SECTION **8**

# FUTURE DIRECTIONS

From the research conducted during this project, it is clear that the transit industry is making significant inroads in improving TTI. While complete integration with other traveler information is still in its infancy, TTI has been proven to improve the perception of transit services and to have the potential to result in a mode-shift toward public transit. However, continued improvements must be made in TTI to ensure this mode-shift.

During the course of this research effort, four key strategies for improved TTI have been identified; the strategies are being deployed by transportation agencies outside the United States or have been implemented by nontransit industries. These strategies are as follows:

1. Improving the data that provides the basis for TTI;
2. Completely integrating TTI with other traveler information, particularly traffic information for "one-stop" regional information shopping;
3. Providing more customer-focused and personalized information, such as bus stop–level schedules and maps and IVR systems; and
4. Providing real-time information using a variety of dissemination media.

In each subsection below, the best examples of agencies that have met these challenges in providing improved TTI are presented.

## 8.1 IMPROVEMENT OF UNDERLYING DATA

While the importance of developing and maintaining accurate and comprehensive data that provides the basis for TTI applications has been discussed earlier in this report, it is a key strategy that can be used to improve traveler information. Data quality directly affects everything along the "information chain," as described as follows (*1*):

> The information chain from collection of raw data through its conversion into meaningful information to its delivery to end users will usually involve a number of organizations spanning the public and private sector. A common division of responsibilities seen in partnerships is as follows. The public authority has the role of data provision and maintenance of data quality. Meanwhile the private organizations have the role of using that data to deliver (commercial) information services to the public.

Thus, if the initial data used by a public agency to generate information for dissemination is not accurate, the information will not be accurate. This lack of accuracy of the underlying data can have significant consequences for the public's perception of the information; therefore, the public's use of the information may be reduced. There are four areas in which data quality can be improved to, in turn, improve TTI:

1. Level of detail,
2. Coverage,
3. Accuracy, and
4. Maintenance.

### 8.1.1 Level of Detail

The level of data detail affects TTI in several ways. For example, data detail can affect routing from Point A to Point B, depending on the customer's mode of travel: "The most suitable route for a pedestrian, for example, might not be the same as that for a cyclist both in terms of the attractiveness of that route and its distance" (*2*). Further, the information generated by scheduling and itinerary-planning systems that rely on bus-stop inventories can be affected by the level of detail provided in the inventory. For example, if a scheduling and itinerary-planning system is being used to guide a person with disabilities from his or her home to a bus stop, it is very important to know whether the path of travel is accessible. Such level of detail may not be necessary for other TTI applications, but it is critical in this type of application.

### 8.1.2 Data Coverage

Data coverage can be critical, particularly when a customer is traveling within a region that has multiple modes or a wide geographic area. For example, if a customer is traveling from San Francisco to San Rafael in Marin County, California, the data underlying the itinerary-planning engine must contain not only data for transit services within the city that will take the customer to the Golden Gate Transit Larkspur Ferry, but also data for services that connect to the ferry once the ferry is at Larkspur Landing (in this case, Golden Gate Transit bus services).

### 8.1.3 Data Accuracy

Data accuracy also significantly affects the accuracy of TTI. For example, if the specific geographic location of a bus stop is in error, several TTI elements will be in error, including real-time arrival or departure information for that stop; onboard next-stop announcements, which could be made at the wrong time; and itineraries that involve that stop. If the location of a bus is not accurate, it will affect the accuracy of the prediction of when that bus is going to arrive at the upstream stops.

### 8.1.4 Data Maintenance

Data maintenance must be performed on a regular basis to ensure continuing data accuracy. Further, as is implied in Section 4, data maintenance can be optimized if an agency maintains only one database that is used for all TTI applications. Often, this is a challenge because different TTI applications need varying levels of detail and coverage. Historically, agencies have had multiple bus stop inventories: one to drive a scheduling system; one to drive an AVL system; one to drive the onboard annunciation system; and so forth. With just one comprehensive bus stop inventory, data maintenance is facilitated, as is building interfaces from each TTI application to this data. For example, it would be ideal to have one bus-stop inventory that underlies scheduling, AVL, onboard annunciation, automatic passenger counting, real-time transit information, trip and itinerary planning, and IVR systems.

## 8.2 INTEGRATION WITH OTHER TRAVELER INFORMATION

A Thematic Long-term Approach to Networking for the Telematics and ITS Community (ATLANTIC) is a project funded by the European Commission, U.S DOT ITS Joint Program Office, and Transport Canada. ATLANTIC is reviewing "the coverage, content and results of European, American and Canadian ITS research and development programs" (*3*). ATLANTIC supports eight forums, two of which specifically address ATIS (i.e., the Telematics-based Traffic and Travel Information Services and Intermodal Collective Transport Information forums). This 18-month project, which ends in December 2002, has done a significant amount of work in examining the present and future of ATIS.

As part of ATLANTIC, a review of U.S. ATIS business models was shared with ATLANTIC participants, and comments were made on this review from a European perspective (*4, 5*). While traffic information was the primary focus of the model review and subsequent European comments, there are many issues that directly relate to the future of TTI systems, as follows:

- **Integration with traffic information:** There are formidable social barriers to providing public transport information; these barriers make it difficult for politicians to challenge the automobile culture by investing in ATIS that provide both transit and traffic information (*6*). However, users have expressed a need for multimodal traveler information: "In Europe, the largely coordinated approach to traffic and travel data appears to have resulted in the establishment of a robust value chain and the identification by key players of profitable positioning points within that value chain" (*7*).
- **Sale of public data, systems, or both:** In terms of TTI, public transit has the opportunity to sell its data (e.g., real-time bus arrival information), "as long as the data being sold is of sufficient quality and is on a level that the private sector cannot replicate by gathering similar data on their own" (*8*). Given that the private sector cannot replicate public transit operational data, this could give transit a distinct advantage in selling its data. Transit agencies selling their data could turn around the relatively recent market of firms that provide transit agencies with a for-fee service that collects, processes, and disseminates real-time information.
- **Content of TTI:** The need for travel time data has been expressed. This is an area that public transit has not undertaken to date. If travel times were provided as part of TTI (and could be compared with the travel times on other modes), the public would be able to make more informed choices about mode(s), route(s), and so forth.

The many presentations made in association with the ATLANTIC project have the same theme—the integration of information services provides the most value to the user of ATIS, of TTI services, or of both. Many current (as of December 2002) projects in the United Kingdom and Europe are focused on the full integration of traveler information, such as Transport Direct, which was mentioned earlier in Section 3.2. In a presentation given at the 8th World Congress on ITS, Transport Direct—a fully integrated system—was presented, as shown in Figure 86 (*9*). Note that Traveline is an existing U.K. system to provide TTI throughout the United Kingdom by dialing one phone number (0870-608-2-608).

Further, over and over again, the idea of providing travel times using various modes has been expressed, representing the need for complete integration of transit and other traveler information. Calculating travel times for different modes is not trivial and would require that many sources of data be combined and processed to predict travel times and that a rather sophisticated algorithm be developed to perform this calculation. In order to handle data from multiple sources, the data would have to be stored using a standard. The TRIDENT

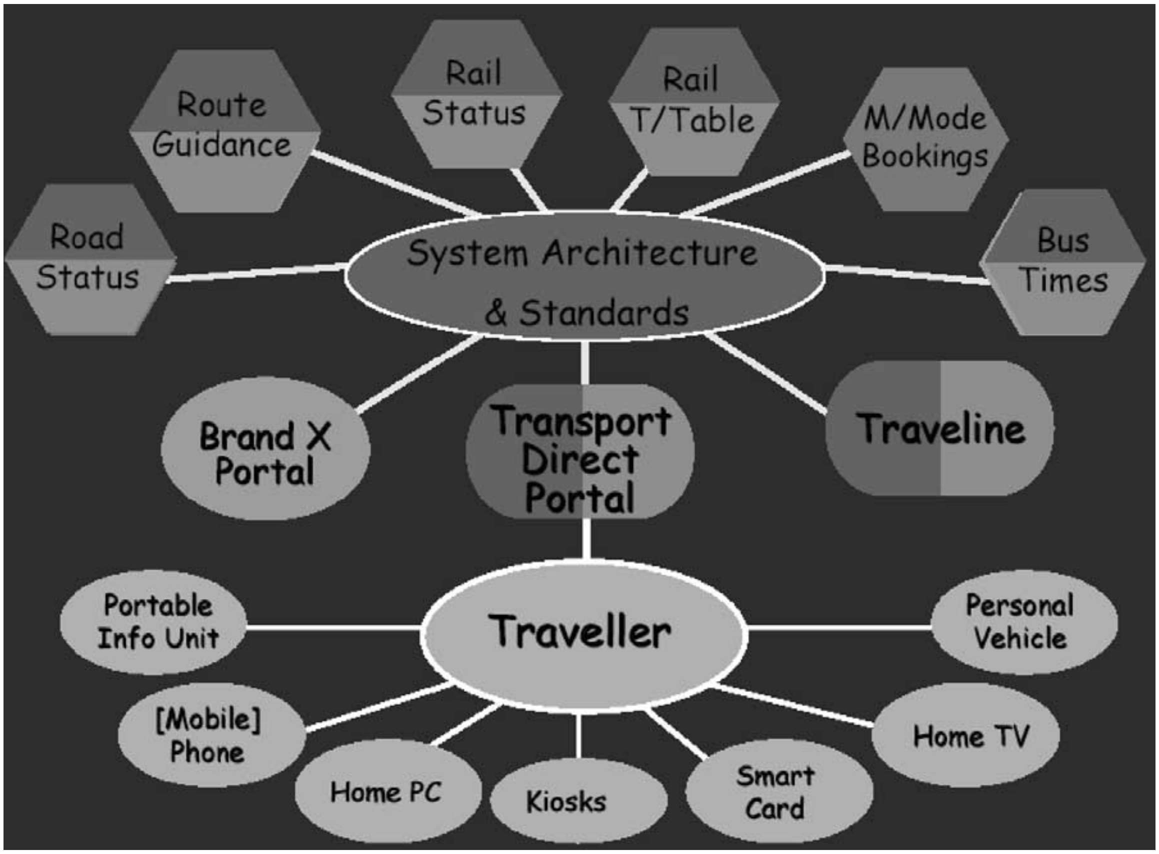



*Figure 86. Vision for Transport Direct in 2003 and beyond.*

project, which was described in Section 7.5, addresses the issue of standards for travel data. However, if the ultimate goal of improved TTI is to be completely integrated with other travel and on-travel services, standards alone are not going to generate such improvements.

Developing an algorithm that is sophisticated enough to produce accurate and reliable travel time predictions has recently been achieved through the DOM project, which was described in Section 5.2.5. In DOM, multimodal routing includes a comparison between travel times and costs for travel by public transport and travel by car (*10*):

> The traveling times for cars consider the individual streets' speed profiles and figures drawn from past experience. The costs are calculated on the basis of values from the German automobile association. The intermodal public transport route is calculated using all forms of public transport (rail and local forms of transport) as well as footpaths and taxi trips.

The evaluation of DOM is not yet complete, so the user's perception of the reliability and accuracy of the travel time predictions is not yet known. In any case, North American transportation agencies should take note of the results of this and other similar initiatives in the United Kingdom and in Europe in order to begin achieving full integration of TTI and other travel information.

Three U.S. initiatives that are attempting to achieve full integration include the 511 system (as mentioned in Section 7.1), the Intermodal Passenger Information System, and TRIPS123. As of February 2003, fourteen 511 systems have been deployed, with many more deployments expected in the near future. While transit has not always been a component of deployed 511 systems, there has been an emphasis on including transit. Further, there have been many discussions of including real-time transit information via 511, if it is available. For example, Utah's 511 system will eventually contain real-time train arrival information for UTA.

An example of a 511 system that may eventually include real-time transit information in addition to real-time traffic and related National Park information is the Tri-State Advanced Rural Traveler Information System (TRIO), which is under development for the states of Maine, New Hampshire, and Vermont. Several technologies (collectively called the TRACKER system), including a real-time transit information system, have been deployed in the bus system in Bar Harbor, Maine, called the Island Explorer. This system, which operates from mid-June through Labor Day each year, serves Acadia National Park and the surrounding communities. It has been proposed that TRIO, which will be integrated into the 511 system, include the real-time departure information that is generated by the TRACKER system.

The Intermodal Passenger Information System is best described as follows (*11*):

> [The] project is a multi-phase effort to implement a fully integrated intermodal and multimodal traveler information system for trips anywhere in the Northeast Corridor. Such an integrated system would provide travel information for long distance, inter-city travelers from origin to destination at various stages of the trip process: trip planning, trip initiation, and en-route. Stage 1 efforts have assisted in linking the trip planning systems of Greyhound and New Jersey Transit; soon to be added are the trip itinerary planning systems of SEPTA, WMATA and MdMTA [Maryland Transit Administration in the Baltimore area]. This effort is also being coordinated with the work FTA is advancing in trip planning at the federal level.

TRIPS123, which is expected to be operational in early 2003, is a multimodal traveler information system for the New York–New Jersey–Connecticut region. The system comprises three distinct services: (1) the free Traveler Information Center, which allows travelers to make better informed travel choices; the free Transit Advisory System, which assists travelers to make regional trips using multiple carriers; and the for-fee Personalized Traveler Service, which proactively alerts travelers about any events that could affect their travel times (*12*).

In terms of the need for standards that specifically address the integration of TTI with other traveler information, the development of the National Transportation Communications for ITS Protocol (NTCIP) is supposed to fulfill that need (*13*):

> NTCIP is a family of communications standards for transmitting primarily data and messages between microcomputer control devices used in Intelligent Transportation Systems (ITS). NTCIP is intended for use in all types of management systems dealing with the transportation environment, including those for freeways, traffic signals, transit, emergency management, traveler information, and data archiving. NTCIP is intended for use between computers in different systems or different management centers, and between a computer and devices at the roadside. NTCIP allows agencies to exchange information and (with authorization) basic commands that enable any agency to monitor conditions in other agencies' systems, and to implement coordinated responses to incidents and other changes in field conditions when needed.

The use of NTCIP is not widespread enough yet to have solved the basic problem of multiple transportation agencies providing data into one repository, which then disseminates the information to the customer. The TRIDENT project in Europe, described in Section 7.5, has begun to be successful in addressing this issue.

The Transit Communications Interface Profile (TCIP) is the transit series of standards that are part of the NTCIP family. TCIP contains nine data and message standards, as follows:

1. **NTCIP 1400: TCIP Framework**
2. **NTCIP 1401: Common Public Transport Objects**
3. NTCIP 1402: Incident Management
4. **NTCIP 1403: Passenger Information**
5. **NTCIP 1404: Scheduling and Runcutting**
6. **NTCIP 1405: Spatial Representation**
7. NTCIP 1406: On-Board
8. NTCIP 1407: Control Center
9. NTCIP 1408: Fare Collection

Of the nine standards, five are directly related and used in TTI systems. These are numbers 1, 2, 4, 5, and 6 in the list above. Currently, FTA and APTA are leading an effort to complete the standards development and to expedite deployment of systems using the standards. A pilot implementation of a TTI system using the standards is being planned for Summer 2003.

As mentioned in Section 5.2.4, there are several aspects of this project that are unique to most TTI systems and have applicability to providing TTI services in the United States. First, this personalized service must process and integrate data from several different sources. The architecture, which was shown in Table 10, identifies categories of the providers of information and transit services as follows:

- Content owner;
- Content provider;
- Service operator;
- Service provider; and
- Network provider.

This categorization could be used in the United States; however, as of December 2002, most U.S. transit agencies that provide TTI services are owners and providers of content and service. Perhaps using a more distributed architecture, such as the one used in PIEPSER, would relieve transit agencies of the responsibilities associated with directly providing such information. On the other hand, having transit agencies directly provide this information ensures the quality of the information.

Second, this service is provided to a limited number of transit customers—those who purchase monthly transit passes. These pass buyers have the option to subscribe to this service. If they subscribe, data on their regular transit trips is recorded, along with their mobile telephone number. Limiting the service to pass holders minimizes the data processing required.

Third, Unified Modeling Language (UML) is the standard language used for system design and software. Using a standard language such as UML facilitates the system design by allowing both actual and conceptual components to be defined (*14*):

> [PIEPSER] does not only deliver disruption messages [via Short Message Service], but also suggestions on alternative ways to act. The generation of these scenarios takes into account the traffic conditions regarding traffic flow and the availability of car parks. Furthermore, information is also provided on current road works and diversions.

## 8.3 PROVISION OF MORE CUSTOMER-FOCUSED AND PERSONALIZED INFORMATION

Throughout this report, the idea of what the customer needs has been discussed frequently. Several TTI systems that provide personalized TTI have been presented to show how transit agencies are becoming more customer-focused, and the fact was discussed that choice riders are no longer satisfied with paper schedules and speaking to a customer service operator to obtain TTI. In this section, two examples of improved TTI that integrate other traveler information, an element discussed in Section 8.2, are presented: stop-specific timetables and IVR technology.

### 8.3.1 Stop-Specific Timetables

Transport for London recognized the need to provide improved static and dynamic traveler information to the public. The Countdown system, previously described in detail in Section 5.2.1, is providing real-time information to the public at bus stops. In terms of static data improvements, Transport for London has redesigned bus timetables and maps to provide customers with information at the bus stop level. Through Transport for London's website, customers can obtain bus stop specific schedules (journeyplanner.tfl.gov.uk/user/XSLT_STT_REQUEST?language=en, as of December 2002).

London Bus timetables that were available before stop-specific timetables were developed, such as the one shown in Figure 87, were typical schedules showing all stops along the route and the time that the bus would be at each stop (*15*). These timetables were viewed as difficult to understand, did not provide clear information about the bus at an individual stop, and did not reflect how the buses actually run.

Stop-specific timetables, such as the one shown in Figure 88, were designed based on extensive customer research. Customer response has been very positive since the distribution of these schedules, which started in March 2002. It is expected that all 65,000 timetables will be available by the end of the 15-month rollout (the rollout is being done by area) in June 2003. The features of these stop-specific timetables are as follows:

- From a bus user's point of view, the timetable
  - Provides information about his or her bus from his or her stop,
  - Is easy to read and understand, and
  - Reflects how the buses actually run.
- The design features include the following:
  - The frequency chart portion of the timetable, which
    - Removes "spurious accuracy,"
    - Provides information in a large font size,
    - Has clear time banding,
    - Uses a 12- and 24-hour clock,
    - Shows first and last buses, and
    - Shows night buses separately.
  - The route diagram portion of the timetable, which
    - Shows the direction of travel,
    - Shows the current stop,
    - Shows where the bus has been,
    - Shows the approximate journey time, and
    - Clearly links the Night Bus route with frequency.

Spider maps, similar to the familiar London Underground maps, were developed recently to show bus services from specific stops (see Figure 89). Multiple maps are provided for each borough in London (www.tfl.gov.uk/buses/route_maps.shtml). These maps, which were developed based on considerable customer research, are much easier to use than the standard bus maps and give an easy-to-understand graphical view of all of the bus services emanating from a specific stop. Most of the high volume bus stops have spider maps available.

Transport for London also has an interactive map that a customer can use to generate information about particular London Underground stations, including information on bus connections, bus spider map (if available), train times, station facilities, station access, a local area map, and the opening hours if there is a travel information center at that particular stop.

Another improvement in customer-focused information is the use of IVR systems. Voice recognition technology provides the basis for IVR systems, which are beginning to be used to provide TTI. IVR systems can include the following functionality:

- Automatic speech recognition and text to speech (as used by Denver RTD and described in Section 4.2.1);
- Provision of general transit information, including hours of operations, fares, and so forth;
- Paratransit trip reservations, confirmation, and cancellation;
- Paratransit trip notification, which notifies the customer a certain amount of time before the vehicle is scheduled to arrive;
- Transit pass sales;
- Provision of real-time transit information, such as ETA for a specific bus stop;
- Administration of customer surveys; and
- Provision of trip- or itinerary-planning information.

### 8.3.2 IVR Technology

WMATA's RideGuide system, which was described in Section 4.2.1, is available via telephone using IVR technology. This system, implemented in November 2002, allows callers

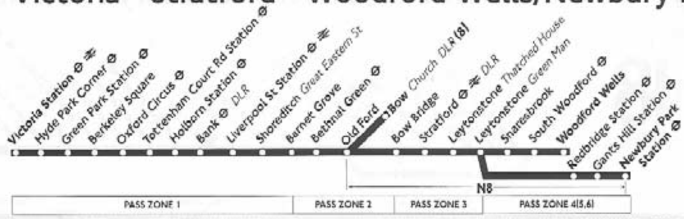
# 8

Daily

# N8

Every night

## Victoria - Oxford Circus - Bow
## Victoria - Stratford - Woodford Wells/Newbury Pk




### Mondays to Fridays

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Victoria Station ⊖ ≋ | 0550 | 0605 | 0620 | 0633 | 0645 | 0657 | 0707 | 0717 | 0727 | 0735 | | 2103 | | 2325 | 2340 |
| Hyde Park Corner ⊖ | 0553 | 0608 | 0623 | 0636 | 0648 | 0700 | 0710 | 0720 | 0730 | 0739 | | 2106 | | 2328 | 2343 |
| Oxford Circus ⊖ | 0559 | 0614 | 0629 | 0642 | 0654 | 0707 | 0717 | 0727 | 0739 | 0749 | *Then* | 2113 | *Then* | 2335 | 2350 |
| Holborn Station ⊖ | 0607 | 0622 | 0637 | 0650 | 0703 | 0716 | 0726 | 0736 | 0748 | 0758 | *about* | 2123 | *about* | 2343 | 2358 |
| Bank Station ⊖ *DLR* | 0617 | 0632 | 0647 | 0700 | 0713 | 0726 | 0736 | 0748 | 0800 | 0810 | *every* | 2131 | *every* | 2350 | 0005 |
| Liverpool Street Station ⊖ ≋ | 0620 | 0635 | 0650 | 0703 | 0717 | 0730 | 0742 | 0754 | 0806 | 0816 | *6-8* | 2134 | *10* | 2353 | 0008 |
| Shoreditch *Great Eastern Street* | 0623 | 0638 | 0653 | 0706 | 0720 | 0733 | 0745 | 0757 | 0809 | 0819 | *minutes* | 2137 | *minutes* | 2356 | 0011 |
| Bethnal Green Station ⊖ | 0628 | 0643 | 0658 | 0712 | 0726 | 0740 | 0752 | 0804 | 0816 | 0826 | *until* | 2142 | *until* | 0001 | 0016 |
| Old Ford *Parnell Road* | 0634 | 0649 | 0705 | 0720 | 0735 | 0749 | 0801 | 0813 | 0825 | 0835 | | 2149 | | 0007 | 0022 |
| Bow *Church DLR* | 0638 | 0654 | 0710 | 0725 | 0740 | 0755 | 0807 | 0819 | 0831 | 0841 | | 2153 | | 0011 | 0026 |

### Saturdays

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Victoria Station ⊖ ≋ | 0550 | 0610 | 0630 | 0650 | 0710 | 0728 | 0742 | 0755 | 0807 | | 0914 | 0921 | | 1930 | | 2325 | 2340 |
| Hyde Park Corner ⊖ | 0553 | 0613 | 0633 | 0653 | 0713 | 0731 | 0745 | 0758 | 0810 | | 0919 | 0926 | | 1934 | | 2328 | 2343 |
| Oxford Circus ⊖ | 0559 | 0623 | 0643 | 0703 | 0723 | 0739 | 0753 | 0806 | 0818 | *Then* | 0928 | 0935 | *Then* | 1943 | *Then* | 2335 | 2350 |
| Holborn Station ⊖ | 0607 | 0627 | 0647 | 0707 | 0727 | 0747 | 0801 | 0814 | 0826 | *about* | 0936 | 0943 | *about* | 1953 | *about* | 2343 | 2358 |
| Bank Station ⊖ *DLR* | 0617 | 0637 | 0657 | 0717 | 0737 | 0757 | 0811 | 0824 | 0836 | *every* | 0946 | 0953 | *every* | 2003 | *every* | 2350 | 0005 |
| Liverpool Street Station ⊖ ≋ | 0620 | 0640 | 0700 | 0720 | 0740 | 0800 | 0814 | 0827 | 0839 | *8-10* | 0949 | 0956 | *7* | 2006 | *10* | 2353 | 0008 |
| Shoreditch *Great Eastern Street* | 0623 | 0643 | 0703 | 0723 | 0743 | 0803 | 0817 | 0830 | 0842 | *mins* | 0952 | 0959 | *mins* | 2009 | *mins* | 2356 | 0011 |
| Bethnal Green Station ⊖ | 0628 | 0648 | 0708 | 0728 | 0748 | 0808 | 0822 | 0835 | 0847 | *until* | 0957 | 1004 | *until* | 2014 | *until* | 0001 | 0016 |
| Old Ford *Parnell Road* | 0634 | 0654 | 0714 | 0734 | 0754 | 0814 | 0828 | 0841 | 0853 | | 1006 | 1015 | | 2021 | | 0007 | 0022 |
| Bow *Church DLR* | 0638 | 0658 | 0718 | 0738 | 0758 | 0818 | 0832 | 0846 | 0858 | | 1011 | 1020 | | 2026 | | 0011 | 0026 |

### Sundays and Public Holidays

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Victoria Station ⊖ ≋ | 0550 | 0620 | 0650 | 0720 | 0735 | 0750 | 0805 | 0820 | 0835 | 0850 | 0903 | 0916 | | 1040 | | 2325 | 2340 |
| Hyde Park Corner ⊖ | 0553 | 0623 | 0653 | 0723 | 0738 | 0753 | 0808 | 0823 | 0838 | 0853 | 0906 | 0919 | | 1044 | | 2328 | 2343 |
| Oxford Circus ⊖ | 0559 | 0629 | 0659 | 0729 | 0744 | 0759 | 0814 | 0829 | 0844 | 0859 | 0912 | 0925 | *Then* | 1052 | *Then* | 2335 | 2350 |
| Holborn Station ⊖ | 0607 | 0637 | 0707 | 0737 | 0751 | 0806 | 0821 | 0836 | 0851 | 0906 | 0919 | 0932 | *about* | 1102 | *about* | 2343 | 2358 |
| Bank Station ⊖ *DLR* | 0617 | 0647 | 0717 | 0747 | 0759 | 0814 | 0829 | 0844 | 0859 | 0914 | 0927 | 0940 | *every* | 1110 | *every* | 2350 | 0005 |
| Liverpool Street Station ⊖ ≋ | 0620 | 0650 | 0720 | 0750 | 0802 | 0817 | 0832 | 0847 | 0902 | 0917 | 0930 | 0943 | *12* | 1113 | *10* | 2353 | 0008 |
| Shoreditch *Great Eastern Street* | 0623 | 0653 | 0723 | 0753 | 0805 | 0820 | 0835 | 0850 | 0905 | 0920 | 0933 | 0946 | *mins* | 1116 | *minutes* | 2356 | 0011 |
| Bethnal Green Station ⊖ | 0628 | 0658 | 0728 | 0758 | 0810 | 0825 | 0840 | 0855 | 0910 | 0925 | 0939 | 0953 | *until* | 1124 | *until* | 0001 | 0016 |
| Old Ford *Parnell Road* | 0634 | 0704 | 0734 | 0804 | 0816 | 0831 | 0846 | 0901 | 0916 | 0931 | 0947 | 1001 | | 1133 | | 0007 | 0022 |
| Bow *Church DLR* | 0638 | 0708 | 0738 | 0808 | 0820 | 0835 | 0850 | 0905 | 0920 | 0936 | 0952 | 1006 | | 1138 | | 0011 | 0026 |

### Route N8 - Sunday night/Monday morning to Thursday night/Friday morning — Fri night/Sat morn & Sat night/Sun morn

| | Sunday night/Monday morning to Thursday night/Friday morning | | | | | | | | | | | | | | Fri night/Sat morn & Sat night/Sun morn | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Victoria Station ⊖ ≋ | 2355 | 0015 | 0035 | 0055 | 0115 | 0135 | 0155 | | 25 | 55 | | 0425 | 0455 | 0525 | 2355 | --- | 0015 | 0025 |
| Hyde Park Corner ⊖ | 2358 | 0018 | 0038 | 0058 | 0118 | 0138 | 0158 | | 28 | 58 | | 0428 | 0458 | 0528 | 2358 | --- | 0018 | 0028 |
| Oxford Circus ⊖ | 0006 | 0026 | 0046 | 0106 | 0126 | 0146 | 0206 | | 36 | 06 | | 0436 | 0506 | 0536 | 0006 | A | 0026 | 0036 |
| Holborn Station ⊖ | 0018 | 0038 | 0058 | 0118 | 0138 | 0158 | 0218 | | 48 | 18 | | 0448 | 0518 | 0548 | 0018 | 0028 | 0038 | 0048 |
| Bank Station ⊖ *DLR* | 0025 | 0045 | 0105 | 0125 | 0145 | 0205 | 0225 | | 55 | 25 | | 0455 | 0525 | 0555 | 0025 | 0035 | 0045 | 0055 |
| Liverpool St Station *Bus Station* ⊖ ≋ | 0027 | 0047 | 0107 | 0127 | 0147 | 0207 | 0227 | | 57 | 27 | | 0457 | 0527 | 0557 | 0027 | 0037 | 0047 | 0057 |
| Bethnal Green Station ⊖ | 0035 | 0055 | 0115 | 0135 | 0155 | 0215 | 0235 | *Then* | 05 | 35 | | 0505 | 0535 | 0605 | 0035 | 0045 | 0055 | 0105 |
| Old Ford *Parnell Road* | 0040 | 0100 | 0120 | 0140 | 0200 | 0220 | 0240 | *at* | 10 | 40 | | 0510 | 0540 | 0610 | 0040 | 0050 | 0100 | 0110 |
| Bow Bridge *Marshgate Lane* | 0043 | 0103 | 0123 | 0143 | 0203 | 0223 | 0243 | *these* | 13 | 43 | | 0513 | 0543 | 0613 | 0043 | 0053 | 0103 | 0113 |
| Stratford *Bus Station* ⊖ ≋ *DLR* | 0047 | 0107 | 0127 | 0147 | 0207 | 0227 | 0247 | *mins* | 17 | 47 | *until* | 0517 | 0547 | 0617 | 0047 | 0057 | 0107 | 0117 |
| Leytonstone *Thatched House* | 0051 | 0111 | 0131 | 0151 | 0211 | 0231 | 0251 | *past* | 21 | 51 | | 0521 | 0551 | --- | 0051 | --- | 0111 | 0121 |
| Leytonstone *Green Man* | 0056 | 0116 | 0136 | 0156 | 0216 | 0236 | 0256 | *each* | 26 | 56 | | 0526 | 0556 | --- | 0056 | --- | 0116 | 0126 |
| Wanstead Station ⊖ | 0058 | 0118 | 0138 | 0158 | 0218 | 0238 | 0258 | *hour* | 28 | 58 | | 0528 | 0558 | --- | 0058 | --- | 0118 | 0128 |
| Snaresbrook *Hermon Hill* | 0101 | --- | ↓ | 0201 | 0221 | ↓ | 0301 | | ↓ | 01 | | ↓ | 0601 | --- | 0101 | --- | --- | 0131 |
| South Woodford *George Lane* ⊖ | 0104 | --- | ↓ | 0204 | 0224 | ↓ | 0304 | | ↓ | 04 | | ↓ | 0604 | --- | 0104 | --- | --- | 0134 |
| Woodford Wells *Horse and Well* | 0110 | --- | ↓ | 0210 | 0230 | ↓ | 0310 | | ↓ | 10 | | ↓ | 0610 | --- | 0110 | --- | --- | 0140 |
| Redbridge Station ⊖ | --- | --- | 0142 | --- | --- | 0242 | --- | | 32 | -- | | 0532 | --- | --- | --- | --- | --- | --- |
| Gants Hill Station ⊖ | --- | --- | 0146 | --- | --- | 0246 | --- | | 36 | -- | | 0536 | --- | --- | --- | --- | --- | --- |
| Newbury Park Station ⊖ | --- | --- | 0150 | --- | --- | 0250 | --- | | 40 | -- | | 0540 | --- | --- | --- | --- | --- | --- |

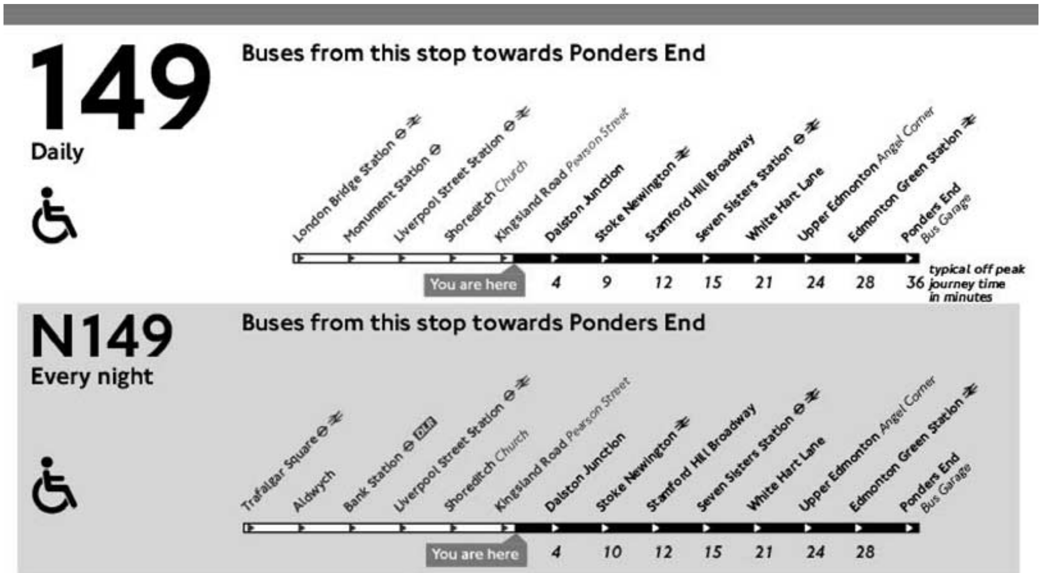
### Friday night/Saturday morning and Saturday night/Sunday morning - contd

| | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Victoria Station ⊖ ≋ | 0035 | --- | 0055 | --- | 0120 | 0135 | --- | 0155 | | -- | 25 | -- | 55 | | 0425 | --- | 0455 | --- | 0525 |
| Hyde Park Corner ⊖ | 0038 | --- | 0058 | --- | 0123 | 0138 | --- | 0158 | | -- | 28 | -- | 58 | | 0428 | --- | 0458 | --- | 0528 |
| Oxford Circus ⊖ | 0046 | 0056 | 0106 | 0121 | 0131 | 0146 | 0156 | 0206 | | 21 | 36 | 51 | 06 | | 0436 | 0451 | 0506 | 0521 | 0536 |
| Holborn Station ⊖ | 0058 | 0108 | 0118 | 0133 | 0143 | 0158 | 0208 | 0218 | | 33 | 48 | 03 | 18 | | 0448 | 0503 | 0518 | 0533 | 0548 |
| Bank Station ⊖ *DLR* | 0105 | 0115 | 0125 | 0140 | 0150 | 0205 | 0215 | 0225 | | 40 | 55 | 10 | 25 | | 0455 | 0510 | 0525 | 0540 | 0555 |
| Liverpool St Station *Bus Station* ⊖ ≋ | 0107 | 0117 | 0127 | 0142 | 0152 | 0207 | 0217 | 0227 | | 42 | 57 | 12 | 27 | | 0457 | 0512 | 0527 | 0542 | 0557 |
| Bethnal Green Station ⊖ | 0115 | 0125 | 0135 | 0150 | 0202 | 0215 | 0225 | 0235 | *Then* | 50 | 05 | 20 | 35 | | 0505 | 0520 | 0535 | 0550 | 0605 |
| Old Ford *Parnell Road* | 0120 | 0130 | 0140 | 0155 | 0205 | 0220 | 0230 | 0240 | *at* | 55 | 10 | 25 | 40 | | 0510 | 0525 | 0540 | 0555 | 0610 |
| Bow Bridge *Marshgate Lane* | 0123 | 0133 | 0143 | 0158 | 0208 | 0223 | 0233 | 0243 | *these* | 58 | 13 | 28 | 43 | | 0513 | 0528 | 0543 | 0558 | 0613 |
| Stratford *Bus Station* ⊖ ≋ *DLR* | 0127 | 0137 | 0147 | 0202 | 0212 | 0227 | 0237 | 0247 | *mins* | 02 | 17 | 32 | 47 | *until* | 0517 | 0532 | 0547 | 0602 | 0617 |
| Leytonstone *Thatched House* | 0131 | 0141 | 0151 | 0206 | 0216 | 0231 | 0241 | 0251 | *past* | 06 | 21 | 36 | 51 | | 0521 | 0536 | 0551 | --- | --- |
| Leytonstone *Green Man* | 0136 | 0146 | 0156 | 0211 | 0221 | 0236 | 0246 | 0256 | *each* | 11 | 26 | 41 | 56 | | 0526 | 0541 | 0556 | --- | --- |
| Wanstead Station ⊖ | 0138 | 0148 | 0158 | 0213 | 0223 | 0238 | 0248 | 0258 | *hour* | 13 | 28 | 43 | 58 | | 0528 | 0543 | 0558 | --- | --- |
| Snaresbrook *Hermon Hill* | ↓ | --- | 0201 | --- | 0226 | ↓ | --- | 0301 | | -- | ↓ | -- | 01 | | ↓ | --- | 0601 | --- | --- |
| South Woodford *George Lane* ⊖ | ↓ | --- | 0204 | --- | 0229 | ↓ | --- | 0304 | | -- | ↓ | -- | 04 | | ↓ | --- | 0604 | --- | --- |
| Woodford Wells *Horse and Well* | ↓ | --- | 0210 | --- | 0235 | ↓ | --- | 0310 | | -- | ↓ | -- | 10 | | ↓ | --- | 0610 | --- | --- |
| Redbridge Station ⊖ | 0142 | --- | --- | --- | --- | 0242 | --- | --- | | -- | 32 | -- | -- | | 0532 | --- | --- | --- | --- |
| Gants Hill Station ⊖ | 0146 | --- | --- | --- | --- | 0246 | --- | --- | | -- | 36 | -- | -- | | 0536 | --- | --- | --- | --- |
| Newbury Park Station ⊖ | 0150 | --- | --- | --- | --- | 0250 | --- | --- | | -- | 40 | -- | -- | | 0540 | --- | --- | --- | --- |

A - Starts from **Tottenham Court Road** at 0023.

London Travel Information 020 7222 1234 Operated by **Stagecoach** for London Buses, London SW1W 9TN 24.9.01 T3527T

*Figure 87. Bus timetable for Route 8 in London.*




**Monday - Friday**

| First buses | 6 to 7am | 7 to 8am | 8am to 8pm | 8pm to midnight | Last buses | N149 |
|---|---|---|---|---|---|---|
| 0511 | 0604 | 0705 | about every **5-8** minutes | about every **8-10** minutes | 0004 | Night buses run every hour from 0140 to 0440 |
| 0526 | 0616 | 0715 | | | 0014 | |
| 0540 | 0628 | 0725 | | | 0024 | |
| 0552 | 0641 | 0732 | | | 0034 | |
| | 0654 | 0738 | | | 0044 | |
| | | 0746 | | | 0054 | |
| | | 0753 | | | | |

**Saturday**

| First buses | 6 to 8am | 8 to 9am | 9am to midnight | Last buses | N149 |
|---|---|---|---|---|---|
| 0511 | At these minutes past the hour 16 37 57 | 0817 | about every **7-10** minutes | 0004 | Night buses run every hour from 0141 to 0441 |
| 0536 | | 0829 | | 0014 | |
| 0556 | | 0841 | | 0024 | |
| | | 0853 | | 0034 | |
| | | | | 0044 | |
| | | | | 0054 | |

**Sunday and Public Holidays**

| First bus | 6 to 7am | 7 to 8am | 8 to 9am | 9 to 10am | 10am to midnight | Last buses | N149 |
|---|---|---|---|---|---|---|---|
| 0511 | 0611 | 0701 | 0801 | 0903 | about every **8-10** minutes | 0004 | Night buses run every hour from 0140 to 0440 |
| | | 0721 | 0818 | 0918 | | 0014 | |
| | | 0741 | 0833 | 0931 | | 0024 | |
| | | | 0848 | 0941 | | 0034 | |
| | | | | 0951 | | 0044 | |
| | | | | | | 0054 | |

01.09.01 2104

LONDON — London Travel Information 020 7222 1234 24 hours — Textphone 020 7918 3015 — Operated by Arriva London North Limited for London Buses

*Figure 88. Stop-specific timetable for Kingsland Road Stop and Route 149.*

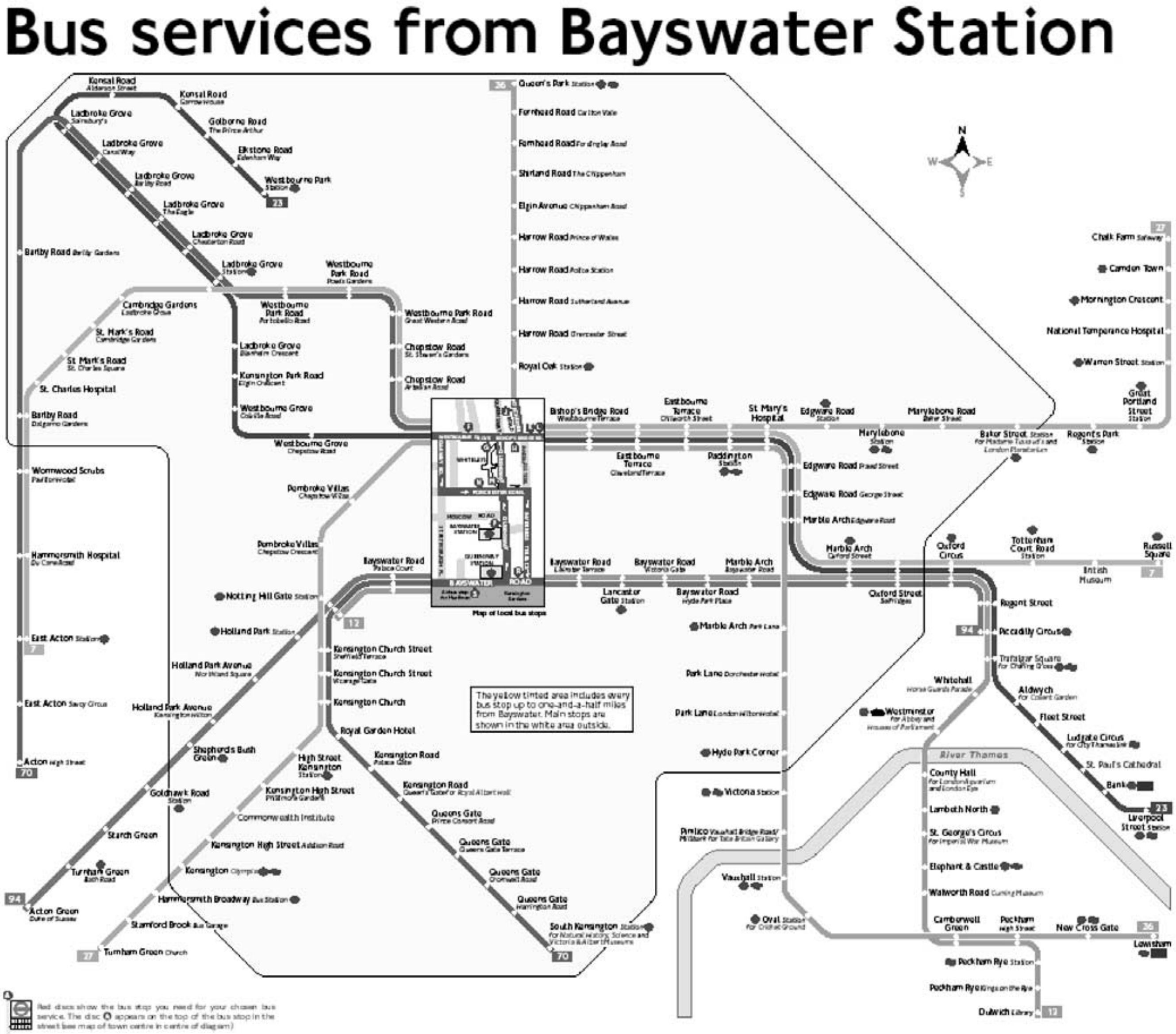



*Figure 89. Spider map for bus service radiating from Bayswater Station in London.*

to speak their responses to the itinerary-building questions, which are identical to those asked on the web application. The use of such voice technology provides access to trip and itinerary planning 24 hours per day, 7 days per week and does not require Internet access. Several other systems across the United States are now implementing this technology, including the Ann Arbor Transit Authority in Ann Arbor, Michigan. International deployments of IVR to provide TTI include the greater Sydney area in Australia (i.e., the Transport Infoline).

In addition to availability to TTI 24 hours per day, 7 days per week, voice-enabled technology can provide additional benefits to agencies, benefits that significantly improve the provision of TTI. These benefits include the capability to handle increased call volume, a reduction in call volume to customer service agents, and a reduction in the number of calls abandoned.

### 8.4 PROVISION OF REAL-TIME INFORMATION

Throughout this report, numerous examples of real-time information systems have been provided. Since the success of these and other similar systems deployed around the world has been discussed already, it would be helpful to view the addition of real-time information to TTI in a slightly different manner: from a planning perspective. The case of Oregon DOT's (ODOT's)Transit Trip Planning system illustrates the careful thinking required when considering, designing, and deploying a comprehensive TTI. The addition of real-time information, which is not a trivial element of a TTI, must be well planned out. ODOT conducted a study to determine the best approach to developing and deploying a comprehensive, statewide transit trip-planning system. ODOT's vision for this system is to "provide the public with seamless access to public transit information and services" (*16*). The outcome of this study was a recommendation to design and implement such a system in three phases (*17*):

- Phase 1: Design and implement a web-based clearinghouse;
- Phase 2: Add an automated trip-planning element; and
- Phase 3: Add long-term functionality, such as *real-time transit information,* and develop universal payment methods.

In October 2002, ODOT began the development of the transit trip planner. The key features of each release (which corresponds to each recommended phase) are as follows (*18*):

- Release 1 features:
  - Interactive tools to locate appropriate service provider(s) (e.g., map-based interface);
  - Public/private transit service providers directory;
  - Comprehensive transit data for each of the transit providers;
  - Links to sites with useful content; and
  - Other information, such as service area boundaries for each provider, bike maps and trails, and key landmarks and activity locations.
- Release 2 features:
  - Ability to automatically generate custom trip itinerary based on the user-specified parameters,
  - Provision of dynamic mapping support,
  - Support of transit information dissemination through various means,
  - Allowance for specialized automated queries to locate transit services, and
  - Provision of system usage statistics and travel patterns to support better transit planning.

Release 1 will be built on the existing ODOT TripCheck℠ system (www.tripcheck.com/), which provides statewide traveler information.

ODOT's approach to building a transit trip planning system is also exemplary because it is designed to address each of the following challenges (*19*):

- A comprehensive listing of transit schedules and other forms of public transportation options are not currently accessible in a seamless, centralized location;
- Transit schedules currently managed by ODOT's TripCheck website are dependent on several internal manual processes, affecting the timeliness of changes and reducing the accuracy of schedule data;
- A majority of transportation providers in the state do not have schedule or contact information electronically via the Internet; and
- The public has no way to easily obtain transportation options for trips within Oregon.

As noted earlier, the addition of real-time information is not considered until Phase 3 of the project. This will ensure that all other features of the system are fully operational and that the public has gotten accustomed to and has a certain level of confidence in using the system. Again, this is unlike many other systems that have introduced real-time information, not as part of an integrated TTI, but as a stand-alone element.

Another good example of introducing real-time information is the 5T system in Turin, Italy, which was discussed in Section 5.2. The 5T system, which has a clear public transport focus, provides real-time information as one of the elements of its TTI services. A customer can easily plan a journey and then check the real-time status of the vehicle(s) he or she would like to take.

The ultimate TTI would combine the real-time information on vehicle status with a trip plan. This has not yet been accomplished, but several TTI systems are striving to make improvements that have features as powerful as that. (e.g., WMATA's RideGuide). As of February 2003, FTA, FHWA, and the ITS Joint Program Office are in the early stages of planning a demonstration program that links real-time information with multimodal trip planning so that customers can obtain door-to-door real-time trip information.

## 8.5 REFERENCES AND ENDNOTES FOR SECTION 8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