens and country. One Swedish senior transportation official stated that, should a terrorist act affect public transportation, Swedish officials would be ill prepared to respond.

Vasttrafik is in the midst of developing a competitive bid process for the operation and maintenance of the tram system in Gothenburg. Transportation officials are currently reviewing a number of important factors that are specific and unique to the operation of the Gothenburg tram system, including traffic operations, security and risk management, rolling stock maintenance, track and electric maintenance, and traffic control systems. Goteborgs Sparvagnar, the incumbent operator, strongly opposes separating the traffic operation portion from the rest of the system. This opposition has raised a number of safety concerns that remain the subject of significant discussion and negotiation. Another factor that is a possible impediment to the contracting proposal for the tram system is the current matrix of rigorous rules and regulations imposed by the Swedish Railway Inspection Authority for the operation and maintenance of trams. These rules and regulations may make it difficult for competitors to bid on tram service. Lack of experience, as well as an enormous initial capital investment, may prohibit potential outside investors. To make a contract profitable and attractive, a new operator must provide service with fewer people or impose a revolutionary view on management and operating processes. At a minimum, the discussion of introducing a competitive bid process to the Gothenburg tram system has placed additional pressure on Goteborgs Sparvagnar to examine every area of its organization to ensure that all resources are being maximized to maintain or improve the quality of service.

Sweden demonstrates its commitment to the safety and security of public transport passengers in a variety of ways.

The commitment reflects the national government's view of social responsibility: there is an extensive social welfare system, illiteracy is virtually unknown, and all Swedes are covered by national health insurance.

Patrons of public transport have high expectations with regard to efficiency, and these expectations are taken very seriously by the transport agency. Swedes simply assume that good quality of service includes safe service—these concepts cannot be separated. Optimum personal security is a fundamental “right” of each Swedish citizen. Violations to this right are the exception rather than the rule.

Vasttrafik is committed to providing areawide real-time passenger information to the patrons of public transport. On-time service is a key element in increasing personal security for Swedish citizens using public transport, as passengers tend to worry mainly about their journey—will they arrive on time? Consequently, the main purpose of providing optimum passenger information is to dramatically reduce the level of uncertainty and worry among passengers. This goal is achieved when all passengers feel that they are in full control of their travel situation. Vasttrafik believes that access to real-time information substantially relieves passenger doubts and contributes significantly to passengers' positive perception of safety and security. This real-time information includes information about disturbances in service and is available through a personal computer, mobile phone, short message service (SMS) text, or pager. Patrons can read the real-time departure information from all stops on the light rail and bus system in the city on the Internet. A traveler's council was established to assist with evaluating the quality of service provided on all modes of transport. In addition, the marketing department conducts routine rider surveys that focus on the patron's experience and perception of their overall “comfort” during their journey.

Sweden has begun experimenting with using digital video cameras on specific light rail vehicles and bus lines as a means of deterring graffiti and occasional acts of violence. Particularly for patrons using the public transport system at night (or during the dark months), video surveillance makes travelers feel more comfortable and minimizes any worries that their safety and security could be compromised. In addition to video cameras, private security personnel are used on specific lines during the weekend.

### Switzerland

The banking, insurance, shipping, and freight industries accommodate an enormous amount of international trade through Switzerland. This influx of international activity and attention might lead one to believe that Switzerland could potentially be a likely target for acts of terrorism. However, according to senior transportation officials in Zurich, the public transport system throughout Switzerland is not prepared to respond to incidents involving terrorism.

Safety is considered an inherent part of service quality.

Although accident statistics were not available, Swiss officials have identified an important trend in accidents that have surfaced over the past 5 years. This trend is associated with switch defects and has propelled a major campaign to reduce switch problems by 10%. In addition, the design of the recently introduced low-floor Cobra trams will help prevent derailments. Another major area of concern is vandalism and graffiti. Vehicles are inspected several times during the day. Any vehicle found to be defaced or vandalized is immediately removed from service. Again, public perception is a critical link to maintaining patron confidence in the public transport system.

Lighting and walkways for the new Stadtbahn Zug were designed with increased security in mind.

Administrative oversight for safety seems to be a bureaucratic function established at the national government level through a series of regulations and rules. It is unclear how compliance is monitored and service impacted by these functions. In the tendering process, the safety record of a potential provider does not appear to be an explicit factor during the selection process. “Security” is dealt with through image projection, as demonstrated through various marketing campaigns. Because crime is relatively low in Switzerland, transit agencies depend on local police and security companies, rather than on transit police.

### England

Prior to the establishment of TfL, bus service in London was autonomous and independent. There was no overall transportation policy or service plan for the city. This resulted in a lack of coordinated city transport services, particularly in emergency situations. Safety and security are now being improved with increased use of CCTV, educational programs in schools, better coordination with the police, improved access to bus stops, and shelters that are equipped with adequate lighting and real-time customer information.

As a result of several serious and high-profile accidents, the National Rail network has been under severe pressure to improve safety performance indicators. There does not, however, appear to be a strong oversight function in place to ensure the successful implementation of recent rail safety recommendations. TfL seeks to make these recommendations a priority and ensure their implementation. TfL also strives to improve the security of trains and stations. Some of the concerns about the privatization of the London Underground center on the dismal safety record of the National Rail system, which has been charged with failing to hold its contractors to an acceptable level of accountability with regard to maintenance of equipment and track. One of TfL's major goals is to improve the quality and capacity of London's commuter services through a franchise replacement process and through investment programs to increase the capacity of the network and address overcrowding, reliability, and safety.



## QUALITY ASSURANCE AND CONTROL

### Sweden

Recent tenders from Vasttrafik stated that proposals would be weighted in favor of quality over price (55% quality to 45% price). As part of their proposals, operators had to answer a number of questions about how to ensure quality, how to engage staff in ensuring quality work, and how to share with staff any bonuses for quality improvements. Vasttrafik has started a “quality school” for drivers and has adopted a program of quality passenger terminals.

Costs in the most recent tenders had increased by approximately 30%, and Vasttrafik attributes this increase to the operators’ emphasis on performance. Vasttrafik offers quality incentives for driver performance and appearance, cleanliness of both personnel and vehicles, and headway and routing performance efficiency.

Vasttrafik is also responsible for ferry transport services. Styrsobolaget, the ferry operator, has been certified according to the International Safety Management (ISM) code since 1997 (ISM is an international standard for safety procedures for shipping companies and onboard staff, with the goal of preventing accidents at sea). Vasttrafik has focused on rider satisfaction as the primary means of assessing quality, with ridership surveys used as the principal tool for determining rider satisfaction. The continuous management improvement plan, common to many U.S. transit properties, is used, and numerous monitoring and milestone targets are measured. Vasttrafik also uses its version of total quality management as evidence of its abilities to satisfy customers and improve quality.

Passenger information needs were the driving force behind Vasttrafik’s GoTIC traffic management scheme. Shelter displays, information kiosks, stop-post displays, interior vehicle displays, personal computers, and telecommunication equipment are all used to convey information in this integrated system. A traffic and travel information center was developed to provide passengers with information about travel disruptions. Quality control criteria were established by surveying users about their greatest concerns about public transport; users’ responses led to the development of the center. Passengers regard real-time information about service disruptions as more important than minute-by-minute countdowns to bus arrivals. A travel index, which takes into account any disturbances in traffic flow and the passenger load on different parts of the system, is used to optimize the efficiency of the passenger journey and the overall transport system. An automatic information support system has been developed using static information stored in a database and real-time information from the KomFram system. Quality assurance is provided by feedback from operators and passengers collected in surveys and personal interviews.

Five percent of the Gothenburg population is eligible for specialized transport services at any time, and 12% is eligible some of the time. Vasttrafik is developing and refining

a “free ride model,” which is intended to help optimize the use of FlexRoute services, as compared with shared taxis. The goal is to have FlexRoute services cost no more than 50% of the shared taxi cost. The quality assurance function is provided by (1) the automated trip notification system and (2) the call logging component of the PLANit system. About 25% of passengers use the automated trip booking and notification system today, and smartcard technology is expected to further increase the proportion of users. User satisfaction continues to climb—at last count, 97% expressed satisfaction with the system, with the service-minded drivers described as the most significant factor in passenger satisfaction.

In Jonkoping, Lanstrafiken negotiates with the operating company and its labor union to develop a performance bonus incentive plan. Incentive bonuses are provided for performance judged to be better than that specified in the contract. Passenger satisfaction is measured by rider surveys. Quality control in the design and construction of the new exclusive bus lanes was achieved through milestone reviews by the Lanstrafiken staff, the busway designer, and the city staff. An independent construction manager monitored quality control during construction.

### Switzerland

Quality control and assurance for the new urban railway in Zug will be provided by the public transportation staff, which will conduct numerous thorough reviews during the design and construction stages. Design reviews begin when 10% of the plan is completed and continue when 30%, 65%, and 90% are completed. Construction management will be performed by both the property and the Swiss Federal Railroad system.

Feedback from customers of the Mobility CarSharing is quick and easy, as many customers provide this information when reserving a car. Quality control is also measured by periodic user surveys. Performance at the call center, including waiting time per customer, is continuously monitored so as to readily identify areas for improvement and to increase customer satisfaction with the system.

The quality of service provided by VBZ in Zurich has been degraded by switch problems over the past decade. The cold winters necessitate that switches be heated to avoid icing up, but the heat causes the rails to expand, which can cause service problems. Collisions between trams have occurred as a result of switch malfunctions and driver error. The quality solution to the collision problem is to provide better signal information to the driver and to more frequently perform manual checks of the switches, which are sometimes vandalized. Quality improvement efforts include better maintenance of switches, automation of the switches, and better training of VBZ personnel. VBZ is also upgrading its real-time information center to provide better information to drivers and field maintenance staff.

VBZ has a very impressive maintenance operation, with

0.7 maintenance workers for each driver. Maintenance quality is outstanding. VBZ performs all of its maintenance in house at its own facility with its own staff. Complete rebuilds are scheduled every 6–8 years, increasing the useful life of the trams well beyond the life tracked for financial amortization reasons. Continuous daily monitoring of performance ensures improvement in process and performance of VBZ.

The VBZ quality programs are a model of efficiency and are continually being updated. Zurich's Modern Mobility Management program was accorded exemplary status at the 2000 World Fair in Hannover, Germany.

## England

Passenger satisfaction with bus service quality in London is largely based on three critical items: journey time, wait time, and staff behavior. Bus priority lanes and signals provide quality improvements by improving accessibility, improving network efficiency, and shifting more trips to public transport (and thus reducing traffic levels). The bus priority system includes bus route length priorities (bus lanes and gates), along with bus advance areas and lanes for queue jumping (i.e., bypassing traffic queues at intersections). Bus priority has reduced travel time by up to 35%, which has helped generate an increase in patronage and a related 20% revenue gain. Traffic signal priority for buses, using selective vehicle detection at intersections, has cut delays by 32%. Additional quality initiatives include bus network improvements, vehicle quality improvements, fares and ticketing improvements, and supplemental bus priority. Remote viewing along the whole route is the next objective; the goal is to monitor traffic flows and keep private automobiles out of bus priority lanes and away from bus stops (violators will be ticketed). The system will include on-bus and roadside CCTV cameras that will monitor bus lanes, parking and loading facilities, and passenger compartments.

Construction of bus stop improvements and purchase of low-floor, easy-access buses is included in the quality upgrade priority list. London Buses is introducing several other quality initiatives: more buses, fare freezes, new Bus-Saver tickets, the flat fare, ticketless bus travel, and more low-floor articulated buses.

London Underground proposes to make the best use of the city's Underground network and make the best use of available financing, whatever its source; the most important factor is the way the assets are managed. Good industry practice demands an approach that considers performance and cost over the whole asset life-cycle of design, construction, maintenance, refurbishment, and replacement. London Underground also believes that what is true for individual assets is also true for asset systems. The Underground's assets should therefore be managed on a system basis, and the quality of systems integration is the single biggest factor influencing the future performance of the London Underground. To maximize incentives to deliver, responsibility

for performance management should be where the systems integration skills are—namely, in the marketplace. By contracting with private-sector asset management companies on a long-term performance basis, London Underground hopes to access a stable, diversified set of skills and create incentives for an efficient, innovative whole-life approach to the business of managing, upgrading, and maintaining the assets of the Underground.

Under the proposed PPP, full responsibility for the performance of the assets will be accorded to the partners, who will be free to make their own investment decisions. There is no leeway when it comes to safety, however. London Underground retains statutory railway safety responsibility as “infrastructure controller” and can impose decisions unilaterally where safety requires such decisions. The format of the London Underground PPP reflects not only the objectives originally set by the central government, but also a seasoned response to the environment in which London Underground works. The division of responsibilities among London Underground, the central government, the partners, and the mayor plays to the strengths of each partner.

The 26 member companies of ATOC work together to improve rail services through improved passenger information, fare schemes that offer substantial discounts, publication of national rail timetables (incorporating all train companies' schedules) and conditions of carriage, and coordination of assistance for passengers with disabilities.

The 1993 Railways Act set up a rigid framework for the operating companies that is meant to reward success and let failure occur if the operating companies cannot perform. Two major accidents have caused ATOC to focus on safety and infrastructure improvements through capital investment. The Ladbroke Grove diesel fuel fire and the Hatfield event caused by either gauge corner cracking or fractured rail have led to strong quality control and safety improvements. ATOC believes that the quality of the inherited infrastructure from the central government was not good enough for the level of service now being demanded by the traveling public. ATOC recognizes that it must drive up quality of service to a level that customers perceive to be reliable, at the same time creating sufficient capacity to carry the forecasted 50% increase over the coming decade in passengers who want to travel by train.

Replacing the infrastructure will occur in a variety of ways, ranging from replacing broken rails to upgrading older fleet vehicles. Identifying the causes of delay is relatively simple, but of no comfort to the passenger; ATOC has therefore set up task forces to analyze not only the causes of each problem, but also ways to fix it. These task forces will enable ATOC to rectify the underlying problems, to respond more effectively when problems do occur, and to devise robust contingency arrangements to ensure the return to quality service.

Quality improvements have been made regarding punctuality and reliability, but train operators acknowledge the need for further improvement. New investment in trains and

infrastructure is an important step toward improved quality. The industry punctuality record does not match current passenger perceptions of service. Present scoring systems count only the peaks on weekday commuter services and have a huge allowance for the declaration of “void” days (which are declared for anything deemed beyond the operator’s control, such as animals on the track, slippery track, or serious infrastructure failure). Safety on the railways will never be compromised for punctuality according to SRA. ATOC members have considerable incentives for improving performance, the first being to make customers happy so that they will become repeat customers. ATOC members also operate to performance regimes that earn the members bonuses from SRA for exceeding the timekeeping targets and penalize the members for missing the targets.

ATOC members have set up a joint National Performance Task Force to coordinate local initiatives aimed at identifying and rectifying the root cause of major delays. Of particular concern is the speed with which services get back to normal after an incident, so that onerous subsequent delays are avoided. ATOC members are improving their communications and problem diagnosis so that contingency arrangements can swing swiftly into place.

Improving the infrastructure and system reliability requires capital investments. The country’s entire rail system will have a new train protection and warning system installed by the end of 2003, with full automatic train protection to be added to all high-speed lines. New customer information systems that will provide real-time train information are being installed at nearly every station. ATOC members have instituted an internal “Teamtalk” program to encourage and collect employee feedback and suggestions for improved quality service, as well as to make certain that information flows both up and down the organization.

A variety of survey techniques have been used to evaluate the effectiveness of each component of the ROMANSE project. To measure user reaction, surveys were typically conducted at bus stops, train stations, and other areas where passengers gather; the results were compared against baseline surveys taken before installation of the system. The ROMANSE project also included an urban incident detection system, known as INGRID, which was evaluated using data collected in the 7-month period from May to November 1994. Events that altered traffic conditions were classified as incidents, and these incidents were categorized as severe, moderate, or minor. The evaluation process revealed that user confidence was most negatively affected by false alarms.

Monitoring and evaluating the socioeconomic benefits of the project is extremely subjective at best, but efforts have been made to express results in terms that can be reduced to monetary units. The common yardstick for comparing the products has been the amount of time, on some sort of average, that each user would have to save in order to justify the capital investment (based on values of time set forth by the transport department). The savings were relatively low except for variable message signs and TRIPlanner, which

are installed at a wide variety of locations and which provide travel information useful for trip planning.

Upgrading quality on the dense and comprehensive network of Travel West Midlands is difficult, but several quality initiatives are underway. Efforts at infilling and at providing express service on some of the most heavily traveled corridors have been successful. The West Birmingham route was carefully planned to provide quality service to students and shoppers. Route branding has also been used to improve quality of service on upgraded routes. Market analysis surveys geared to both existing and potential customers are used to measure and improve quality of service. Staff members are also surveyed for their views on quality product development. Future plans for upgrading quality largely focus on low-floor buses and partnerships to provide the necessary infrastructure improvements. Improvements include designated bus lanes, priority at traffic lights, and upgraded facilities at stops, many with real-time information.

As the operator of Midland Metro, Travel West Midlands ensures an integrated multimodal public transport network and improvements in ticketing and fare collection procedures. System reliability has been improved through upgraded scheduled maintenance and investment in a new maintenance facility. The number of timing checks on route performance has increased. However, according to Travel West Midlands staff, safety remains Travel West Midlands’s priority. All stops are well lit and have CCTV and direct intercom links to the control center. Where the Metro runs parallel to the road, the trams are governed by the same speed limits that control all other traffic. In central business areas, trams slow for the benefit of pedestrians. Trams are also fitted with warning bells. Special crossing points with unobtrusive fencing enable pedestrians to cross the tracks safely. The lightweight overhead power wires are well out of reach. Where the system runs along the road, wires are at least 5.8 m (19 ft) high, except where the line runs under bridges, where they are still 5 m above the road.

## **BUS AND RAIL MAINTENANCE**

Maintenance programs and responsibilities varied among countries, transport companies, modes of transportation, and related infrastructure. The transport service providers visited during this mission were almost exclusively contractors, with responsibility for rolling stock maintenance specified in their contracts.

Generally, bus transport service was provided through a tendering process, with the responsibility for maintaining the rolling stock outlined in the contract and the reliability of the bus fleet measured through contract performance specifications. For the infrastructure related to the provision of bus transportation, responsibility was generally split between the owner (responsible for street furniture, customer information systems, and bus transfer stations) and the contractor (responsible for bus maintenance facilities).

Light rail (i.e., tram) transport was generally provided through a tendering process for operations and vehicle maintenance with the capital investment (i.e., vehicle purchase) supported by the owner (i.e., municipality or government). Heavy rail transport was generally provided through a tendering process for the operation and maintenance of rolling stock, with the infrastructure maintenance the responsibility of the public sector. This arrangement was especially common with the shared right-of-way track and power infrastructure.

Special transport service (i.e., paratransit and elderly services) was exclusively provided through a tendering process, with the maintenance responsibility for rolling stock provided by the contractor. Street furniture was minimal and incorporated into existing “big bus” service.

### Sweden

Maintenance responsibility for all modes of transportation service belongs to the service operator. During the tendering process, expectations in terms of fleet reliability (i.e., maintenance) are included in the contract specifications. Specific performance standards are stipulated, with both incentives and penalties. Although contract specifications vary somewhat throughout the region, contract payment is generally valued at 75% of the tendered amount and 25% of the farebox receipts. There is a 10% (of base tender) incentive based on a quality-of-service survey conducted twice yearly and representing 15% of trips. Incentive bonuses are earned for customer satisfaction levels of 80% or higher. Penalties are assessed for missed trips (3,000 SEK), trip performance below 90% (1,000 SEK), inadequate trip signage (i.e., destination and route designation) (3,000 SEK), and failure to have the free Metro publication onboard a bus (1,000 SEK). The incentive program and the penalty program help ensure reliability.

Maintenance responsibility for system and common infrastructure assets belongs to the municipality or authority. This responsibility applies to the operating communications systems, customer information systems, track and electrification systems, fare collection systems, and street furniture and equipment. The authority typically contracts the maintenance service to the original equipment manufacturer, with incentives and penalties to ensure a high level of performance.

### Switzerland

Maintenance in all transport agencies visited was the responsibility of the operating companies, with the single exception of the shared railway, which was maintained by SBB. In Zurich, VBZ’s goals for the year included reducing the number of switch problems by 10%. This goal resulted when a review of system delays and lost trips identified switch failures as a leading cause of system interruptions.

One problem with the new Cobra tram cars in Zurich is that the cars, at 36 m, exceed the physical capacity of the

maintenance garage. The operating company is exploring means of “bending” the car into the garage—once inside, the car will then be moved onto the maintenance tracks. This new method points out the need for ensuring full integration of all aspects of the system, including the supporting infrastructure.

### England

Maintenance in both bus and rail systems is a mix of private, public, and partnership endeavors throughout the three cities visited. The greatest challenge lies with the rail infrastructure of the national railroad and the London Underground. Investigations of recent derailments and accidents show the cause to be deferred or delayed maintenance of the signal systems or track.

## LOW-EMISSION VEHICLE TECHNOLOGIES

Transit properties in Europe began aggressively experimenting with alternative power plants and fuels beginning in the early 1980s. Two primary public policy methods are used in Europe to reduce bus pollution. The first method uses traffic management techniques, such as signal prioritization and dedicated bus lanes, to ease traffic congestion, thereby reducing idling times for all modes of traffic and encouraging people to choose mass transit. The second method is the testing and implementation of different power plants on the bus and the use of cleaner burning fuels such as ultra low sulfur diesel (ULSD), compressed natural gas (CNG), and liquefied natural gas (LNG). These methods require the support and active participation of transit properties.

### Clean Diesel

The combination of ULSD and particulate filters on new diesel engines is what is referred to in the industry as “clean diesel.” ULSD is diesel fuel with less than 30 parts per million (ppm) of sulfur content, as opposed to regular diesel fuel, which has more than 500 ppm of sulfur. When combined with the use of newer model diesel engines equipped with particulate filters in the exhaust system, ULSD reduces emissions significantly across the board compared with regular diesel, especially the reduction of particulate matter.

### CNG and LNG

Both CNG and LNG are defined as alternative fuels, and different engine and power trains are needed for their operation. CNG is a technology that has been in service throughout the world for over a decade, and CNG fueling infrastructure is available in most countries. The experience reported in the European cities visited, however, shows the per-mile cost of CNG to be higher, and the range between fill-ups

lower, than is the case with diesel fuel. These two factors have been the primary reasons for CNG's relatively low market share.

LNG has an almost negligible market share because of the relative difficulty in both obtaining and handling the fuel. Except for a small pilot program that was canceled several years ago in Birmingham, England, and three LNG buses currently being operated in London as a pilot, the use of LNG is rare.

### **Diesel-Electric Hybrid Buses**

Diesel-electric hybrid engines are another alternative propulsion system. Simply stated, these power plants have a small diesel engine that powers a generator that charges a set of batteries that, in turn, powers the electric drive motor on the bus. In addition, the diesel engine can, depending on the hybrid configuration, engage and provide electricity directly to the motor when additional torque power is needed, such as on an incline or when pulling away from the curb with a heavy load. However, for much of the duty cycle, the small diesel engine is operating at a rate that maximizes the efficiency of the engine, thereby optimizing fuel consumption and minimizing emissions. Regeneration techniques, such as using the braking power of the bus to further charge the batteries, also improve the power plant's range and low emission levels.

When the diesel engine on a hybrid is a clean diesel engine, emission levels are extremely low. However, hybrid technology is still in the early stages of commercial use, and, thus, its capability for long-term, heavy-duty transit service is still in question. In addition, the capital cost, at least in the United States, of procuring the bus itself has recently been as much as 40% higher than comparable diesel or CNG buses. But the fueling infrastructure needed is no different than that needed for a normal diesel bus.

### **Trolleybuses**

Trolleybuses are powered by electricity. Overhead power lines carry electricity to trolleybuses via articulated poles attached to the bus roof, in much the same way as trams are powered. Although trolleybuses have almost zero emissions (not counting the emissions created at the power-generating source), a trolleybus can be nearly twice as costly to purchase, and the cost of building and maintaining the wiring infrastructure is high. In addition, trolleybuses have the decided disadvantage of running on inflexible routes, just like light rail, because they can only be operated where there are existing overhead wires.

### **Fuel Cells**

Fuel cells for vehicle power plant applications have been in development for over a decade. Although the widespread economical use of fuel cells, particularly in engines large

enough to power a transit bus, is estimated to be 10–20 years away, fuel cells promise a power plant that uses a potentially renewable fuel and that produces zero emissions.

A fuel cell converts the chemical energy of a fuel into electricity without combustion. Currently, fuel cells use hydrogen gas as the base fuel. In most applications, a series of individual fuel cells are combined in a "stack" configuration to produce the needed amount of electrical energy. The individual fuel cell itself generally consists of two flow plates with an electrolyte membrane in the middle. The membrane is usually covered with a catalyst to start the chemical reaction. Hydrogen gas is pumped over one side of the membrane, while oxygen is pumped over the other. As the hydrogen passes over the catalyst-covered membrane, it dissociates into positively and negatively charged ions. The positive ions pass through the membrane because they are attracted to the oxygen molecules, and the negative ions are collected at an electrode on the membrane and produce an electrical charge. Depending on the application, the energy from this electric current either runs an electric motor directly or continuously charges a battery that, in turn, powers the engine. The only emissions are water or water vapor and heat.

Currently, the hydrogen fuel itself is most often processed from natural gas. There is, thus, a certain amount of energy used, and emissions produced, to create the fuel itself. However, hydrogen can also be produced by splitting apart water molecules into hydrogen and oxygen using an electrolyzer. This process, when using solar, wind, or hydropower, is truly a green approach to producing hydrogen. There is also the possibility that hydrogen can be processed from ethanol, which itself is produced from renewable corn and other agricultural crops.

### **Sweden**

Beginning in the early 1980s, the city of Gothenburg realized that traffic management policies, while effective, had reached the level of diminishing returns and that further emission reductions would need to come from vehicle tailpipes. The result was a policy requiring the transit agency to stop buying diesel buses. Although well intended, this policy effectively caused emission levels to get worse over the short term because no alternatively fueled buses were then on the market, and the agency's existing diesel buses were forced to continue in service past their useful lives.

Over the long term, however, the great benefit of this policy was to force the Swedish bus makers, Volvo and Scania, to begin developing cleaner diesel engines, and today the diesel engines these manufacturers produce are among the cleanest in the world. Gothenburg city management now agrees that it was a mistake to try and dictate the means to an end, when it was the end result itself—lower emission levels—that was important. Today, 1,450 of Gothenburg's 1,500 transit buses are diesel buses burning ULSD fuel, with the average age of the fleet being 5 years.

According to Gothenburg city management, future transit bus purchases will likely be clean diesel vehicles.

The 50 remaining buses in the fleet are powered by CNG and are fueled through a privately operated fueling station at one of the transit garages. In addition, one hybrid diesel-electric bus is being tested to determine its suitability for revenue service.

All of the 250 buses operating in Jonkoping are clean diesel buses manufactured by either Neoplan or Scania, and the average age of the fleet is only 2 years. Hans Funck, Arriva's district manager, prefers clean diesel over the use of CNG because of clean diesel's "very comparable emission levels and lower costs of operations." The primary additional cost of operating CNG are the higher marginal cost of the fuel itself and, especially, the separate fueling infrastructure. (Funck's experience with CNG comes from Arriva's contract to operate the Malmo, Sweden, bus fleet. Malmo's 120 buses operate on CNG and are manufactured by Volvo. When asked why Arriva runs CNG buses in Malmo while operating clean diesel buses in Jonkoping, Funck replied that it was a political decision by the municipality.) Funck mentioned that one rather ironic problem encountered with the newest Scania clean diesel bus was that the engine runs so cool that the particulate filter is not activated.

### Switzerland

The Zug transit bus fleet is 100% diesel. The fleet runs on ULSD, but the high average age of its fleet means that very few clean diesel engines have yet been purchased. According to Stephan Kempf, engineer for the canton of Zug, several CNG buses have been tested in previous years, but they were found to be more difficult to maintain than diesel because of the cost of the fueling infrastructure. The higher cost led the canton government to make a business decision to eliminate the use of CNG and purchase clean diesel engines on all new buses as the fleet is upgraded.

Zurich operates some trolleybus lines, but the vast majority of the bus fleet consists of diesel engines burning ULSD. Zurich's bus fleet is similar in age to that of Zug, and its emissions levels, even with the use of ULSD, are higher than would be expected with clean diesel buses. Zurich experimented with CNG buses for several years, but the program has been canceled.

According to Beat Cagienard, deputy CEO of VBZ, until recently the agency was moving toward the trolleybus as a means of lowering emissions, but has since concluded that "the trolleybus is a dying technology" because of its cost and because of the availability of better methods of reducing emissions. VBZ had commissioned a report in the summer of 2001 that compared the costs and benefits of diesel buses, CNG buses, and trolleybuses. In addition to concluding that the trolleybus was not a cost-effective way to reduce emissions, the report strongly favored clean diesel as opposed to CNG. The study found that the benefit-to-cost ratio of CNG was not as good as that of ULSD.

Cagienard said that "CNG would make a lot of sense for a system that is basically starting from scratch... but a mature diesel system like Zurich cannot afford it."

### England

London has a fleet of 6,000 buses running over 600 routes making 17,000 stops. London's bus fleet consists of a wide variety of types and ages. Although all London buses run on ULSD, only the most recently purchased buses operate using clean diesel technology. The latest addition to the fleet is a Volvo TL, a low-floor double-decker that will eventually replace the old rear-entry double-deckers. As buses reach the end of their useful lives, they will be replaced with clean diesel buses. Beginning in 2003, London will run three fuel cell buses in the hopes of furthering the development of this technology. In addition, London is currently running three LNG buses in a pilot program, but no results are yet available.

Several private carriers operate Hampshire County's bus system. These private carriers have experimented over the years with a wide variety of alternative fuels and power plants, but the vast majority of the buses consist of diesel engines.

The county ran a pilot using 12 CNG buses, but no information was available about their performance. The county has also run hybrid diesel-electric buses, but found their performance and reliability to be poor, primarily because of problems with the drivetrain. The county has no current plans to experiment further with hybrids, but its staff believes that diesel-electric technology is promising and will improve over time.

Hampshire County has also experimented with several fuel cell buses, and officials believe that this technology is for the long term.

Travel West Midlands's bus fleet in Birmingham is made up of many makes and models of varying ages, but all burn ULSD. Travel West Midlands's current policy is to purchase only clean diesel buses, and the agency has begun to take delivery of several hundred Volvo TL, low-floor double-decker clean diesel buses, as well as many Mercedes Benz 60-ft articulated clean diesel buses.

According to infrastructure manager Steve Jasper, Travel West Midlands has experimented with CNG and LNG buses in the past, but agency managers believe that "clean diesel engines with particulate traps are actually cleaner."

## FARE COLLECTION

### Sweden

Vasttrafik wanted its new ticketing and fare payment system to support Gothenburg's overall transportation goals and to facilitate regional intermodal travel and transfer options for passengers. The ticketing system was not viewed solely as a fare payment function, but as an integral tool to help

meet Vasttrafik's customer service objectives and fare system goals.

Vasttrafik's customer service objectives are the following:

- Depart on schedule,
- Provide information,
- Make the trip pleasant,
- Treat passengers well, and
- Get passengers to the final destination.

Vasttrafik's fare system goals are the following:

- Create a stimulus for travel,
- Make sure that the pricing is equitable,
- Make sure that the ride is worth the cost,
- Increase prepaid revenues, and
- Make sure that the purchasing of tickets is flexible and simple.

Today, Gothenburg has a farebox recovery ratio of 56%, but in the mid 1990s Gothenburg was experiencing only a 30% recovery ratio, with a fare evasion rate of 15% on buses and trams. To build an effective fare payment system, reduce fare evasion, and lower operating costs, the city focused on a comprehensive strategy that encompassed marketing, fare policies, customer satisfaction, and technology.

Ticket inspectors were added to check for valid fare payment on the bus and rail. In addition, all tickets and transfers are validated on the bus or tram as proof of payment. Along with the increased inspections, the authority began a marketing campaign built around the theme of "everyone profits when you pay your fare."

Nonpayment of fares on buses was a crucial issue for the transport authority. As a means of speeding up boarding, bus passengers could typically enter a bus using any door. This practice made it easy for riders to avoid paying a fare. In 1997, in a major policy change, passengers became required to board the bus through the front door.

Another effective policy was to allow the contractors to keep 25% of the passenger fares. The normal practice in Sweden was to pay the private service providers through a performance-based arrangement that did not include a percentage of collected fares. With this type of incentive contract, however, service providers were encouraged to attend to fare payment issues, to focus on increasing ridership levels, and to develop controls to reduce fare evasion.

As a result of these efforts, fare evasion dropped to single-digit numbers. There continues to be a concern about nonpayment of fares on the tram system, but a new smartcard-based ticketing system that is being installed on the region's trams, buses, and rail lines should address this problem.

In 1999, when the different regional transport authorities merged into one organization, Vasttrafik inherited two incompatible magnet-based ticketing systems (from different vendors) and one contactless smartcard pilot. Although the

bus service is contracted out, Vasttrafik owns and is responsible for the ticketing computers and systems.

One of the legacy systems, from ERG-AES Prodata, supported a zone-based fare system with basically one zone per community. This system used single-ride tickets, value cards, and period passes. The system was self-service, and the fare instrument was a paper and plastic magnetic card that was validated by machine.

The other system, Cubic Scanpoint A/S, supported a complex zone structure that could have multiple zones per community. This other system also used single-ride tickets, value cards, and period passes. Driver involvement was required to validate the destination and farecard.

Vasttrafik's decision to acquire a new smartcard ticketing system for the region was based on several factors. Besides the incompatible magnetic systems, the maintenance costs were high on the current 15-year-old equipment. There was also a concern that the older system, with its limited capabilities, was susceptible to fraud. After a public tendering process, Vasttrafik awarded a contract to the ERG Group to deliver and support a comprehensive smartcard system. The system was to be installed and operational by 2002 on more than 200 trams, 50 trains, 26 boats, and 1,300 buses. Plans are for the old fare collection system to remain in place until 2004.

In addition to onboard equipment, the contractor will provide ticket processors, contactless smartcard validators, and portable sales equipment, validation, and inspection devices. The contractor also required GPS equipment to track vehicle positions in order to calculate distance-based fares.

Auto-reload capability for the farecards is an important part of the system, but in the early stages the system will offer only prepaid farecards supported through a network of vending machines, ticket offices, and mobile outlets. In subsequent phases, the system will be enhanced to support Internet sales, automated teller machine sales, and electronic purse charges and credit cards.

With the new smartcard system, Vasttrafik will be conducting a test to evaluate the merits of having passengers check in and out by tapping their smartcard against the reader as they board and disembark the bus or other transport vehicle. If accepted by the public, this model relieves the customer of calculating the exact fare and finding the exact change because these tasks are done by the ticketing system. The model also helps minimize fare evasion.

Gothenburg's fare policies are regionally coordinated, even though there are multiple transportation operators. Fares are relatively expensive and provide about 56% of the operating costs, and all rail systems are barrier free. To allocate the fare revenues equitably among the operators, a survey is performed every 4 years to determine system use and to establish the revenue allocation formula. Once the smartcard system is used throughout the region, allocating fare revenues will be easier and more equitable because actual customer transactions and boardings will be used for calculations.

Although the smartcard is being implemented on a regional basis, the innovation is part of a national policy in Sweden to move toward making travel on public transportation simpler across the different regions by using a common fare payment instrument. Initially, the card will only support a transit application, but the overall goal is to have the cards be used to purchase other services.

Through the early 1990s, Jonkoping continued to see a decline in bus ridership. At the same time, the merchant base in the CBD was losing customers to the commercial areas outside the city. In 1996, the city of Jonkoping and the public transport authority (Lanstrafik) decided to leverage their resources and work together on addressing the declining numbers of riders and shoppers.

Jonkoping has been successful in attracting riders back to the system while increasing the farebox recovery from less than 50% to almost 70%. On two new routes served by articulated buses, the recovery is over 100%.

Patrons needing to purchase a fare ticket are required to use the front door, while riders with a card or pass can board through the other doors and validate their tickets at machines located at each door.

The transport authority's current fare structure includes single-ride payment, farecards, and passes or discount cards. Fare integration for the patrons was improved by having the fare tickets accepted on the ferries and rail system. Current plans are to transition to a smartcard ticketing and fare payment system. With the smartcard system, the transport authority is considering an option to integrate the onboard bus computers, GPS system, and onboard ticketing machines to allow zone- and distance-based fare models.

Over the years, Jonkoping has successfully implemented various field tests demonstrating the use of multiple-application, contactless proximity cards for electronic payment systems in transportation. The city had already used smartcards in programs to automatically debit and collect payments electronically from vehicles traveling on multilane toll roads and parking on and off the street.

### Switzerland

ZVV is responsible for coordinating and administering transport services for the canton of Zurich. This responsibility includes integrating the fare systems and distributing the fare revenues. The fares in the region are zone based and provide convenient fare integration for the customers, who can use the same ticketing system across different towns, transportation modes, or service providers.

Zurich, with an honor system or proof-of-payment fare model, has fare inspectors to randomly check tickets onboard the transport cars to determine whether passengers have a valid ticket or pass for their journey. Customers are required to purchase their fares before boarding the bus, tram, train, or ferry vehicle. Fare tickets are sold at vending machines located at the tram stops and stations throughout the city. The machines accept only coins and do not return change.

The practice of not accepting bills or returning change improves the reliability (i.e., availability for patrons) and helps reduce the equipment maintenance and service costs.

The passenger fare revenues collected by ZVV are allocated to each of the operators using negotiated agreements and a service formula. Between 53% and 56% of the costs are recovered from passenger revenues. The canton of Zurich and the local governments provide the additional operating funds based on a formula allocation and level of service.

The existing ticketing machines have been in service for many years and do not offer the increased functionality available with today's technology and new electronic payment systems. Similar to other regions in Switzerland, Zurich is in the process of moving to a smartcard-based fare payment system. The new smartcard fare payment system offers the region more options to increase fare integration between service providers. In addition, the system streamlines the process for allocating passenger revenues back to the appropriate operators.

In Zug, operators of the new urban railroad will be responsible for coordinating ticketing equipment and fare integration with the different private bus service providers. In the initial phase, the fare payment process will use the existing systems and work to transition to a standardized regional fare instrument.

### England

Passengers in Birmingham can purchase a single ride fare on any Travel West Midlands bus with exact change or buy a pass or multiuse ticket at another location. The majority of bus riders, 63%, use a flash pass to board a bus. The company has been field-testing a smartcard fare payment system and is planning to implement smartcard systemwide.

The Midland Metro light rail line, also operated by Travel West Midlands, operates on the proof-of-payment model. On a random basis, conductors board the cars to inspect the passenger fare tickets to ensure validity. The fare payment and ticketing component of the Metro was problematic from the initial opening. The ticket vending machines were intended to accept coins and bill notes and issue the full range of single, return, transfer, and day tickets, including the day pass. However, the equipment was slow and often experienced problems processing transactions and issuing tickets. Because there was only one machine per platform, there could be long lines to purchase a ticket. The machines were not linked to the Metro control center, making it difficult to monitor and correct malfunctions or to download the data, which had to be done manually. There was also a problem with vandalism of the machines. The situation worsened as the equipment consistently malfunctioned and was not available for customers. With a high out-of-service rate, the vending machines were removed from service at all stops except for two terminals, West Bromwich Central and Bilston Central.



As a result of these problems, there was an increase in the number of riders not paying to use the system. Subsequently, in early 2001, conductors were hired to check fares on the line. With the presence of conductors on most of the trams, fare evasion became less of a problem.

The London transportation systems have been in the middle of a demanding and difficult process to meet legal and public mandates to increase the levels and quality of service. At the same time, all of the transport modes' different governing and administrative groups had to redefine their roles and make major changes to their organizational functions.

One of the first decisions made in this process was to upgrade the ticketing and fare payment system with smartcards in order to improve integration across all public transport modes, making public transport more attractive for patrons. The new ticketing system was designed to support priorities to

- Improve interchange options and coordination of ticketing between service modes;
- Make the system compatible with the National Rail system through a common ticketing and fare system;
- Speed up boarding by improving ticketing and eliminating the need for cash transactions; and
- Simplify fares for London Bus, Underground, Docklands Light Railway, and Tramlink.

In 1998, London Transport awarded a 17-year contract to the Transys consortium to update the ticketing infrastructure for TfL and London Underground and to develop and deliver an integrated contactless smartcard ticketing system. The Transys group was required to replace the existing fare collection equipment, including fare gates and onboard bus

devices, and provide new ticket vending machines and the supporting revenue systems. New bus ticket machines have already been installed on more than 6,000 London Transport buses.

The Transys consortium, made up of four principal partners—Electronic Data Systems Limited (EDS), Cubic Corporation (CTS), International Computers Limited (ICL), and WS Atkins—invested £150 million (\$234 million) to develop the new system for London.

One of the initial fare-payment-driven strategies put in place to increase efficiency was a “pay before you go” bus service. In October 2001, a new bus service, W7, was established with the goal of speeding up bus journeys by reducing the time buses wait at stops. Drivers on the route do not accept cash payments; patrons must have a prepaid ticket to board the bus. Ticket vending machines were installed on the street at each of the bus stops for customers to purchase a single ticket or a 1-day pass. The ticket machines along these routes accept exact change only (i.e., no bills or notes). In addition, sales outlets were established along routes to sell 7-day and monthly bus passes and travelcards.

The smartcard fare payment system affords London policymakers alternative strategies to develop programs and target specific fare ticketing policies that support broader transportation initiatives. The capabilities of the chipcard technology can be used to overcome some of the barriers to using public transport, make bus-to-bus and bus-to-Underground journeys more attractive, and increase the number of prepurchase options for passengers. An example of this added flexibility is that London can now easily and quickly implement a flat fare policy to encourage bus travel in the city to complement the mayor's proposed congestion charging scheme for central London.

**APPENDIX A—STUDY MISSION TEAM MEMBERS**

Jeanne Krieg, *Team Leader*, General Manager, Eastern Contra Costa Transit Authority (Antioch, California)

Debra Astin, Transit Planner, City of Scottsdale (Arizona)

Jeanette Berry, Senior Project Manager and Planner, Chittenden County Transportation Authority (Burlington, Vermont)

David Braun, General Manager, First Transit Inc./Greater Peoria Mass Transportation District (Peoria, Illinois)

Philip Carroll III, Deputy General Manager—Operations, Metropolitan Atlanta Rapid Transit Authority (Atlanta, Georgia)

Agapito Diaz, Director of Revenue, Los Angeles County Metropolitan Transportation Authority (Los Angeles, California)

Marti Dilley, Manager, Statewide Systems, Alaska Department of Transportation and Public Facilities

John Flynn, Vice President of Technology Management, Chicago Transit Authority

Cynthia Gallo, Director of Safety, Massachusetts Bay Transportation Authority

Susan Joseph, Senior Management Analyst, Regional Transportation Commission of Southern Nevada

Joseph Marie, Director, Rail Service Delivery, Port Authority of Allegheny County (Allegheny, Pennsylvania)

Danielle Matland, Director of Transportation, City of Annapolis Department of Transportation (Annapolis, Maryland)

John Mickelson, Jr., Chief Engineer and Senior Director of Engineering and Construction Management, Metropolitan Transit Authority (Houston, Texas)

Kathryn Harrington-Hughes, *Mission Coordinator*, Director of Operations, Eno Transportation Foundation (Washington, D.C.)

**APPENDIX B—STUDY MISSION HOST AGENCIES/COMPANIES****Sweden**

Vasttrafik Goteborgsomradet AB

Goteborgs Sparvagar

Thoreb AB

Gothenburg Traffic Information Center (GoTIC)

Specialized Transit Service Authority

LogistikCentrum

PLANit

Jonkopings Lanstrafik

**Switzerland**

Amt fuer Oeffentlichen Verkehr (Zug Office of Public Transport)/Stadtbahn Zug

SBB (Swiss Federal Railways)

Mobility CarSharing

Verkehrsbetriebe Zurich (Zurich Public Transport)

**England**

London Buses

Transport for London

Greater London Authority

Clear Channel/Adshel

London Transport Museum

Association of Train Operating Companies

London Underground

Hampshire County Council

Travel West Midlands

**APPENDIX C—ACRONYMS AND ABBREVIATIONS**

ADA	Americans with Disabilities Act
APTA	American Public Transportation Association
ATOC	Association of Train Operating Companies
AVL	automatic vehicle location
CBD	central business district
CCTV	closed-circuit television
CEO	chief executive officer
CNG	compressed natural gas
CTS	Cubic Corporation (in London)
DDA	Disabilities Discrimination Act (in England)
EDS	Electronic Data Systems Limited (in London)
FTA	Federal Transit Administration
GIS	geographical information system
GLA	Greater London Authority
GoTIC	Gothenburg Traffic Information Center
GPS	global positioning system
ICL	International Computers Limited (in London)
ISM	International Safety Management
ITS	intelligent transportation systems
LBI	London Bus Initiative
LCD	liquid crystal display
LED	light-emitting diode
LNG	liquefied natural gas
LRV	light rail vehicle
ppm	parts per million
PPP	public-private partnership
ROMANSE	Road Management System for Europe
SBB	Swiss Federal Railways
SMS	short message service
SRA	Strategic Rail Authority (in England)
STS	Special Transport Services
TCRP	Transit Cooperative Research Program
TETRA	Terrestrial Trunked Radio
TfL	Transport for London
ULSD	ultra low sulfur diesel
VBZ	Verkehrsbetriebe der Stadt Zurich (Zurich Public Transport)
ZVV	Zurcher Verkehrsverbund (Zurich Transport Association)